

**GIAHS
PROPOSAL**

**THALE NOI WETLAND PASTORAL
BUFFALO AGRO-ECOSYSTEM**

**SEPTEMBER
2021**

PROVINCIAL ADMINISTRATION OFFICES

PHATTALUNG

SONG KHLA

NAKHON SI THAMMARAT

GIAHS PROPOSAL

**GLOBALLY IMPORTANT
AGRICULTURAL HERITAGE SYSTEMS PROPOSAL**



THALE NOI WETLAND PASTORAL
BUFFALO AGRO-ECOSYSTEM

TABLE OF CONTENT

I.	SUMMARY INFORMATION TABLE	5-10
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II.	EXECUTIVE SUMMARY	11-16
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III.	SIGNIFICANCE OF THE PROPOSED SYSTEM	
	1) Historical background	17-20
	2) Unique System	20-21
	3) Critical Roles of Buffalo in the Wetland Area	21-30
	4) Remarkable agroecological interaction among livestock, fishery and plant through agriculture in wetland developed in harmony with environment	31

IV. GIAHS SELECTION CRITERIA

1) Food and Livelihood Security	34-46
2) Agro-biodiversity	48-63
3) Local and Traditional Knowledge Systems	64-89
4) Cultures, Value Systems, and Social Organizations	90-100
5) Landscapes and Seascapes Features	101-105

V. ACTION PLAN FOR DYNAMIC CONVERSATION

Annex 1. Scientific References	106
Annex 2. Land Use Maps	118-120
Annex 3. Satellite image of the Thale Noi lake	121

I. SUMMARY INFORMATION TABLE

Name/ Title of the proposed GIAHS site	Thale Noi Wetland Pastoral Buffalo Agro-ecosystem
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Requesting Agency/ Organization, and contact information	1) The Thale Noi Pastoralist Community Enterprise 2) The College of Local Wisdom, Thaksin University 3) Phatthalung Provincial Agriculture and Cooperatives Office 4) Phatthalung Provincial Livestock Office 5) Phatthalung Provincial Administration Office 6) Songkhla Provincial Administration Office 7) Nakhon Si Thammarat Provincial Administration Office
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Responsible ministry and contact information	Ministry of Agriculture and Cooperatives, Thailand
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Location and geographical coordinates	The site is located in the Southern Region of Thailand. It is situated in the wetland area of Thale Noi Non-hunting Area to the north of Songkhla Lake, the largest lake in Thailand, at Latitude 7° 45' to 8° 01' N to 100° 15' E. It is the smallest, northernmost basin in the chain of lagoons that form Songkhla Lake. Thale Noi wetland is one of the largest natural freshwater lakes in South East Asia. The Phru Kuan Ki Sian located at the latitude 7°50' N to 100° 08' E within the Thale Noi Non-hunting area with the area of 4.94 km² has been promoted as Thailand's first Ramsar Site since 1998. The freshwater wetlands are situated approximately 20 km inland from the east coast peninsula of the Gulf of Thailand and 115 km north of the Malaysian border in Satun province. Covering the land of 3 provinces i.e. Phatthalung, Songkhla, and Nakhon Si Thammarat with the total area of approximately 460.64 km² (ONEP,2011). The proposed site encompasses 2 sub-districts of Phatthalung Province (Thale Noi and Phanang Tung), 3 sub-districts of Nakhon Si Thammarat Province (Khreng, Laem and Khuan Chalik), and Ban Khao sub-district of Songkhla Province.
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Figure 1 Location of the site

**Accessibility of
the site to capital
city or major cities:**

Thale Noi Wetlands (TLN) is about 850 km south of Bangkok. The site is located 130 km to the north of Hat Yai city (Songkhla province), the largest city in the south of Thailand. A paved national road links the site to this city. The site is also linked by national roads to the airport in Trang city, approximately 90 km away.

From Bangkok:

1) Via Suvarnabhumi International Airport: One and a half hour to Hat Yai International Airport, and approximately two hours from the airport by car to Phatthalung city (by highway no. 4 = 105 km), and half an hour from Phatthalung city to the proposed area (road no. 4001 = 25 km), totally 130 km.

2) Via Don Mueang International Airport: One and a half hour to Trang Domestic Airport, and approximately one and a half hours by car from the airport to Phatthalung city (by highway no. 4 = 63 km), and half an hour from Phatthalung city to the proposed area (road no. 4001 = 25 km), totally 88 km.

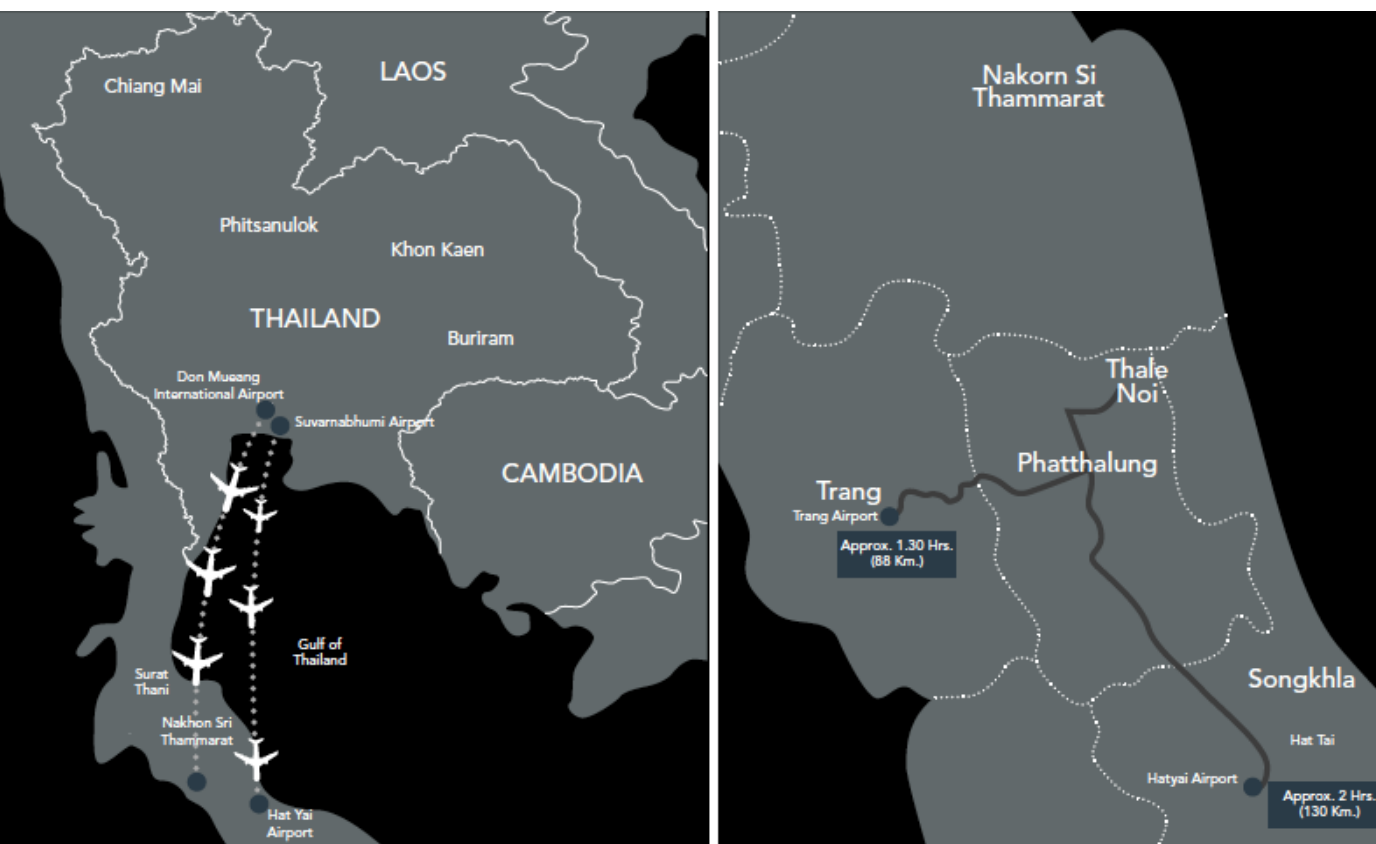


Figure 2 Routes from Bangkok and major cities to the site

**Area of coverage
of the system and
where necessary
the buffer zone¹**

698.90 sq. km² (69890 ha)

**Agro-ecological
zones**

for agriculture,
forestry and
aquaculture²

Tropical monsoonal climate zone, elevation <20 m, terrain slopes <0.5% and evapotranspiration (ET_o) 150-163 (FAO, 2017). Number of growing period days is 340 days. The fertility of alluvial soil in TLN area allows for a diversified range of livelihood practices, such as lowland rice farming, fisheries, buffalo grazing, forestry, and gathering of wild species. Several activities of great importance to sustainable local livelihoods are found only in this particular area, especially the tradition of cultivating native rice in open lakeshore soils, the “Yok Yo” fishing technique utilizing a giant net suspended from a fixed wooden super-structure and the wetland buffalo pastoralism which is at the center of this proposal.

