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*Research Article*

# Ecosystem Services of a Wetland in the Politically Unstable Southernmost Provinces of Thailand

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**Abstract**

This study aims to answer questions about the importance and utilization of wetland provisioning ecosystem services (ES) in the disturbed southernmost provinces of Thailand, calling for the need for sustainable wetland management. Generally, natural resources management in the unrest area has been neglected because security-related policies have usually received higher priority. The study surveyed a sample of 328 households to explore the types and importance of provisioning wetland ES that have value to the local people. The statistics used to analyze data are percentage, mean, standard deviation, and calculation of the value of provisioning ES. Quantitative data were presented to a participatory workshop of 22 stakeholders to explore guidelines for wetland management. The results indicate that wetland plays a vital role in the livelihood of the local community by providing a variety of provisioning ES. Nine of the 13 ES addressed in the study were perceived as important to very important by the local people. Based on the guidelines provided by the stakeholders, an initial strategy has been formulated in the study.

**Keywords**

wetlands, ecosystem services, value, southernmost, politically unstable

## Introduction

Wetlands are natural ecosystems important in fulfilling human well-being and poverty eradication (Barbier, 2011; Ramsar Convention Secretariat, 2016; Rebelo, McCartney, & Finlayson, 2010; Sellamuttu et al., 2012). They provide all four types of ecosystem services (ES): provisioning such as food (Das, Behera, & Mishra, 2015; Gosling, Shackleton, & Gambiza, 2017; Köbbing, Beckmann, Thevs, Peng, & Zerbe, 2016; Mehvar, Filatova, Sarker, Dastgheib, & Ranasinghe, 2019; Merriman et al., 2018; Walker, 2019), fresh water (Prasada, Dhamira, & Masyhuri, 2019; Turyahabwe, Kakuru, Tweheyo, & Tumusiime, 2013), raw material (Mehvar et al., 2019); regulating such as wastewater treatment and natural disaster prevention (Liu, Xu, Yue, Teng, & Hu, 2018; Liu et al., 2019; Liu, Zhao, et al., 2018; Zhu, Ryan, & Gao, 2019), pollination (Vickruck, Best, Gavin, Devries, & Galpern, 2019), habitat for plant and animal species (Clarkson, Ausseil, & Gerbeaux, 2018; Sun, Zhen, & Giashuddin Miah, 2017), and climate regulation (Merriman & Murata, 2016); cultural services such as tourism and recreation (Do, 2019; Ondiek, Kitaka, & Oduor, 2016; Paudyal, Baral, & Keenan, 2018); and supporting services such as nutrient cycling (Hong, Zhang, Ma, Gu, & Lee, 2019).

Despite their many services, the current situation regarding wetlands around the world is one of the decline and deterioration. Between 1970 and 2015, both inland and coastal wetland areas decreased by about 35% (Ramsar Convention on Wetlands, 2018), particularly in developing countries (Chaikumbung, Doucouliagos, &

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Scarborough, 2019). In Thailand, wetlands covered an area of 36,616 $km^2$ or 7.5% of the country area. Of these, 44.9% were freshwater sources and 55.1% were coastal areas (Lertsahakul et al., 2010). The decline and degradation of these wetlands ultimately affect human well-being (Kumar et al., 2011). The need for sustainable management of wetlands is thus crucial to ensure a regular flow of the services to meet human needs.

The southernmost provinces of Thailand including Pattani, Yala, Narathiwat provinces, and some parts of Songkhla province have been in a state of unrest for 15 years (Benharoon & Binsaleh, 2013; Binsaleh & Binsaleh, 2013). There are complex causes, including forced assimilation to the national Thai identity, frictions between government policies and religious beliefs, systemic discrimination in local governance, political marginalization, abuses of the local population by security forces and state officials, and pressures to achieve autonomy (Benharoon, 2013; Burke, Tweedie, & Poocharoen, 2013; Engvall & Andersson, 2014; Jampaklay, Ford, & Chamratrithirong, 2017). This long-standing unrest has affected the social and economic quality of life, as people feel frightened and unsafe (Benharoon, 2013; Benharoon & Binsaleh, 2013; Vajirakachorn, 2012; Wichaidit, Songwathana, Balthip, & Woods, 2019), and their income per capita is much lower than in neighboring provinces (Burke et al., 2013). As peacebuilding policy has been given the highest priority, attention to the management of natural resources and environment has been minimal. Reviews of research over the past 5 years indicates that research has focused more on education (e.g., Awal, Jaafar, Mis, & Lateh, 2014; Churngchow & Sinprajukpol, 2016; Haruthaithanasan, 2018; Kritpracha, Kaosaiyaporn, & Atisabda, 2015; Mudor & Bunyarit, 2013; Niemted, 2016), social and economic well-being (Benharoon, 2013; Jaruma, 2013; Laeheem & Boonprakarn, 2017; Yanya, Abdul-Hakim, & Abdul-Razak, 2013), and health (Boonderm et al., 2017; Mosamae, Neamsuvan, Asae, Bensulong, & Tuwaemaengae, 2012; Neamsuvan, Kama, Salaemae, Leesen, & Waedueramae, 2015). In contrast, research on local natural resources management has been sparse, with a focus on marine and coastal resources (Hajisamae, 2009; Hajisamae, Yeesin, & Chaimongkol, 2006; Thampanya, Vermaat, Sinsakul, & Panapitukkul, 2006). However, people there still depend greatly on agriculture (Bundhuwong, 2013) which in turn relies strongly on ES provided by natural systems. Resource management has been given lower priority because people have had to survive in the midst of the complex conditions of the area.