**Topographic
features**

Located just a few kilometers inland from the Gulf of Thailand, approximately 94% of the wetland is land, the remaining 6% is water. Its wetland types are listed as lake, marsh, Melaleuca swamp forest, paddy fields, and swamp grass land, comprising a wide diversity of fresh water habitats and “one of the few surviving intact fresh water wetland ecosystems in Thailand”.

Thale Noi (‘Little Sea’, elevation 0.5 meters) is a lowland lake and wetland approximately 5 km wide and 6 km long. It is the smallest of the lakes that together comprise the Songkhla Lake (Lagoon), Thailand’s largest inland water body. Water levels of the Thale Noi fluctuate significantly according to seasonal conditions, dropping to around 80 cm in dry season and increasing to a depth of 3 meters in some areas during the wet season. The lake and wetland area are biologically diverse, providing multiple habitat types supporting a vast array of flora and fauna, including numerous migratory bird species. Dense Melaleuca (peat) forests are found in the north and south of the area, while extensive rice paddy fields to the east and remaining areas combine swamp marsh, grassland and sedge beds. These areas also provide an ideal area for wetland buffalo husbandry. As a whole, the Phru Kuan Ki Suan of the Thale Noi wetland is widely recognized as an important wildlife conservation zone, was Thailand’s first site to receive the prestigious RAMSAR designation.

¹ Only the core area is designated as a GIAHS, meanwhile the buffer zone can be defined as a surrounding area that contributes to the conservation, management, and sustainability of the system. Determination of the buffer zone is not mandatory but is useful information for management of the site.

² An Agro-ecological zone is a land resource mapping unit, defined in terms of climate, landform, and soils, and/or land cover, and having a specific range of potentials and constraints for land use.

Home range and Shelters of Thale Noi Buffalo on Land use 2017

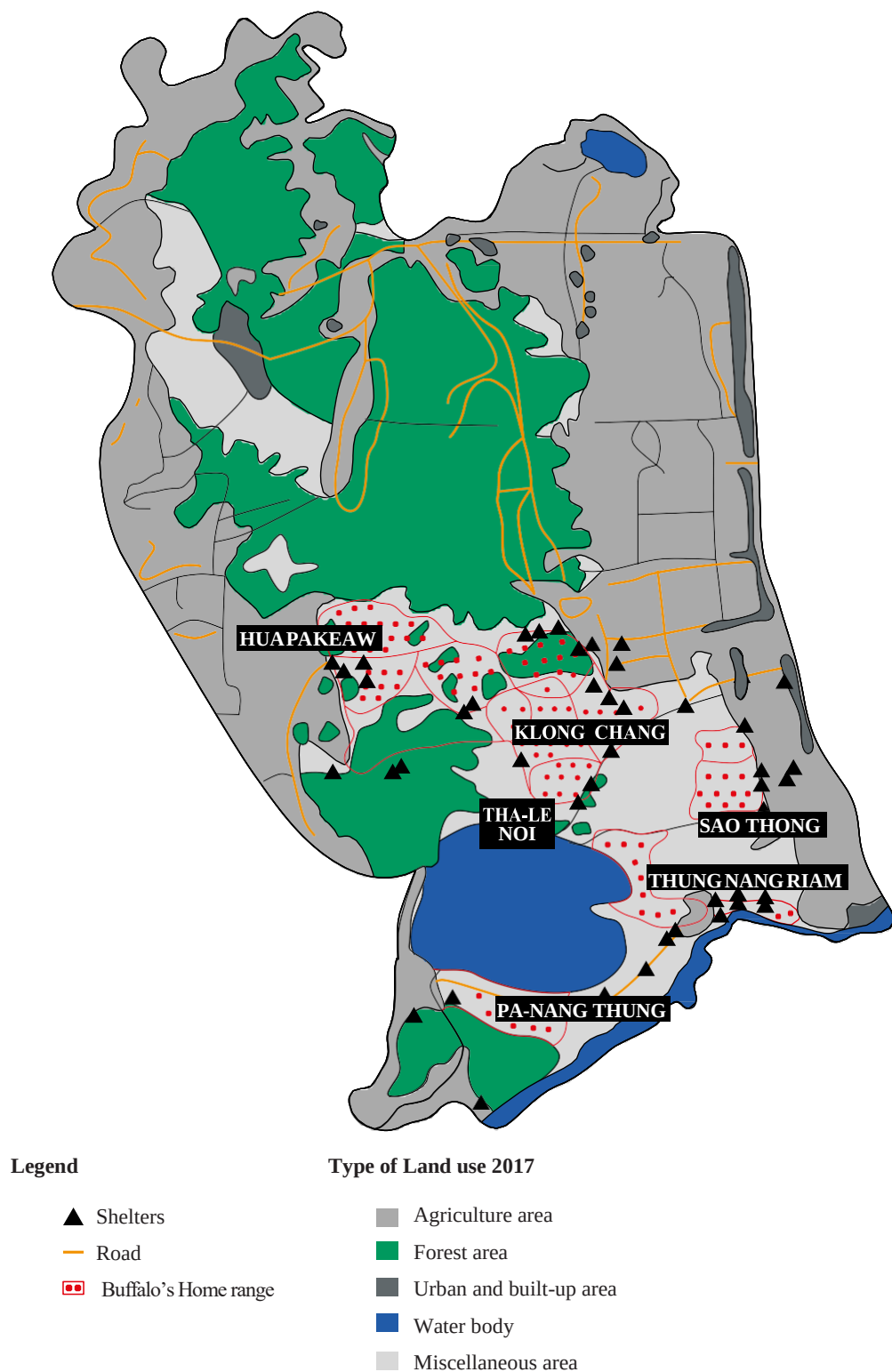


Figure 3 Home range and location of buffalo shelters around TLN wetlands. Much of the grey “Miscellaneous” area indicates grassy plains used as grazing

Climate type:	Tropical monsoon climate ('Am' in Köppen-Geiger Pohl system), hot and humid climate, with 9 months of precipitation per year. Average annual temperature is 27 degrees Celsius and average humidity is 79%. Average annual rainfall is 2,035 millimeters. The most humid time is from October to November, and in November rainfalls are the heaviest, at approximately 500 millimeters. The driest months from June to August, when freshwater evaporation rates are very high and significantly affect the lake water levels (Thai Meteorological Department, 2019).
Approximate population (benefit)	39,819 people from 6 communities or sub-districts (in 4 districts of 3 provinces)
Traditional communities and/or Indigenous population (if applicable)	-
Main source of livelihoods:	The Thale Noi wetland area is an important source of water, food for household consumption of local communities. Most area of the wetland is state-owned (the Non-Hunting Area) and opens for public and communal use, whilst the surrounding areas are mainly owned by individuals. Various parts of the area are presently used for fishing, cattle grazing, tourism and cultivation of rice, rubber, oil palm, orchard, vegetable and Krajoed (<i>Lepironia articulata</i>), which is a type of aquatic plant used in woven products.

II. EXECUTIVE SUMMARY

The Thale Noi Wetland Pastoral Buffalo Agro-ecosystem of Phatthalung Province involves a diversified system of inter-related local livelihood strategies, with buffalo pastoralism as the central unifying cultural, socio-economic and ecological element of the whole landscape. For several centuries, buffalo have played an essential role in the entire local way of life surrounding the Thale Noi ecosystem, and in shaping and maintaining the precious ecosystem balance of the Thale Noi, one of Thailand's most important wetland conservation zones.

The proposed Thale Noi wetland GIAHS site is located within the greater Songkhla Lake Basin. Since 1975, the area is a Non-Hunting Wildlife Conservation Area. The area is one of Thailand's most important biodiversity conservation zones at the same time that it is a productive working cultural landscape.

The Thale Noi wetland is itself a highly dynamic ecosystem. Its biophysical structure and functional relationships are overwhelmingly determined by flooding associated with the annual Asian monsoon. Nearly completely inundated with water for five months out of the year, it provides important nesting and feeding grounds to many endemic and migratory bird species, and is a zone of high overall biodiversity and primary productivity. At the same time, this landscape has remained, year after year, amenable to a diverse set of human livelihoods and ways of life. For example, Fishing is a year-round activity, with many distinct techniques developed to catch particular species.

Buffalo pastoralism has played a critical functional role in this high-value and high biodiverse ecosystem and landscape.