Pru Lan Kwai (PLK) is a unique and significant wetland situated in two provinces in the southernmost part of Thailand. Up to the present, the literature on PLK and ES management is still extremely limited. A study by Makaraphirom et al. (2018) in the Saiburi watershed, of which PLK is part, points out that there are many problems of resource management and complex issues in the unrest areas, for example, deforestation and wildlife exploitation for commercial purposes, repeated floods and drought, soil erosion and landslides, inefficient irrigation systems, river mouth excavation, coastal erosion, and illegal fishing equipment. For the PLK itself, however, there is a serious lack of basic information such as the amount of water surface, runoff, groundwater, water quality, soil, plant species, species composition, or economic value. This is despite the importance of identifying ES and community perceptions of their value as an important step in providing decision support for formulating effective policies and environmental practice guidelines (Garrido, Elbakidze, & Angelstam, 2017). De Groot, Stuip, Finlayson, and Davidson (2006) have underlined the importance of assessing the significance of wetlands in relation to livelihoods of people in the relevant area.

Exploring the use and management of wetland ES to create improved well-being and enhanced economic security should help to relieve stress and difficulties experienced by local people in the unrest area if it can sustainably support their livelihoods in terms of food security, higher income, better quality of life, and lower risk of natural disaster, thus reducing pressure on their insecure situation. As an initial step aimed at raising awareness of the value of ES associated with PLK, this study has addressed three key questions: (a) what are the benefits of PLK ES to local communities? (b) in what way is the wetland important to the local people? and (c) what are the stakeholders' proposed guidelines for wetland management? This research should provide important information on wetland services for policy makers and stakeholders and establish a basis for appropriate and sustainable wetland management approaches in the future.

## Methods

### *Study Area*

PLK is a freshwater wetland ecosystem with geographic coordinates at 6°34′49.77″ N, 101°26′33.75″E. It is one of the important wetland ecosystems of the Saiburi river basin in the three southern border provinces of Thailand (Figure 1). It covers an area of approximately 2,400 ha (Avae, 2004) in two provinces: Pattani (Talo Mana Subdistrict, Nam Dam Subdistrict, and Pa Ku Subdistrict in Thung Yang Dang District) and Yala (Wang Phaya Subdistrict and Tha Thong Subdistrict in Raman District). It is a natural freshwater ecosystem in a pan basin surrounded by mountains, receiving large flows of water from the surrounding mountains and the Saiburi river, draining into the Gulf of Thailand. The average depth of water is about 1 to 3 m.

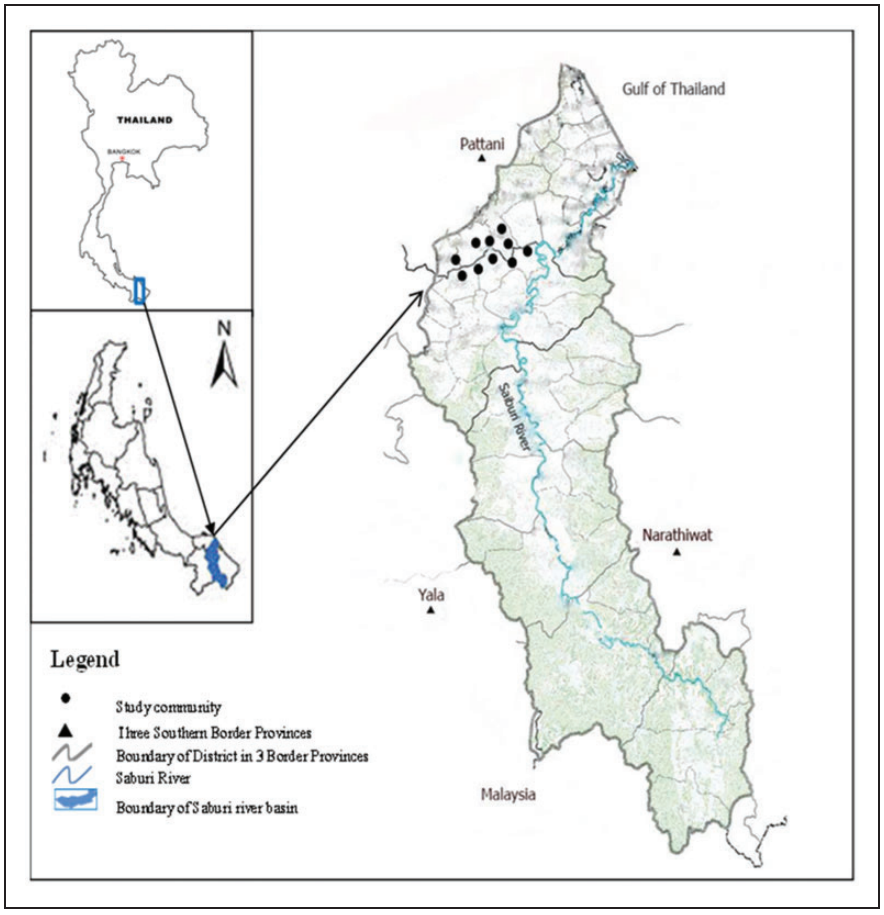


**Figure 1.** Map of the PLK wetland showing its location in Saiburi river basin, southern border provinces (Pattani, Yala, and Narathiwat) of Thailand.