Buffaloes are an essential source of cultural and economic value in local communities, in which they have special totemic significance. The sale of buffalo provides periodic but relatively large sums of money that support major household expenses. Buffalo also play an important role in the symbolic and spiritual life of local people, as they are present in different forms in many local ritual contexts, ceremonies, and festivals.

About seven thousand buffalo range relatively freely across the grassy plains surrounding the Thale Noi for eight to nine months of the year.

In the monsoon season, they dive down to graze the submerged grasses, staying underwater for up to ten seconds at a time.

The trampling of buffalo changes the local topography, creating waterways and depressions that function as new landscape niches beneficial to many other species. Meanwhile, the grazing of buffalo reduces overgrowth of grasses and shrubs, stimulates new growth, distributes seeds of native plants, maintains water quality, cycle nutrients that maintain overall fertility and ecosystem integrity, and so provides essential feeding and nesting grounds for many species of endemic and migratory birds.

The buffaloes have important ecosystem balancing function. Buffalo eat grass and some plants. Many birds walk together with buffalo to find food and eat insects or flies that sit on the body of buffalo. Grazing by buffalo increases native plant and wildlife diversity by reducing water stress and increasing photosynthesis.

Remarkable agroecological interaction among buffalo grazing, water plant cultivation, fishery production and bird conservation thank to critical scale of wetland buffalo pastoralism - have enhanced sustainable development of agricultural in protected freshwater wetland area over many generations and has supported farmer food and livelihood security in the area.

Thale Noi is a scenic land- and water-scape increasingly known as a high value destination for eco-tourism. Herds of swimming buffaloes present an impressive spectacle, and attract a growing number of eco-tourists. Bird life is abundant, and easily observed from small boats for hire, often guided by pastoralists who provide expert knowledge of the local practices and area.

This combination of natural beauty, rich avian life, charismatic buffalo, and vibrant cultural life has recently made Thale Noi one of the most visited tourist attractions of Phatthalung province.

The Wetland-Buffalo Pastoral System is of direct significance to core FAO strategic objectives, including food security, support for sustainable local agricultural production, and reduction of rural poverty. At the same time, the system presents a novel and special opportunity to establish complementary and multidimensional conservation zones, linking existing efforts to conserve specific species habitat and ecosystem services to the traditional human practices that are already partially responsible for habitat creation and continuation of ecosystem integrity and resilience. In recognizing the links between traditional cultural practices and environmental knowledge and ecosystem integrity and resilience and hemispheric migratory ecological networks, the proposed site provides an important empirical model of the ways in which high-value agricultural heritage sites are simultaneously of local, regional and global ecological significance.

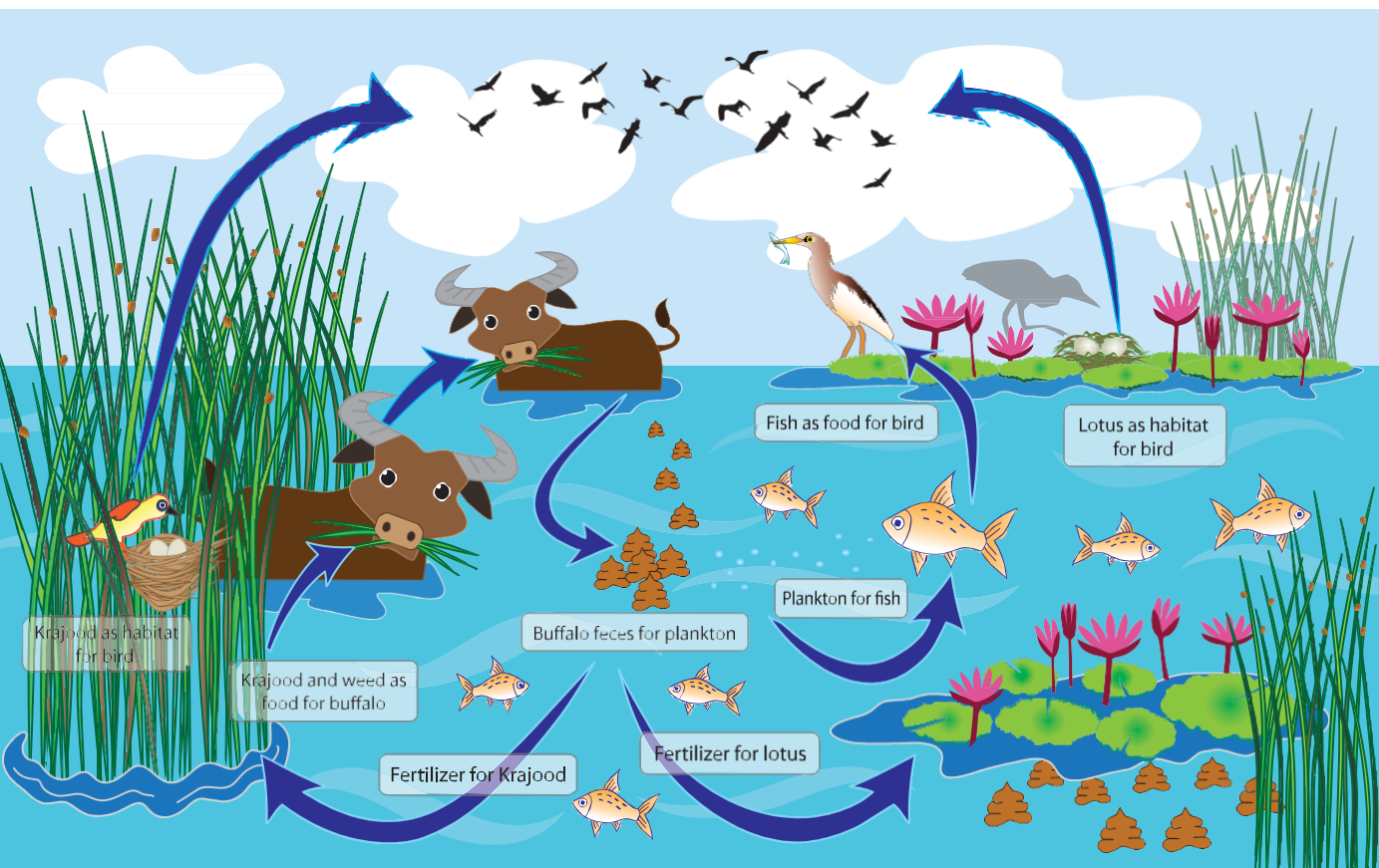


Figure 4 An Agro-ecological cycling model of the Thale Noi Wetland Pastoral Buffalo system



Areas

Proposed GIAHS site (698.90 km²)

Thale Noi Non-Hunting area (460.64 km²)

Thale Noi Freshwater lake (28 km²)

Phru Khuan Ki Sian Ramsar site (4.94 km²)



Proposed GIAHS site

Thale Noi Non-Hunting Area

Boundary line

Thale Noi Lake

Phru Khuan Khi Sian (Ramsar site)

Figure 5 Overlapping areas of the proposed GIAHS site among Thale-noi non-hunting area, Thale-noi Freshwater lake and Phru Khuan Khi Sian Ramsar site. It encompasses 6 sub-districts of 3 provinces i.e. Phatthalung (Thale noi, Phanang Tung), Nakorn Si Thammarat (Khreng, Laem, Khuan Chalik) and Songkhla (Ban Khao).



Figure 6 Thale Noi wetland ecosystem



Figure 7 Water buffalo grazing on the marshland

III. Significance of the Proposed System

Historical Background

Swamp Buffalo (*Bubalus Bubalis buffalo*) in Thai Culture and Society

There are three types of buffalo in the world, the swamp buffalo called water buffalo, the river buffalo and Mediterranean buffalo. The buffalo mostly found in Thailand has been classified as the swamp type, which are the same type in other ASIAN countries and some ASEAN countries. The swamp buffalo is the indigenous buffalo in Thailand. Traditionally, they were raised by small farm holders for multipurpose roles as complementary with their crop production.

The swamp buffalo have been used for centuries by Thai farmers to do the hard work of ploughing rice fields, planting and harvesting rice. The animal's manure is also a great natural fertilizer, and buffalo meat is nutritious. As such, in the past, the number of buffaloes a family owned became one of the indicators of financial status. However, with the arrival of the mechanization of farming around the 1960s, tractors (iron buffalo) have replaced water buffalo and their population has rapidly declined all over Thailand. Nowadays, there are only a small number of rice paddies in remote areas that still use water buffalo for ploughing. Due to the sharp fall in their numbers, many people have become concerned that water buffalo may gradually disappear in Thailand. Statistics from the Thailand agricultural statistical center showed.

that Thailand had about 5.5 – 6.5 million buffalo during 1971 and 1981. The buffalo population declined to 1.8 million, and 0.95 million in 1999 and 2015, respectively. At present (November 2019), the number of water buffalo is about 1.27 million. Most of buffalo production (approx. 72%) are in Northeast region.

Thought the buffalo in the proposed GIAHS site are the swamp type as in the other regions of Thailand, they have developed, from time to time, some differences in characteristic and behaviour resulting from the unique system mentioned later such as light skin tone, excellent ability of swimming and diving and etc.

Due to its close relationship with the farmer's life, buffalo have always played an integral part in Thai culture and Thai society. There are several Thai songs that talk about buffalo, such as "Smell of mud and buffalo song". In addition, the Thai alphabet's fourth letter is also said "KHO KHWAI" (๙). "KHWAI" is the carabao or water buffalo.

Buffalo raising in Thale Noi wetland area. According to a local folktale of Thale Noi community, it is indicated that Thale Noi was created from a buffalo muddy patch, owned by "Nai Rang" ("Nai" mean Mr.).

He was a wealthy man from Ban Choom Pon, Sating Phra District, Songkhla Province. He owned and raised many buffalo. One day, Nai Rang asked his people to take the buffalo into the area (Thale Noi at present), because there were so many buffalo and they enjoyed playing, stomping and tumbling about in the muddy patch for a long time each day. The area and the community inhabiting it has thus become known as Thale Noi, or “small sea”.

Another commonly-told folktale about the history of Thale Noi community tells: About 700 years ago, the King of Sukhothai spread his power into the south of Thailand. He assembled the people to cut down trees to construct a fleet of battleship to fight Malay enemies in the far south. All of the takhian trees (*Hopea odorata*) were cut down from Thale Noi area. After that, the area became extremely dry and there was no rain for three years. Later, a wildfire broke out and consumed several thousand rai. Thale Noi was severely burnt. When the rainy season arrived, the burnt area turned into a big lake that was soon filled with crocodiles, elephants, and buffalo, as well as many smaller animals. These large creatures stomped their feet in the lake mud, enlarging it with their very bodies. Even until now, Thale Noi is still enlarging itself, becoming larger and deeper.

In addition, there are a number of the mural paintings in Wat Wang (“Wat” mean Buddhist temple), Lumpum Sub-district, Muang District of Phatthalung province (Old City), situated near Songkhla Lake and Thale Noi, was built in the time of King Rama IV (1851-1868 A.D.) demonstrates that buffalo husbandry in Thale Noi wetland has been operated for more than 200 years. (Figure 8)

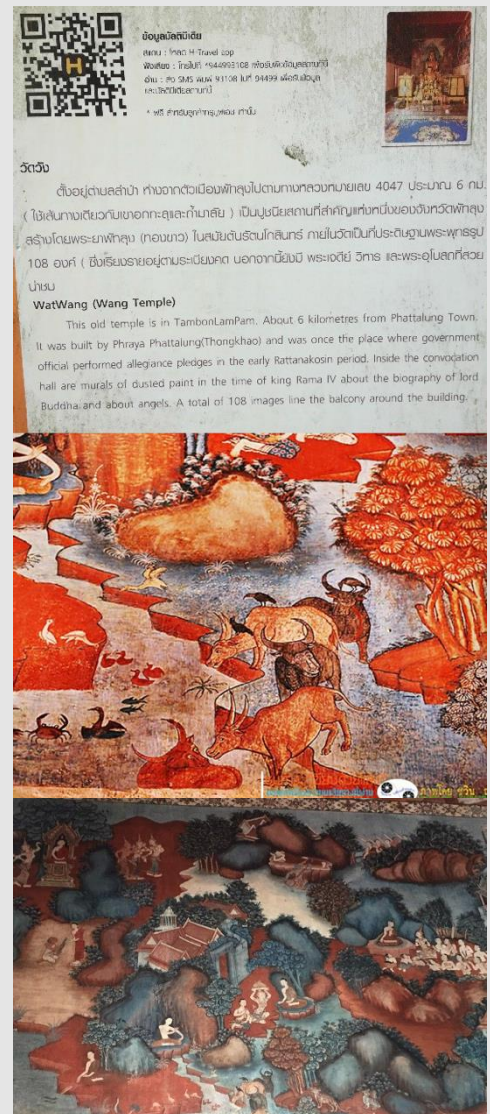
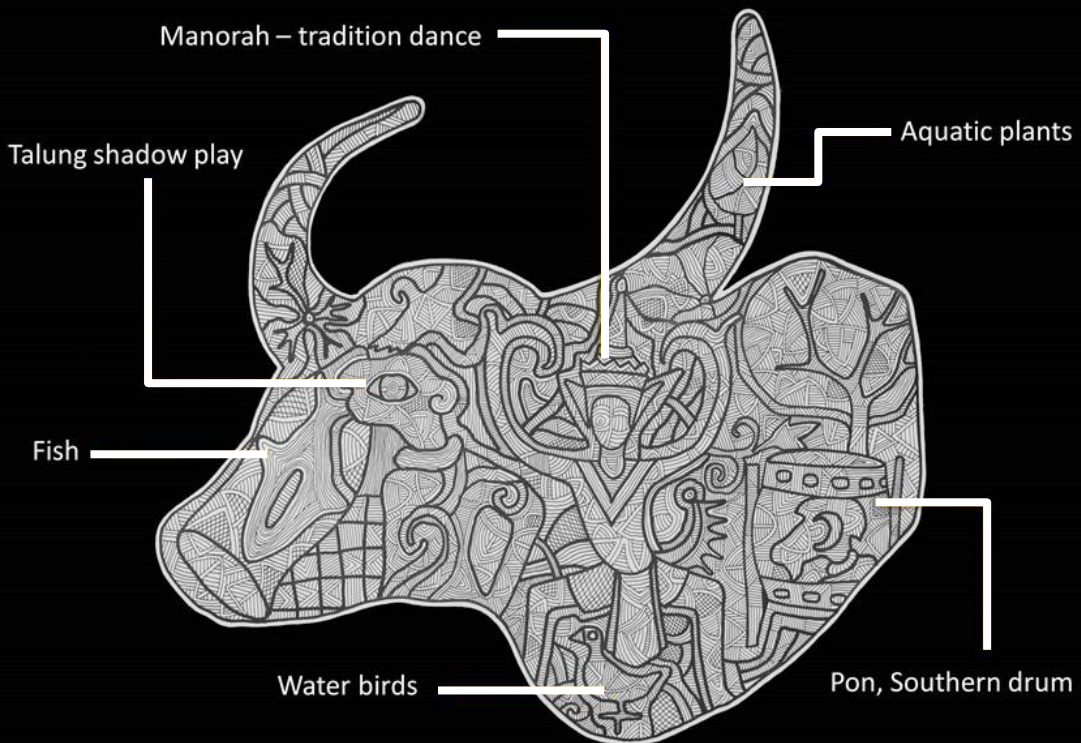


Figure 8 Mural painting in Wat Wang

A history of life with buffalo

Buffalo are the single-most significant element in the cultural, economic, and agricultural aspects of local community life (Figure 9). They were historically essential to rice cultivation, as they were used to prepare and fertilize rice paddy fields and to transport agricultural goods. Their meat is considered a delicacy and is still consumed at communal festivals and other important occasions throughout the region, and many different buffalo foods, including meat balls, and dried and salted buffalo meat products are made and sold around Thale Noi. In the past, buffalo milk was also an important part of people's diet. It was commonly consumed with rice and in the swamp forest area where coconuts are scarce, local people used buffalo milk for substitution.



Buffalo as background to community food security

At present, buffalo are raised and sold for consumption, and in Thale Noi they are seen as the background to community food security. The wetland buffalo pastoral system strengthens food security and income and improves quality of life for the local community. Buffalo husbandry in the wetland depends mostly on free ecological services, including food source and natural habitats. It is considered low budget and risk-free. Buffalo caregivers can spend their extra time earning their living from other activities, such as fisheries, non-timber product collection, and boat rides for tourists. Income from selling buffalo accounts for 55% of total income per year, providing relatively large but periodic sums of money that support major household expense or savings.

2. Unique Systems

The Thale Noi Wetland Pastoral Buffalo Agro-ecosystem site is an exceptionally unique area that together comprise the only lagoon of Thailand (ONEP,2000). The site that is proposed here can be divided into two principal areas. The great majority, about 94% of the total area, is terrestrial, comprised of flood plain, swamp forest, and open grassy plains. About 6% of the total area is permanently covered in fresh water, comprising the Thale Noi itself, which is 5 km wide, 6 km long, and 1.2 meters deep on average. The wetland combines lake, marsh, *Melaleuca* (paperbark) swamp forest, riparian forest, paddy fields, and swamp grasslands. The lake and wetland are biologically diverse, providing multiple ecological services and habitats that support a vast array of plants and animals.