The climate is tropical monsoon. The total 2,400 ha contains various natural ecosystems such as lake, marsh, canals, grassland, and swamp forest, and man-made ecosystem such as paddy field. However, a major part of the wetland is still natural with some parts of it are used by local people for crops. The wetland is home to many wild species, for example, animals such as the little cormorant (*Microcarbo niger*), gray heron (*Ardea cinerea*), and lesser coucal (*Centropus bengalensis*); perennial plants including mile a minute (*Mikania cordata*), malabar gooseberry (*Melastoma malabathricum*), jambolan plum (*Syzygium cumini*), and paperbark tree (*Melaleuca quinquenervia*); and water plants, including water primrose (*Ludwigia hyssopifolia*), catathea (*Schumannianthus dichotomous* (Roxb.) Gagnep), and water clover (*Marsilea crenata*).

## Data Collection and Sampling

This study used both quantitative and qualitative data collection and analysis. The population for quantitative study was the people living in areas adjacent to the PLK wetland area in Tha Thong Subdistrict and Wang Phaya Subdistrict, Raman District, Yala Province and Paku Subdistrict, Nam Dam Subdistrict and Talo Mana Subdistrict, Thung Yang Dang District, and Pattani Province, totaling 9,661 persons or 1,812 households in December 2017 (Namdam Subdistrict Administrative Organization, 2014; Paku Subdistrict Administrative Organization, 2016; Talo Maena Subdistrict Administrative Organization, 2014; Tha Thong Subdistrict Administrative Organization, 2015; Wang Phaya Subdistrict Administrative Organization, 2014). The calculated sample was 328 households. The respondents were either the head of the household or a representative of the family who is 20 years old or more. All participants provided informed consent and whether the consent was written or verbal. A stratified random sampling was used to determine the number of sampled households in each subdistrict, allowing each community to have equal representation, followed by systematic random sampling to select the households in each subdistrict.

The questionnaire was created by the researchers, with some questions on wetland ES adapted from

Chuwew et al. (2014) to make them suitable in the context of the area. The questionnaire contains five main parts: demographic information on the respondent, socioeconomic information on the household, utilization of ES, perception of the respondent on the importance of the ES and natural resources (in Likert-type scale), and open-ended suggestions for the management of PLK wetland. The questionnaire was written in Thai. However, data were collected by researchers who speak both Thai and the local language of Malay between October 2017 and March 2018.

A participatory workshop was organized to conduct a qualitative study of people's perceptions and ideas for the formulation of guidelines regarding the management of ES provided by the wetland. The participants were selected using criteria of stakeholders determination based on the systematic consideration model by Masawat, Roongtawanreongsri, and Sawangchote (2017). The criteria cover four considerations: benefits: both direct and indirect benefits that they received from the wetland, impact: the severity of environmental impact and impact on quality of life from the change of the wetland, degree of participation: level of participation in the management or protection of the wetland, and the level of the respondent's importance and influence on other community people (further details appear in the cited literature). Twenty-two representatives of stakeholders met the criteria and participated in the workshop. All writings produced by participants, such as large sheets of paper recording participant inputs, were collected, discussed under the guidance of four cofacilitators and audio-recorded.

### Data Analysis

Data were analyzed according to the research questions and grouped into three data sets. First, the data on provisioning services utilization and benefits were analyzed using a descriptive analysis and value estimation. The unit of quantity of the services used is reported in kilograms, with the exception of cattle which is reported in number. The benefit of each service was calculated using the market price of the local market, allowing the value of the total benefit of sample households to be calculated. Second, the data on the perception of local people regarding the importance of natural resources in PLK wetland were represented on a 5-point Likert-type scale so that a total score, mean score, and percentage for the scale items could be calculated. The five possible scores of the scale were defined as follows: *very important* (4.51–5.00), *important* (3.51–4.50), *moderately important* (2.51–3.50), *slightly important* (1.51–2.50), and *not important* (1.00–1.50). Finally, data on the suggested guidelines for wetland ES management were compared with the information recorded in the workshop and then verified by the workshop cofacilitator.

## Results

### Demographic and Socioeconomic Characteristics of Sampled Households

Among 328 sampled households living in 10 communities around the swamp forest, the majority of the respondents were females ($n = 201$; 61%), 48 years old on average ($\pm 15$), with Islamic belief ($n = 291$; 89%), had obtained education lower than bachelor's degree ($n = 305$; 93%), and lived in the community for more than 40 years ($\pm 17$). The average number of household members was five ($\pm 2$). The average distance from the house to the wetland was 2.6 km ($\pm 1.3$). Fifty-six percent of the respondents stated that their main occupation was farmer ($n = 185$; 56%). The second most reported occupation was labor ($n = 55$; 17%). In addition, 77% stated that they did not have a second income ($n = 252$), thus relying solely from their main occupation. The average monthly income of households was US$276 ($\pm 198$), and the average expenditure was US$181 ($\pm 165$). Legally, the land around the PLK should not be owned by people as it belongs to the government, yet a small proportion of the respondents ($n = 30$; 9%) reported that they owned an average of 0.16 to 0.80 ha.

### Utilization of Provisioning ES by Local Households

The respondents' report of the usage could be divided into six categories: (a) fishing, which refers to all kinds of aquatic animals in the wetland; (b) livestock, which included cows, buffaloes, ducks, goats, and sheep; (c) natural product gathering, including mushroom (*Boletus griseipurpureus* Corner), firewood, teal (*Callonetta leucophrys*), and herb; (d) short-term crop production, that is, seasonal crops such as watermelon, corn, chili, and cucumber; (e) receiving water from the wetland to grow rice; and (f) monoculture crops of rubber and oil palm. The categorization of the last two services takes after Feurer et al. (2019) and Suwarno, Hein, and Sumarga (2016).

The number of households, the proportion, and the value of the uses are given as an overview in Table 1. From 328 households which were the sample of this survey, fishing gained the highest proportion ($n = 76$; 23.3%) with the average annual value of US$1,433, followed by livestock ($n = 65$; 19.8%). However, livestock value of use was the highest, worth US$20,044 per year. The proportion of households gathering natural products was close to the livestock, yet with much lower value ($n = 59$; 17.9%, US$291 per year). The remaining uses were similarly low in proportion including short-term

**Table 1.** Utilization of Provisioning ES and Market Value From the Sample of 328 Households in 2018.

| Provisioning ES | No. of households | % | Total annual value (in US$) |
|---|---|---|---|
| Total households surveyed (sample) | 328 | 100 | — |
| Fishing | 76 | 23.3 | 1,433 |
| Livestock | 65 | 19.8 | 20,044 |
| Gathering of the natural products | 59 | 17.9 | 291 |
| Short-term crop production | 21 | 6.4 | 2,482 |
| Rice farming | 15 | 4.6 | 639 |
| Monoculture crops | 10 | 3.0 | 8,626 |
| Total household that used ES | 246 | 75 | 33,515 |
| Total household that did not use ES | 82 | 25 | — |

*Note.* 1 US$ = 31.88 THB at the time of data collection.
ES = ecosystem services.

crop production ($n = 21$; 6.4%, US$2,482 per year), rice farming ($n = 15$; 4.6%, US$639 per year), and monoculture crops from rubber and oil palm ($n = 10$; 3.0%, US $8,626 per year). In total, there were 246 households (75%) using provisioning ES from the PLK wetland area and generating the total market value of US $33,515 per year.

*Fishing.* Fishing proved to be an important use of ES of the PLK wetland, as the proportion of households was the highest, compared with other ES. It is noted, however, that not everyone can make use of fishery due to the required skills, expertise, and fishing gear such as boats and nets. Forty-one species of fish and aquatic animals were caught by the households, with the amount varying based on fishing gear and fishing season. Generally, the main fishing season was considered to be during flooding or the rainy season between October and December. The total amount caught was divided for household consumption (78%), for sale at local market (21%), and for sharing (1%). The top 10 most caught fish species (71%) were snakehead fish (*Channa striata*), walking catfish (*Clarias batrachus*), gray featherback (*Notopterus notopterus*), common silver carb (*Barbonymus gonionotus*), Burmese trout (*Family Cyprinidae*), butter catfish (*Ompok krattensis*), small scale mud carp (*Cirrhina microlepis*), naked catfishes (*Hemibagrus filamentous*), beardless barb (*Cyclocheilichthys apogon*), and striped tiger leaffish (*Pristolepis fasciata*), respectively. The value of fisheries accounted for 0.58% of the average annual income of the fishing households. Table 2 presents more detail of each species' total catch and distribution.

*Livestock.* Raising cows, buffaloes, goats, and sheep in the PLK wetland still follows a traditional unique culture. In the morning, owners let the animals graze freely in the wetland and drive them back into pens in the evening while counting and exploring the overall health condition of each animal. The animals were considered an asset that could be readily sold in time of a family's urgent need for cash. Ducks were raised near the house not in the wetland area. The five kinds of animals were particularly connected to the Muslim culture, which consumes specific types of meat following religious practice. Thus, raising pigs was found only among a few Buddhist households in the area. Livestock accounts for 12.06% of the average household annual income of those who raised livestock.

*Gathering of the natural products.* Natural products in the PLK wetland varied due to seasons. Despite that, there were only four types of products reported to be collected during the survey. Mushrooms, collected the most, were used for sale (60%) rather than household consumption. The other three remaining products, firewood, teal, and herbs, were used solely for household consumption. This type of use was significant in that it eased the household from expenses in terms of fuel, food, and natural medicines. The value obtained from the products accounted for 0.14% of the average income of the households that collected natural products.

*Short-term crop production.* Some local households produced extra income by cultivating short-term crops on the grassland area of the PLK. Most of the crops are located in Talo Mana, Nam Dam and Pa Ku Subdistrict, Thung Yang Dang District, and Pattani Province. Short-term crops lasted for no longer than 6 months, from planting until harvesting. The cultivation usually starts after the flood season, at the end of January until June. There were four types of cultivated plants: watermelon, corn, chili, and cucumber. The products were used mainly for sale (90%), while some were used for household consumption (8%) and only slightly for giving or sharing with neighbors (2%). The value derived from short-term crop production accounts for 4.16% of the average household income of the short-term crop production households.