Dense *Melaleuca* forests dominate the north and south of the Thale Noi, with extensive rice paddy fields to the east and remaining areas of swamp marsh, grassland and sedge beds. Over 1,170 flora and fauna species are discovered with aquatic vegetation being significantly prominent (Phongchate, 2011). Up to 187 water bird species including migratory and non-migratory birds have been observed (Watcharaporn, 1999). The site provides shelter to migratory bird species such as *Leptoptilos javanicus*, *Theskiornis melanocephalus*, among many others, making it part of an important corridor linking equatorial aquatic environments of peninsular Thailand to inland wetlands of Southeast Asia. The freshwater Thale Noi is also a rich habitat for several rare and endangered animal species, such as Giant Ibis (*Pseudibis gigantea*), White- Winged Wood Duck (*Cairina scutulata*), Fishing cat (*Prionailurus viverrinus*), Parategastes pholpunthini and Tentacled snake (*Erpeton tentaculatum*), all of which are listed by IUCN as endangered.

The site has been long-inhabited by local communities whose diversified livelihood strategies - historically based around buffalo (*Bubalus bubalis*) pastoralism, fish and cultivation of krajood (*Lepironia articulata*) and many local varieties of rice - have been developed to suit this unique and dynamic monsoon wetland environment. These long-standing human livelihood practices are an essential component in the ecology of the area, and to the realization of conservation goals for the region.

The proposed site therefore represents an opportunity to simultaneously address FAO Strategic Objectives of food security, support for sustainable local agricultural production, and reduction of rural poverty as these are also implicated in regional social-ecological resilience to climate change and extreme climatic events. The Globally Important Agricultural Heritage Systems' designation therefore presents a novel opportunity to establish complementary conservation zones, linking existing efforts to conserve species habitat to the traditional human practices that are already partially responsible for habitat creation and long-term ecosystem integrity and resilience.

The social organizations and mutual support are also one of the main characteristics of the system. There is a long history of collaboration among pastoralists in the area. As buffalo range freely in the wetland, they still possess their natural wild instinct. Buffalo pastoralists are within families, relatives and friends closely to beliefs, traditions and culture, making the social system of pastoralists of Thale Noi relatively unique. Effective care for the buffalo herds is highly social and requiring much collaboration and knowledge transmission between individuals, social groups, and through the generations. These include buffalo recognition, buffalo herding, communication techniques, and herbs and medicines for buffalo etc. They have the tradition of exchanging knowledge and benefits which boost the unity among the community members. Due to the insufficient own land together with the protected Thale Noi Non-Hunting

Area wetlands, the need for common use of these lands has bound local people together in community associations that distribute collective responsibility for the maintenance of natural resources on which all depend. These associations also serve as knowledge networks, keeping the local ecological knowledge of buffalo agriculture alive. In general, there are commonly-agreed rules and regulations that provide general guidelines to which all should comply.

3. Critical Function Roles of Buffalo in the Wetland Area

The Thale Noi Wetland Pastoral Buffalo Agro-ecosystem has been operated for some centuries. Buffalo range relatively freely across the grassy plains and interrelate with other living creatures, and as a consequence, become an essential part of the Thale Noi wetland ecosystem. Most importantly, buffalo pastoralism plays a critical functional role in the ecosystem and landscape, by reducing overgrowth, cycling nutrients, maintaining water quality, and providing important feeding and nesting grounds for many species of bird. As mentioned, buffalo herds have also created important canals within the wetlands, and many small trails and wallows that serve as firebreaks as they also provide habitat for birds and other animals.

The critical functional roles of buffalo in the wetland areas the followings:

1) The trampling action of so many buffalo affect the topography of the local landscape, creating waterways across the territory as well as smaller depressions that retain moisture well into the dry season. Both of these landscape features provide benefits (e.g. nesting, hatching, and feeding grounds) to other species. Besides, buffalo-created waterways act as an effective firebreak during dry season, minimizing amount of Carbon created from peat swamp fires.

2) Buffalo assist in seed dispersal, soil improvement that stimulates a higher rate of wetland forest restoration and

3) Buffalo grazing controls the grassland ecosystem, natural habitat, protective shelter, food source and breeding grounds for numerous kinds of animals, especially rare/endangered and endemic species.

Buffalo's Contribution to Biodiversity

(Buffalo in the wetland ecology)

Buffalo grazing in Thale Noi plays an important part in the local landscape ecology. Interaction between cattle grazing and its surrounding plays an essential role in biological diversity and ecosystem functioning in the following ways:

Buffalo and birds

Thale Noi is a renowned water bird conservation zone in southern Thailand. Many bird species depend on the buffalo in different ways. For example, heron, crow and mynas follow the buffalo herds, searching for insects attracted to their feces, and also picking leeches or parasites directly from the buffalo's body (Figure 10). Further, as buffalo tread through the muddy soil, they create depressions that make these buffalo footprint is used as nesting-place by the Black-winged Stilt (*Himantopus himantopus*) and Oriental Pratincole (*Glareola maldivarum*). In grazing the grassy plains, buffalo herds also clear away high growth and displace natural predators, both of which enhance the safety of nesting ground (Figure 11). In addition, birds consume fish in Thale Noi and use lotus leaves as nesting ground. Both fish and lotus are beneficial from buffalo's contribution in this circular system.



Figure 10 Heron and other birds live symbiotically with the buffalo herds.



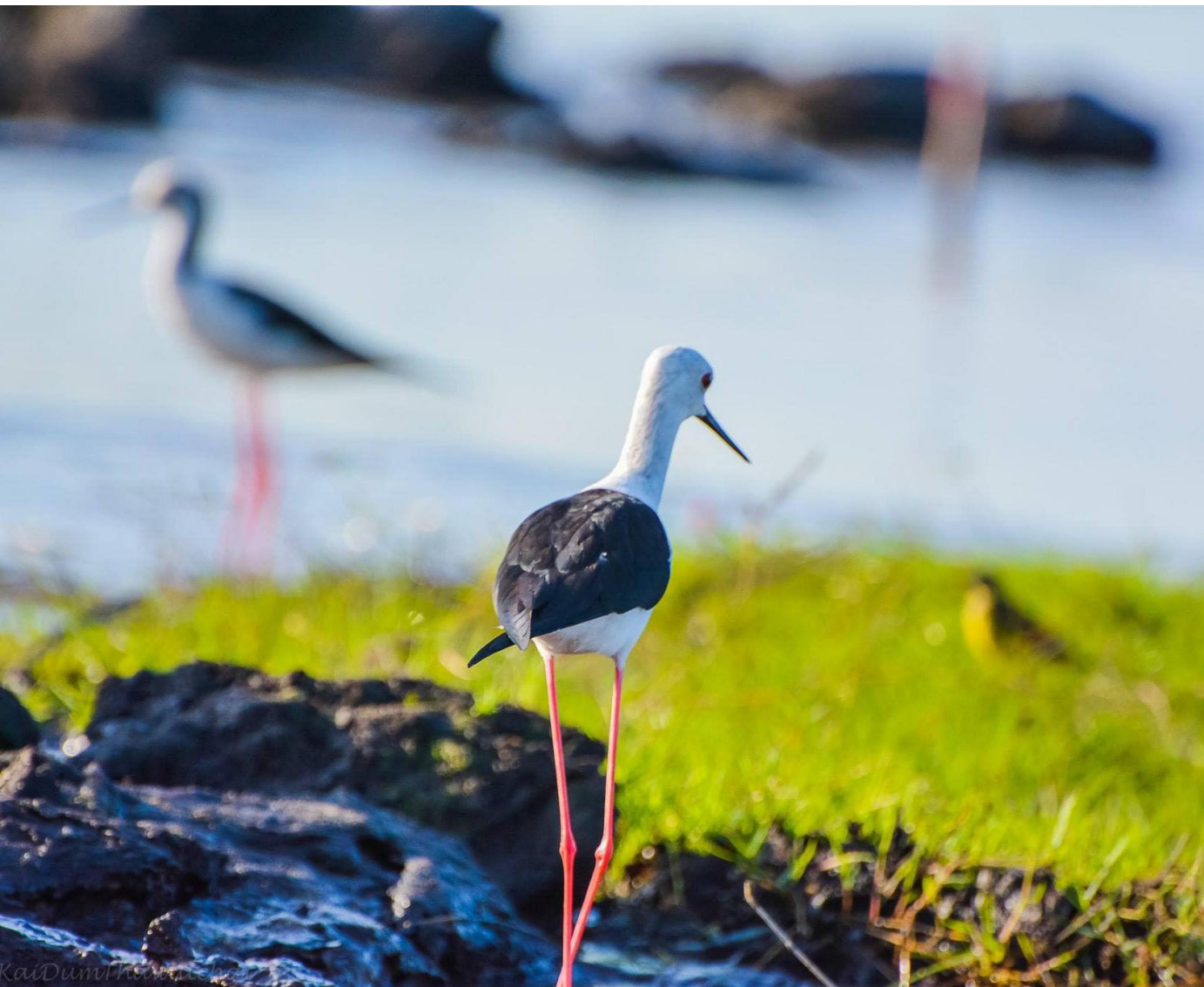


Figure 11 Specific species of bird



Buffalo and fish

Thale Noi supports more than forty species of fish in Thale Noi. Silver barb (*Barbonymus gonionotus*), and Striped Snake-head Fish (*Channa striata*) are among the most prevalent and economically important fish. Buffalo herds also support fish populations, as both buffalo wallows and the areas used for farmer buffalo pens provide protective spawning grounds even as they serve as source of water for other animals in the dry season (Figure 12). In addition, buffalo excrement enrich plankton which feed fishes in the lake.