*Rice farming.* Rice farming relies heavily on natural water resources from a swamp in the PLK wetland. Farmers brought a fast-growing rice variety from other places to grow there. Rice planting starts around June every year. The farming process includes field preparation, plowing, sowing, seedling, transplanting, pest and weed control, harvesting, and storing. Rice grain was mostly (80%) stored for household consumption, while 17% was sold, and only a little (3%) was shared. This is because

**Table 2.** Proportion of Provisioning Ecosystem Service Utilization in 2018.

| | | Quantity of products used/produced | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | For household consumption | | For selling | | For sharing | |
| Provisioning ecosystem services | %[a] | Total | Quantity | % | Quantity | % | Quantity | % |
| 1. Fishing | | (Unit: kg/year) | | | | | | |
| A. 10 species of fish that most households catch | 71 | 513 | 398 | 78 | 109 | 21 | 6 | 1 |
| • Snakehead fish (*Channa striata*) | 11 | 87 | 66 | 76 | 21 | 24 | 0 | 0 |
| • Walking catfish (*Clarias batrachus*) | 10 | 73 | 55 | 75 | 18 | 25 | 0 | 0 |
| • Gray featherback (*Notopterus notopterus*) | 8 | 52 | 44 | 85 | 8 | 15 | 0 | 0 |
| • Common silver carb (*Barbonymus gonionotus*) | 8 | 65 | 51 | 78 | 8 | 12 | 6 | 9 |
| • Burmese trout (*F. Cyprinidae*) | 7 | 51 | 43 | 84 | 8 | 16 | 0 | 0 |
| • Butter catfish (*Ompok krattensis*) | 6 | 40 | 36 | 90 | 4 | 10 | 0 | 0 |
| • Small scale mud carp (*Cirrhina microlepis*) | 6 | 42 | 31 | 74 | 11 | 26 | 0 | 0 |
| • Naked catfishes (*Hemibagrus filamentous*) | 5 | 45 | 30 | 67 | 15 | 33 | 0 | 0 |
| • Beardless barb (*Cyclocheilichthys apogon*) | 5 | 34 | 23 | 68 | 11 | 32 | 0 | 0 |
| • Striped tiger leaffish (*Pristolepis fascia*) | 4 | 24 | 19 | 79 | 5 | 21 | 0 | 0 |
| B. Other types of fish (31 types) households catch | 29 | 212 | 169 | 80 | 41 | 19 | 2 | 1 |
| Total | 100 | 725 | 567 | 78 | 150 | 21 | 8 | 1 |
| 2. Livestock | | (Unit: number of animals/year) | | | | | | |
| • Cow | 33 | 45 | 0 | 0 | 45 | 100 | 0 | 0 |
| • Buffalo | 6 | 8 | 0 | 0 | 8 | 100 | 0 | 0 |
| • Duck | 53 | 72 | 0 | 0 | 72 | 100 | 0 | 0 |
| • Goat | 4 | 5 | 0 | 0 | 5 | 100 | 0 | 0 |
| • Sheep | 4 | 5 | 0 | 0 | 5 | 100 | 0 | 0 |
| Total | 100 | 135 | — | — | — | — | — | — |
| 3. Natural product gathering | | (Unit: kg/yr) | | | | | | |
| • Mushroom (*Boletus griseipurpureus* Corner) | 81 | 138 | 46 | 33 | 83 | 60 | 9 | 7 |
| • Firewood | 14 | 90 | 90 | 100 | 0 | 0 | 0 | 0 |
| • Teal (*Callonetta leucophrys*) | 3 | 3 | 3 | 100 | 0 | 0 | 0 | 0 |
| • Herb | 2 | 20 | 20 | 100 | 0 | 0 | 0 | 0 |
| Total | 100 | 251 | — | — | — | — | — | — |
| 4. Short-term crop production | | (Unit: kg/year) | | | | | | |
| • Watermelon | 57 | 6,250 | 370 | 6 | 5,800 | 93 | 80 | 1 |
| • Corn | 24 | 260 | 90 | 35 | 150 | 58 | 20 | 8 |
| • Chili | 10 | 70 | 20 | 29 | 50 | 71 | 0 | 0 |
| • Cucumber | 9 | 110 | 70 | 64 | 40 | 36 | 0 | 0 |
| Total | 100 | 6,690 | 550 | 8 | 6,040 | 90 | 100 | 1 |
| 5. Rice farming | | (Unit: kg/year) | | | | | | |
| • Rice farming | 100 | 1,630 | 1,305 | 80 | 275 | 17 | 50 | 3 |
| Total | 100 | 1,630 | 1,305 | 80 | 275 | 17 | 50 | 3 |
| 6. Monoculture crops | | (Unit: kg/yr) | | | | | | |
| • Rubber | 90 | 18,214 | 0 | 0 | 18,214 | 100 | 0 | 0 |
| • Oil palm | 10 | 10,000 | 0 | 0 | 10,000 | 100 | 0 | 0 |
| Total | 100 | 28,214 | 0 | 0 | 28,214 | 100 | 0 | 0 |

[a]The percentage is calculated from the total in each group of service.

rice is the main food staple of every household. The value derived from rice farming accounts for 1.28% of the average household income of the rice farming households.

*Monoculture crops.* Two popular crops planted near PLK wetland were rubber and oil palm. They receive provisioning ES benefit because of their reliance on soil and water resource from the PLK. Plantation activities have

not existed as long as other service uses, going back about 15 to 20 years. Data from the survey showed that of the crops available, rubber proved to be the major plant preferred (90%). Among the households that planted monoculture crops, the value derived from this activity accounted for 19.34% of the average income. Monoculture has changed the original land type from grassland, rice fields, and area near the wetland edge to rubber and oil palm plantation, with various negative effects on flows of ES.

Table 3 summarizes the contribution of the value of ES to the total household income. The contribution ranges from 0.14% (gathering of the natural products) to 19.34% (monoculture crops), while Table 4 summarizes the value of all uses with the contribution to the wetland area. We calculated it in two levels: the first is in the area of specific habitat where the service was drawn, and the second is in the total PLK area. The total value per hectare of PLK wetland was US$13.96. This does not account for other ES that have not been quantified and valued, that is, regulating services, supporting services, and cultural services.

### *Perception on the Importance of ES and Natural Resources in the PLK*

From the total of 13 natural resources listed in the questionnaire, 7 were perceived as very important, 2 as important, and 4 as moderately important (Table 5). The very important services included freshwater, fish production, nature state of the wetland, its beauty, the surrounding area, trees, and other aquatic animals. Expectedly, resources that were sources for food, income, and daily activity received a high importance score. Significantly, the respondents listed the nature and beauty of the wetland as very important too. No resource was perceived to be only slightly important or not important. Further interviews revealed the views, as in the quote later. Note that the interview was in Malay and was translated verbatim to English by the researchers.

> I have been fishing in the wetland for almost 30 years and seen all the changes during this time. Phru Lan Kwai is very significant to me and my family. I can fish all year round to support household consumption and sell for

**Table 3.** Percentage of the Income From Provisioning ES to the Total Household Income of the Households That Utilize the Particular ES.

| Provisioning ES (number of households) | Average annual income of the households in that ES group (US$) | Average annual value of ES (US$) | Percentage of the ES value to the total household income in that ES group |
|---|---|---|---|
| Total value from the use of ES = US$33,515 | | | |
| Fishing (76) | 3,227 | 19 | 0.58 |
| Livestock (65) | 2,556 | 308 | 12.06 |
| Gathering of the natural products (59) | 3,604 | 4.93 | 0.14 |
| Short-term crop production (21) | 2,838 | 118 | 4.16 |
| Rice farming (15) | 3,338 | 43 | 1.28 |
| Monoculture crops (10) | 4,460 | 863 | 19.34 |
| Did not use ES (82) | | | |

*Note.* ES = ecosystem services.

**Table 4.** Overall Value Estimation of the Provisioning Ecosystem Services per Area of Habitats and Total Area.

| ES | Habitat | Total habitat area (ha) | Total value of the service (US$) | Value per hectare of the habitat area (US$/ha of corresponding habitat) | Value per hectare of the total wetland area (US$/ha of PLK) |
|---|---|---|---|---|---|
| Fishing | Freshwater pond, streams, and canals | 800 | 1,433.44 | 1.79 | 0.60 |
| Livestock | Grassland | 400 | 20,043.79 | 50.11 | 8.35 |
| Gathering of the natural products | Swamp and scrub forest | 320 | 290.97 | 0.91 | 0.12 |
| Short-term crop production | Paddy field | 320 | 2,481.81 | 7.76 | 1.03 |
| Rice farming | Grassland | 320 | 639.12 | 2.00 | 0.27 |
| Monoculture crops | Grassland | 240 | 8,625.97 | 35.94 | 3.59 |
| Total PLK wetland | | 2,400 | 33,515.09 | — | 13.96 |

*Note.* This is only the minimum value of the wetland as there are still other ecosystem services that were not accounted for. PLK = Pru Lan Kwai.

**Table 5.** Perceptions on the Importance of Natural Resources in the Wetland.

| Natural resources in the PLK | Mean | *SD* | Importance level |
|---|---|---|---|
| Survey from 328 respondents | | | |
| 1. Freshwater | 4.17 | 0.737 | Very important |
| 2. Fish production | 4.15 | 0.713 | Very important |
| 3. Nature of the wetland | 3.93 | 0.909 | Very important |
| 4. The beauty of the wetland | 3.89 | 0.860 | Very important |
| 5. The area around the wetland | 3.86 | 0.871 | Very important |
| 6. Trees | 3.77 | 0.950 | Very important |
| 7. Other aquatic animals | 3.60 | 0.710 | Very important |
| 8. Grass (the area around the wetland) | 3.53 | 0.898 | Important |
| 9. Mushroom | 3.43 | 0.875 | Important |
| 10. Birds | 3.34 | 0.835 | Moderately important |
| 11. Wild animals | 3.19 | 0.851 | Moderately important |
| 12. Water plants | 3.10 | 1.001 | Moderately important |
| 13. Various insects | 3.04 | 0.904 | Moderately important |
| Average | 3.615 | 0.854 | Very important |

*Note.* PLK = Pru Lan Kwai; *SD* = standard deviation.

extra income although the catch has been decreased for the past years. However, if there is no water in the PLK, and no fish, it will be tough for me and my family.