Figure 12 Buffalo wallow, or muddy patch

Buffalo and some water plants

Krajood or Grey sedge (*Lepinonia articalata* Retz.) and lotus are the main water plants in the area. Buffalo feces enrich the lake mud, which are in turn dredged as fertilizer for lotus and Krajood plants.

Buffalo and ecosystem

As for the lake area that remains water-covered all year long, aquatic plant species are dominant. The Sacred Lotus (*Nelumbo nucifera*), Water Snowflake (*Nymphoides indica*), Asian Water moss (*Salvinia cucullata*), Golden Bladderwort (*Utricularia aurea*), Hornwort (*Ceratophyllum demersum*) and Green Algae (*Chara spp.*) are most abundant. Many macrophyte populations form dense floating patches on the lake surface, providing refuge and habitat for both mobile and sessile organisms. Aside from aiding seed dispersal and fertilization, buffalo grazing plays a significant role in the nutrient cycling of the Thale Noi. The buffalo herds significantly reduce the number of aquatic weeds, metabolizing about 200 tons of grass and aquatic weeds daily.

This consumption helps reduce Biochemical Oxygen Demand (BOD) loading, as well as the amount of rotting plants and sediments, so improving water purity and nutrient flow in the ecosystem as a whole. In addition, the movement of buffalo herds through the landscape has over time created at least twenty-two important waterways in the Thale Noi area. These are the waterways pastoralists, forest gatherers, and fisherfolk use to move throughout the wetlands. In addition, there are many smaller channels created by buffalo, and these serve as natural fire barriers throughout the swamp forest, as there is danger of fire in the dry season.

In conclusion, this **remarkable agroecological interaction among buffalo grazing, water plant cultivation, fishery production and bird conservation with closely link ecosystem have enhanced sustainable development of agriculture in the protected wetland** over many generations and support the farmer's food and livelihood security in the area. As a whole, the interaction between buffalo and environment is depicted in (Figure 13) next page.

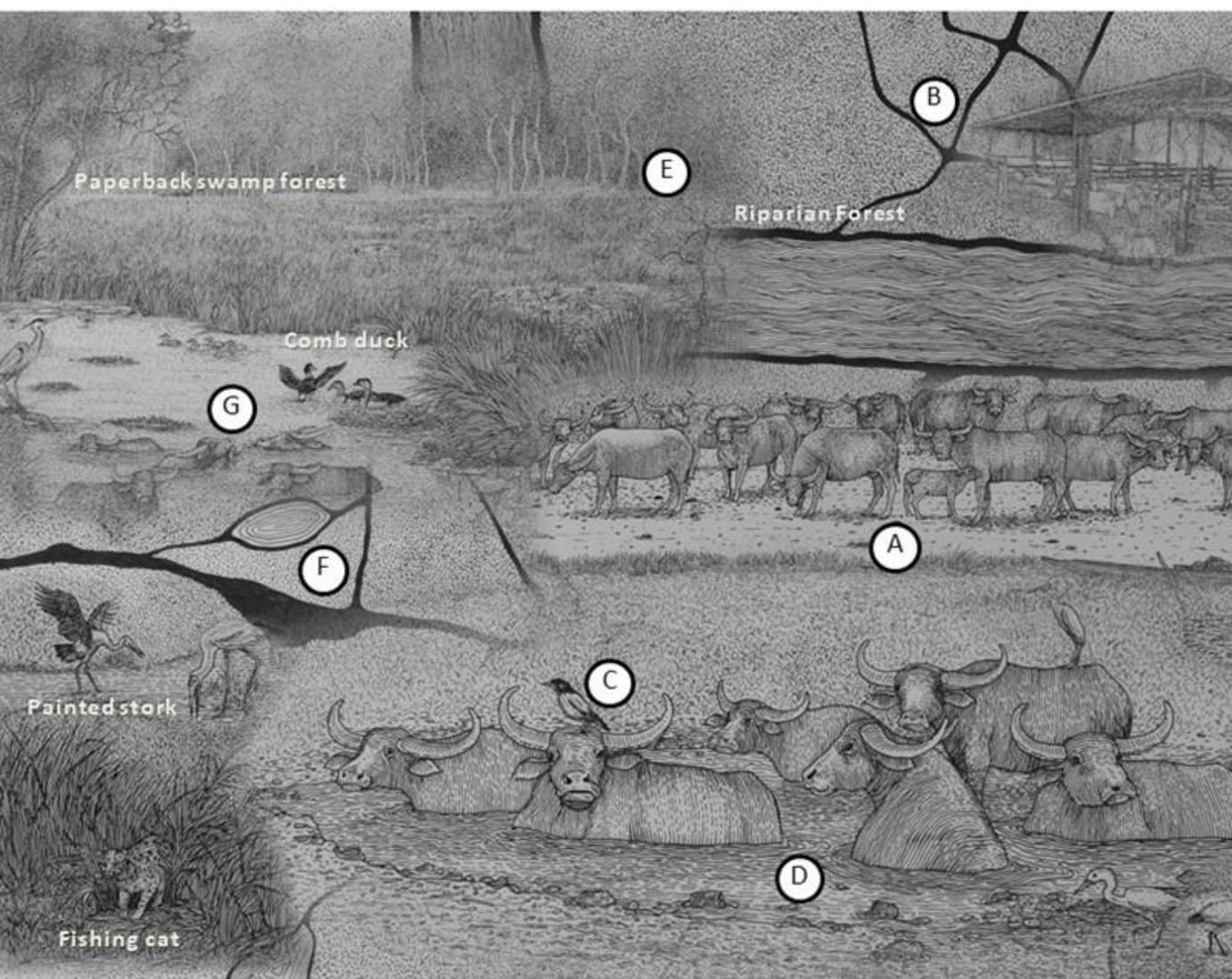


Figure 13 Interactions between buffalo and environment.

- A:** Buffalo range relatively freely in the wetlands at least 9 months a year. As a result, grassland area is naturally controlled. At least 80 species of birds inhabit in the grassland.
- B:** Trampling actions of so many buffalo create interconnected waterways throughout the wetlands. This provides protective habitats for aquatic animals, aquatic animal movement, waterways for local fishermen, and natural fire barriers.
- C:** While buffalo graze the glassy plains, many kinds of birds such as heron, mynas, crows and swallows follow buffalo herds searching for insects. Phatthalung is widely known for its highest quality Swallow's Nest.
- D:** Buffalo wallows or muddy patches dispersing around the wetland provide protective spawning grounds, source of water for other animals in the dry season.
- E:** Buffalo feces on land add rich nutrients to acidic soil of wetland area. This makes the seeds of some plants such as Indian oak (*Barringtonia acutangula* (L.)) grow better in buffalo feces. Consequently, cattle manure helps in seed dispersal and provide nutrient-rich ground for trees to grow better.
- F:** The buffalo herds significantly reduce the number of aquatic weeds and the amount of rotting plants and sediment, thus improving water purity and nutrient flow in the ecosystem as a whole. Buffalo feces submerged in water becomes an essential source of nutrients for zooplankton which provides vital nutrient for the growth of all aquatic animals. Fishermen benefits most from this.
- G:** Buffalo shelter during flood season is a hub for pastoralists to exchange news and knowledge on buffalo pastoralism. Buffalo feces in the shelter can be sold for extra income.
- H:** Generally, buffalo do not eat Krajood (*Lepironia articulata* Retz.) and Ra Pho (*Phragmites karka* Retz.). Krajood is a species of water plant used in weaving products for local people. Ra Pho is used by many water bird species for nesting and raising their chicks. Therefore, buffalo show positive and harmonious relation with humans and birds.
- I:** As buffalo range freely in the wetland, pastoralists are able to earn their living from other jobs, such as fisheries, collecting non-timber forest product and boat rides for travellers.