The nature in the PLK used to be so fertile, but not anymore. I have raised livestock here since I started with only 2 cows. Now, I have more than 20 cows. The grassland around the PLK is the feeding ground for the animals, but is difficult for them in the flood season. I come to check them every evening, consider it a good exercise too.

### *Guidelines for the Management of Wetland Provisioning ES*

Guidelines were suggested by the stakeholders participating in the workshop. They were presented with information describing the current circumstances of the wetland and general principles of wise natural resource management. The participants collaborated diligently to discuss, explore, and finally suggest guidelines for managing the use of PLK provisioning ES. As seen in Table 6, the suggested guidelines closely align with sustainable resource management practices, with participants aiming to make the resources available as long as possible. The guidelines comprise a mixture of controlling, supporting, and promoting measures.

## Discussion

This study has attempted to establish in-depth information on the benefits of wetland ES in the unrest area and its importance to the local communities as well as proposing initial guidelines for wetland management. Certain characteristics of the sampled locals could be expected, as generally in the Muslim custom, men have to work outside to provide for the family and seldom stay at home, thus increasing the chance of finding women at home when the interview took place. The respondents received only compulsory education, leaving school at secondary level, particularly so with those who were 60 years old or more, and receiving education only from a religious setting rather than formal education. The older generation previously did not find higher education necessary, as they could work the land and gain enough to support the family comfortably. However, the situation in the area at the present time has drastically changed politically, socially, economically, and ecologically.

The socioeconomic findings confirm a lower economic status of the local people in the unrest area. Data from the National Statistical Office (2016) on the national household socioeconomic survey in the first 6 months of 2017 found that the average national household monthly income was US$850, with the expenditure US$690. Comparing these figures with those of households in the study area, with an average monthly income of US$200 and expenditure of US $181, the household figures in the study area were 4 times lower than the national average. The findings relating to ecosystem service use indicate that supplementing family food directly from natural resources could partly offset the tight family income. The data showed that fishing, rice farming, and collecting natural products were mainly used for household consumption, while livestock, short crops, and monocultures could provide extra benefits to the family financial

**Table 6.** Stakeholder's Suggested Guidelines for the Management of Provisioning Ecosystem Services in PLK Wetland.

| PLK habitats | Problems/current situations | Suggested management guidelines |
|---|---|---|
| • Overall ecosystems | • Decrease in natural area due to land use changes<br>• Unsustainable practices in and around the PLK: use of chemicals in crop cultivation, use of water unlimitedly, and waste discard from agriculture without proper treatment | • A clear boundary of the wetland should be revisited and formally announced, clearly define public areas and private areas.<br>• Adjacent areas around the wetland should be zoned for land use.<br>• Set up rules for the use of wetlands such as determining the size of land that can be used for farming in each household.<br>• Employ agricultural practices that do not impact the wetland quality. |
| • Freshwater ecosystems | • Loss of fish and aquatic animal species<br>• Declining fish catch<br>• Degradation and loss of fish and aquatic animals habitat | • Academic and fishermen should determine:<br>• gear restrictions, for example, a meshsize not smaller than 2 cm be designated to capture mature individuals, and prohibition of electric shock<br>• season restriction, particularly during spawning season from May to August<br>• Fishermen should agree to release fish too smallback to the water.<br>• Stakeholders should determine protected areas or habitats within the wetland that should not be fished. |
| • Grassland | • Reduction of pasture area due to land use changes<br>• No specific boundary for livestock feeding | • Stock owners should not allow animals to graze freely, rather restriction should be set up as where and how many animals can graze in the wetland.<br>• Stock owners should organize a collaborating group where members can alternately look after the herds, particularly when they graze closer to the agricultural area or at times of disease.<br>• There should be a study on setting stock numbers in response to feed availability; however, while no study has been available yet, it would be wise to consider limiting the number to 5 to 15 animals per household. |
| • Swamp and scrub forest | • Decrease of natural area due to land use changes<br>• Decline of products collected<br>• No restriction on the amount collected | • Community leaders should assign watchmen to regularly monitor the use.<br>• Wood collectors ofany forms mustinform the community leaders or appointed persons before use.<br>• Collection and utilization must be done with a sustainable mind, such as collecting only firewood that are naturally dry and not a large tree, always leave some young mushrooms to flourish, not collect all.<br>• Educating the local people about the importance andusefulness of natural resources in wetland such as species that are medicinal.<br>• There should be a study on carrying capacity or potential assessment of products. |

*Note.* PLK = Pru Lan Kwai.

security. The results strongly confirm that wetlands serve as a food source of people in the local community and the sustainability of the local economy (Ondiek et al. 2016; Ambastha, Hussain, & Badola, 2007; Rebelo et al., 2010). However, the value estimated in this study is merely an estimate given the results of the study. Further research needs to be done to attain a more accurate and complete value of the PLK.

We speculate that the usage frequency of households that use the provisioning services is constrained by unrest in the area. In the interviews, we found that local people were watchful of insurgencies and remained in their house for several days after such incidents occurred. This confirms earlier literature's findings that the community people feel insecure when going outside (Songwathana, Kitrungrote, & Khupantawee, 2016).

The data on the number of the incidents showed that 548 incidents occurred in 2018 (Deep South Watch, 2018). Although data were not available for the number of days people chose not to leave their house, such a high number of incidents suggest that the wetland was used less frequently than otherwise.

As there has been only limited study of the wetland and its utilization, there is still a lack of information on each type of use. This study, however, can identify some potential harm from some of the uses that might affect the state of the wetland if no management is undertaken. Uses such as agriculture, rice farming, short-term crop productions, and monoculture in particular can lead to major problems. Agricultural activities at present can withdraw unlimited volumes of water from the wetland, which can alter the ecological character of the wetlands to the point where essential regulating and supporting ES are lost (The Ramsar Convention on Wetlands, FAO, & IWMI, 2014). In addition, most of farmers in PLK use chemical fertilizers and pesticides which may destroy other ecosystem service values (Verhoeven & Setter, 2010). Without proper control, the wetland public area can be threatened because of pressures from population growth and economic development. Livestock raising in the PLK has not been restricted currently, yet livestock activities can cause damage to soils, erosion, water contamination, damage to native vegetation, harm to native animals, and loss of biodiversity (Sim, 2012). Wetland areas appear to be decreasing due to a lack of clear boundaries, resulting in the decline of habitats for natural plants and fish which can be a supplementary food source and income. Generally, many and various issues require further investigation to aid the sustainable management of the PLK.

The findings on perceptions of the local people regarding natural resources in PLK wetland reflect both direct and nondirect use values. Fresh water, aquatic products, and plants were the most tangible products usually extracted from the wetland and were thus obviously significant. However, the nature and beauty of the wetland also were awarded a high level of significance for their recreational use and value, possibly due partly to their effect on relieving tensions as Tyrväinen et al. (2014) suggested that visiting nature areas has a positive effect on stress relief. This benefit of recreation has been promoted by the local authority by establishing events such as Thung Yang Dang watermelon festival and inland water traveling to support tourism in recent years. The tourism estimation value was estimate roughly at US$39,147, or US$16.31 per hectare of PLK. However, generally people in the community and nearby areas visit the wetland to enjoy the scenic views of sunset in both provinces of Pattani and Yala. Understanding this perception on the importance of ES of the local communities will be helpful in formulating appropriate policies and management actions (Petz, Minca, & Werners, 2012). More specifically, to create effective nature conservation strategies, the type of interaction with nature is significant (Lumber, Richardson, & Sheffield, 2017): It is not sufficient merely to appreciate the beauty of nature but necessary to involve positive practical actions that benefit local nature (Lumber, Richardson, & Sheffield, 2018).

The findings prove that the PLK wetland generates various ES to the surrounding communities and that the local people recognize its importance. This calls for immediate action from decision makers and stakeholders to find a sustainable way for managing this resource to support more efficiently the well-being of the people in low-income communities such as these. This study also identifies some potential problems of the current situation. Thus, the initial guidelines were formulated giving priority to the sustainable use of the direct services. However, these guidelines were still lacking, and more detail studies and planning are urgently needed. The state should not only concentrate on the measures related to security that emphasize the strategy of the local forces (Nirei & Waiwanchit 2016) but also fill the gaps of unbalanced policies by including a plan for natural ecosystem management. It is obvious from the study that if these ecosystems lose fertility, it will directly affect the livelihoods of people in the community and add more pressure to their already insecure life. It is also possible that those phenomena such as inaccessibility to food source, poor livelihoods, and low quality of life can be a supplementary factor worsening deeper conflicts in the current unrest situation. From this study, the following is suggested:

Further studies are highly necessary to provide sufficient data for management directions. As very little information is available at present, the areas of required research are wide-ranging, covering both science such as ecological study and social aspects such as education, relevant to wetland management. Nevertheless, the immediate need for research evidenced from this study includes, for example, hydrology, plants and biodiversity, fish and aquatic stock, grass land and grazing, inventory of species in each biome, and the ecological interactions and their human ecology.

More importantly, local academic or nongovernmental organization should move to empower local communities through action or participatory research to reduce the reliance on the state for improvement in their livelihoods. Sustainably managing their local resources or improving their environment would be a logical move to alleviate poverty. Learning as a community in participatory action research can help local people to build trust, gain confidence, and collaborate with each other, in turn leading to better management of the local ecosystems.

While specific data cannot be secured, general data about the characteristics, benefits and importance of wetlands, and guidance for using wetlands can be prepared and disseminated to local communities and schools to raise awareness and understanding of wetland protection.

## Implications for Conservation

This study gives an overview of the patterns and characteristics of the use of provisioning ES in the PLK wetland in the unrest situation. It also reconfirms the importance of the wetland to the local low-income people despite the high-risk situation of insurgency in the area. Despite it being an initial study, some guidelines from the participatory stakeholders' meeting were formulated. We have found that most of the samples used direct services for family consumption, particularly fisheries (78%), rice farming (80%), and gathering of natural products (100% for firewood, teal, and herb), whereas other uses are for sale at the local market or for neighbor and relative sharing to others. These generate a proportion of 0.14% to 19.34% of total household income. If managed sustainably, the well-being of the people in the area can be secured. This article also confirms that local people perceive the importance of natural resources of wetlands as very high, reflecting the various benefits ranging from physical to aesthetic value. The guidelines proposed by stakeholders for the management of provisioning ES focus strongly on sustainable use. The researchers carrying out this study make a plea for continued research into the PLK wetland, collaboration between academics and local communities in participatory action research, and dissemination of wetland information to raise awareness and preparation for wetland protection in the future.

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