1. Remarkable agroecological interaction among livestock, fishery and plant through agriculture in wetland developed in harmony with environment

This area has been developed, from time to time, a pattern of land use of animal grazing in wetland support by fishing and water plants cultivation, maintaining significant and environmentally friendly. This is evidenced by the fact that this area is covered by Thale Noi Ramsar site and bird conservation zone, which imposes some regulation to prohibit or highly restrict activities in the area. Most of extensive and modern agriculture employed in other area have been prohibited or highly-restricted in the area. But this wetland pastoral buffalo agro-ecosystem have been existed as, one pattern of sustainable agriculture in wetland developed by a strong cultural identity of local community and build on sustainable resource area with no burden on environment. This demonstrates appropriate balance between earning income for community's livelihood and environment and natural resource conservation.

The GIAHS designation, if granted, will underscore the significance of traditional livelihood practices to the local ecosystem's health and functions, and provide important legitimization of existing and planned public and private sector endeavors designed to maintain livelihood viability and conserve ecosystem functions for the future. In this pragmatic sense, the GIAHS designation improves local actor's abilities to act in accordance with existing FAO objectives and the United Nations Sustainable Development Goals towards reduction of rural poverty and improvement of rural productivity, food security and social-ecological sustainability. Moreover, in recognizing the links between traditional cultural practices and environmental knowledge and ecosystem integrity and resilience and hemispheric migratory ecological networks, the Phatthalung site provides an important empirical model of the ways in which high-value agricultural heritage sites are simultaneously of local, regional and global ecological significance.

IV. GIAHS Selection Criteria

The Thale Noi Wetland Pastoral Buffalo Agro-ecosystem involves a diversified system of inter-related livelihood strategies, with buffalo pastoralism as a central unifying cultural, socio-economic and ecological element in the cultural landscape.

Before describing the different dimensions of the system individually, Figure 14 presents a seasonal calendar of principal livelihood activities of the Thale Noi communities.

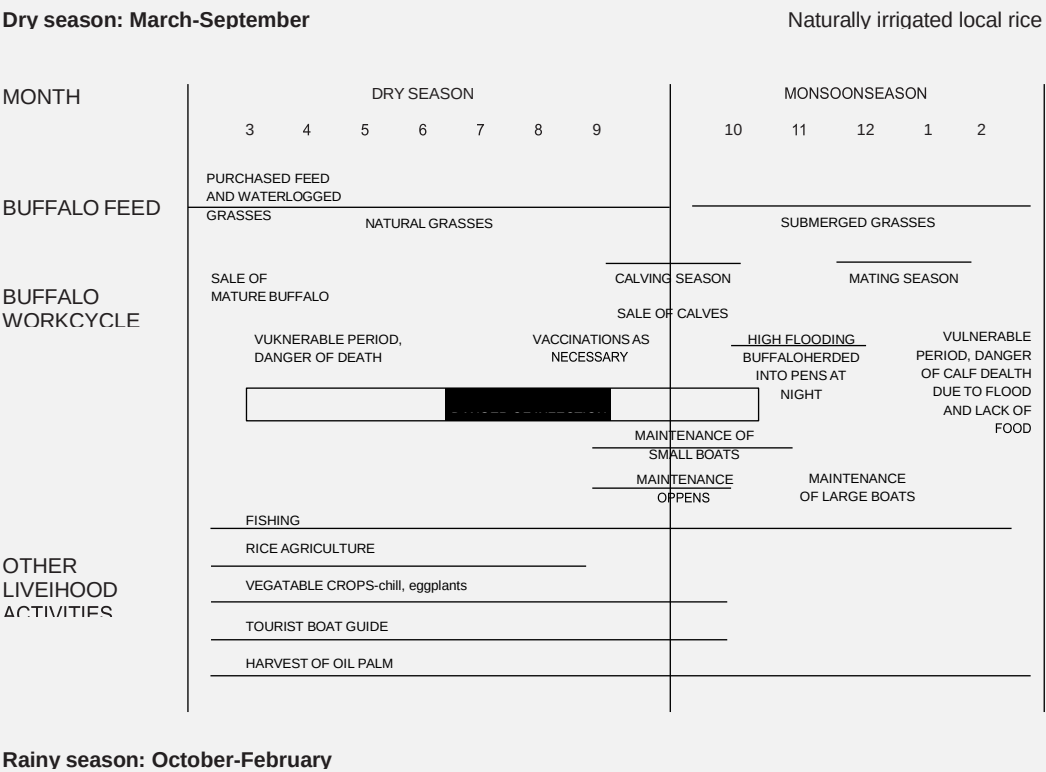


Figure 14 presents a seasonal calendar of principal livelihood activities of the Thale Noi communities.

The principal buffalo grazing area is located within the Thale Noi Non-hunting Area. It is a flat flood plain of grassland and swamp forest, surrounding the Thale Noi, Local pastoralists are from several surrounding communities, including 2 sub-districts of Phatthalung Province (Thale Noi and Phanang Tung), 3 sub-districts of Nakhon Si Thammarat Province (Khreng, Laem and Khuan Chalik), and Ban Khao sub-district of Songkhla Province. Currently, there are 480 cattle caregivers/owners in 19 small groups according to grazing areas and close relation. The grazing area encompasses 160 km². A formal pastoralist community enterprise group was established in 2017 (No. 5-93-05-12/1-0023). The numbers of farmers and buffalo are appeared in the table 1 below:

PROVINCE/ DISTRICT	SUB-DISTRICT	NUMBER OF FARMERS	%	NUMBER OF BUFFALO	%
Phatthalung/ Khuan Khanun	Thale Noi	237	49.37	2,954	40.28
	Phanang Tung	59	12.29	1,019	13.89
	<u>Sub- total</u>	<u>296</u>	<u>61.66</u>	<u>3,973</u>	<u>54.17</u>
Songkhla/ Ranot	Ban-Khao	129	26.88	2,243	30.58
	<u>Sub-total</u>	<u>129</u>	<u>26.88</u>	<u>2,243</u>	<u>30.58</u>
Nakhon Si					
Cha-uat & Hua Sai		12	2.50	280	3.82
Cha-uat	Khreng	12	2.50	280	3.82
Hua Sai		43	8.96	838	11.43
	Khuan Chalik	20	4.17	516	7.04
	Laem	23	4.79	322	4.39
	<u>Sub-total</u>	<u>55</u>	<u>11.46</u>	<u>1,118</u>	<u>15.25</u>
	<u>Total</u>	<u>480</u>	<u>100</u>	<u>7,334</u>	<u>100</u>

Table 1 Number of Farmers and Buffalo in the site
Source: Phatthalung Provincial Livestock Office, 2019

1. Food and Livelihood Security

The Thale Noi Wetlands (TLN) support a diverse complement of agro-pastoral livelihoods that provide the foundation for local food security and ecological integrity. The herds of diving water buffalo are the most emblematic of this entire way of community life. Since the annual ecological cycle of the TLN provides ample nutrition to the grazing buffalo, which are able to range with little supervision by a farmer group's representative to take turns in taking care of the herds for eight to nine months out of the year, other pastoral households are also able to pursue a number of complementary livelihood opportunities which, as a whole, are suited to the regional ecology. Before the Thale Noi Non-hunting area was designated as a protected area in 1975, some buffalo were kept and worked in privately owned farmlands especially rice field.

Their feces were used as natural fertilizers in the rice paddies. After 1975, some of the farmlands which locate in protected area were made state-owned. Since then buffalo are raised only for sale and meat consumption.

Surveys conducted by researchers at Thaksin University in Songkhla indicate that only sale of buffalo may comprise a significant portion of annual income.

In 2018, the average annual income of a farmer/pastoralist was approximately 213,000 Thai Baht (~US\$6,798). Sales of buffalo accounted for approximately 55% of this total, about THB 117,000 (~US\$3,734). The next greatest sources of income were field agriculture (19% of total) and fisheries (12% of total), as shown in Figure 15.

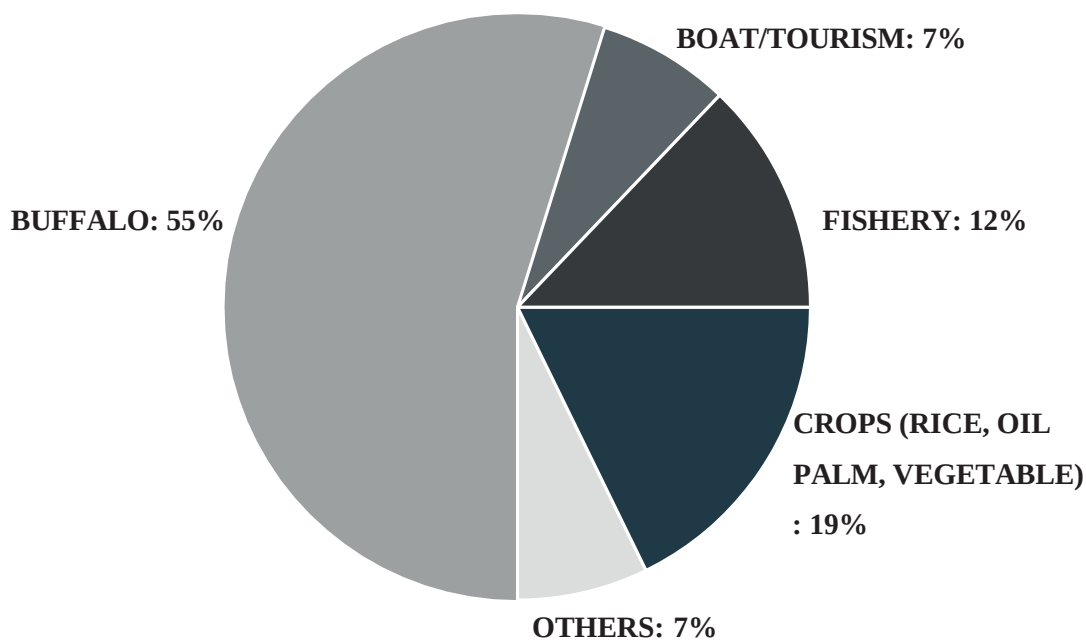


Figure 15 Diversified sources of local income, 2018

Thus, buffalo are an essential source of cultural and economic value in local communities, in which they have special totemic significance. The sale of buffalo provides periodic but relatively large sums of money that support life quality of the pastoralist family. Earnings from sale of buffalo are often kept as savings or reserve for special expenses or substantial expenses such as the building of new houses and cost of investments, education, ordination ceremonies, and marriage.

Meanwhile, more regular incomes earned in other jobs tend to be used for daily household consumption. This was proofed by the unique practice of the Thale Noi buffalo production system, which provides time for other types of earnings as shown in Figure 16. The table demonstrates three months of intensive care of the cattle while other income-derived activities can be performed at some other time.

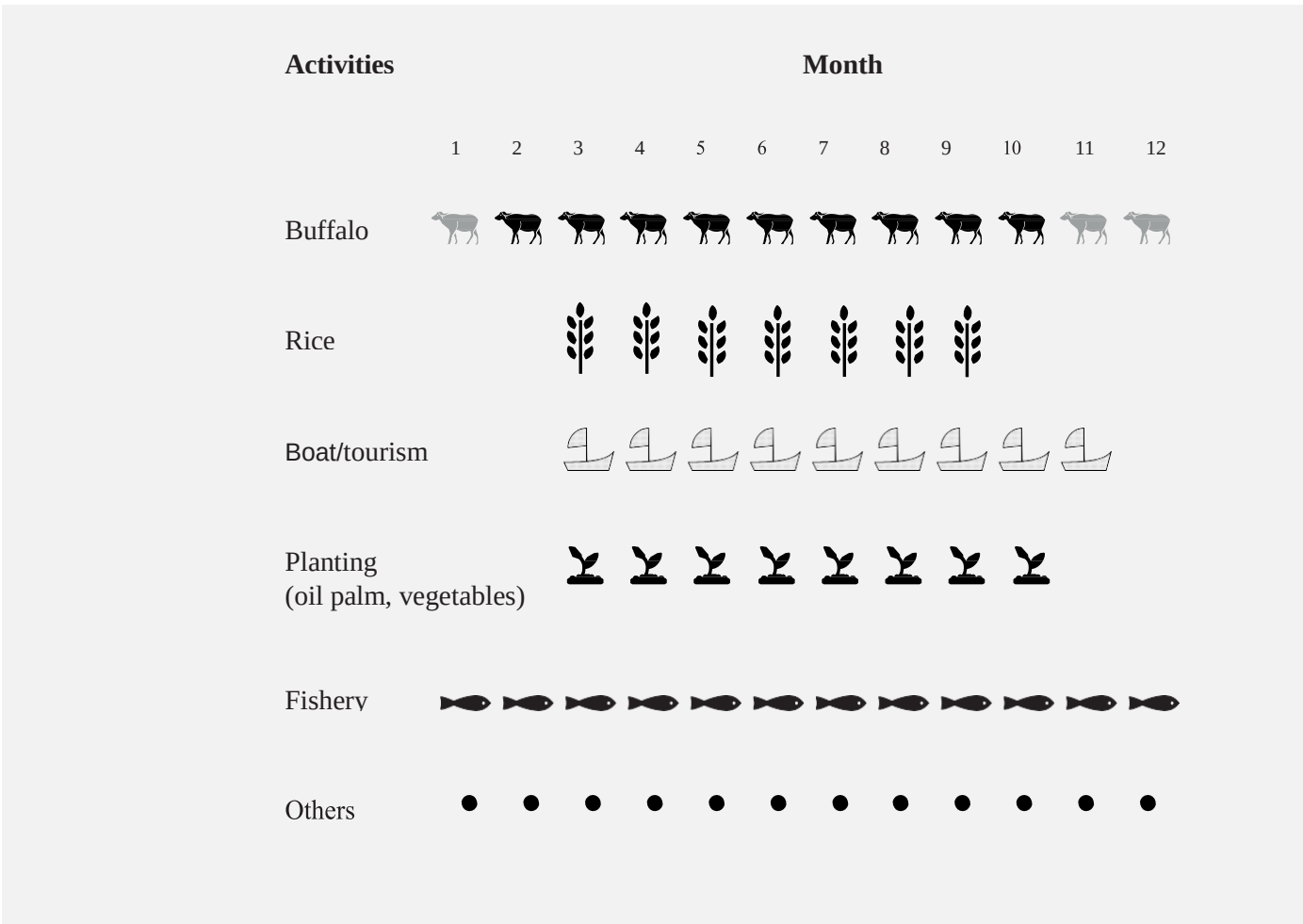


Figure 16 The calendar of buffalo pastoralism and other income-derived activities.

Buffalo from Thale Noi are organically raised and free-range, and raised with great consideration for their wellbeing. As far as consumption, they are considered by local people and visitors as a natural and healthy food closely linked to the local environment and seasonality.

In fact, local studies have demonstrated the qualities of buffalo meat, which is lower in calories, cholesterol and fat than beef is but higher in protein (Table 2).

Table 2. Chemical composition of buffalo meat and beef (Songsang et al., 2015)

CHEMICAL COMPOSITION (%)	BUFFALO MEAT	BEEF
MOISTURE	75.19±0.14B	77.15±0.29A
PROTEIN	21.36±0.14A	20.84±0.42B
FAT	0.85±0.03B	1.04±0.02A
ASH CONTENTS	1.16±0.02B	1.18±0.01A
PH	5.79±0.04A	5.72±0.06B
WATER HOLDING CAPACITY	71.98±0.76A	70.02±0.64B
MILK (PROTEIN; G)	4.5	3.2
MILK (CALCIUM)	195	120
MILK	8.0	14.0

For example, one traditional dish is Buffalo Meat Nang (Figure 17 a, b). Buffalo meat is thinly sliced and marinated with salted and left in an air-tight container for a few days. The semi-fermented meat is then seasoned with coconut sugar and the thinly-sliced inner part of banana tree trunk (a) or lotus stem (b). This dish can be kept for about one month, and so was a very typical dish, found commonly as one dish among many at a particular meal. Buffalo Meat Nang is also sought out by tourists who learn of it, but is growing more difficult to find in local restaurants, as not so many local people understand its wider commercial potential. Faculty members of the Department of Agro- and Bio-industry at Thaksin University are also working with local people to develop new buffalo meat products, such as dried shredded buffalo (Figure 17c), a special kind of sweet buffalo slice jerky (Figure 17d), and buffalo meatballs (Figure 17e) and sausages (Figure 17f). These are appearing in local gift shops, where they are sold especially as healthful food linked to local traditional life and landscapes.



a. Buffalo Meat Nang



b. Buffalo Meat Nang



c. Dried shredded



d. Sweet buffalo
slice jerky



e. Buffalo Meatball



f. Buffalo Sausages

Figure 17 The buffalo meat products.

Buffalo also make an important indirect contribution to local food security. Currently, there are approximately 7,300 buffalo in Thale Noi, representing a considerable source of economic value and individual household income. About 1,500 buffalo are females of breeding age. Each year approximately 50% of these females bear offspring, and about 750 calves are born per year. Buffalo farmers will sell calves when they are between one to four years of age for prices ranging from 15,000 to 35,000 baht. 600 young calves are sold per year, this brings approximately 18 million baht into the community annually (600 buffaloes x 30,000 baht). Thale Noi water buffalo are well known in the region. They are often bought and distributed throughout the southern and the north-eastern provinces. In previous year, traders from the north-eastern provinces purchased a large number of buffaloes for exporting to Vietnam and China (Figure 18).

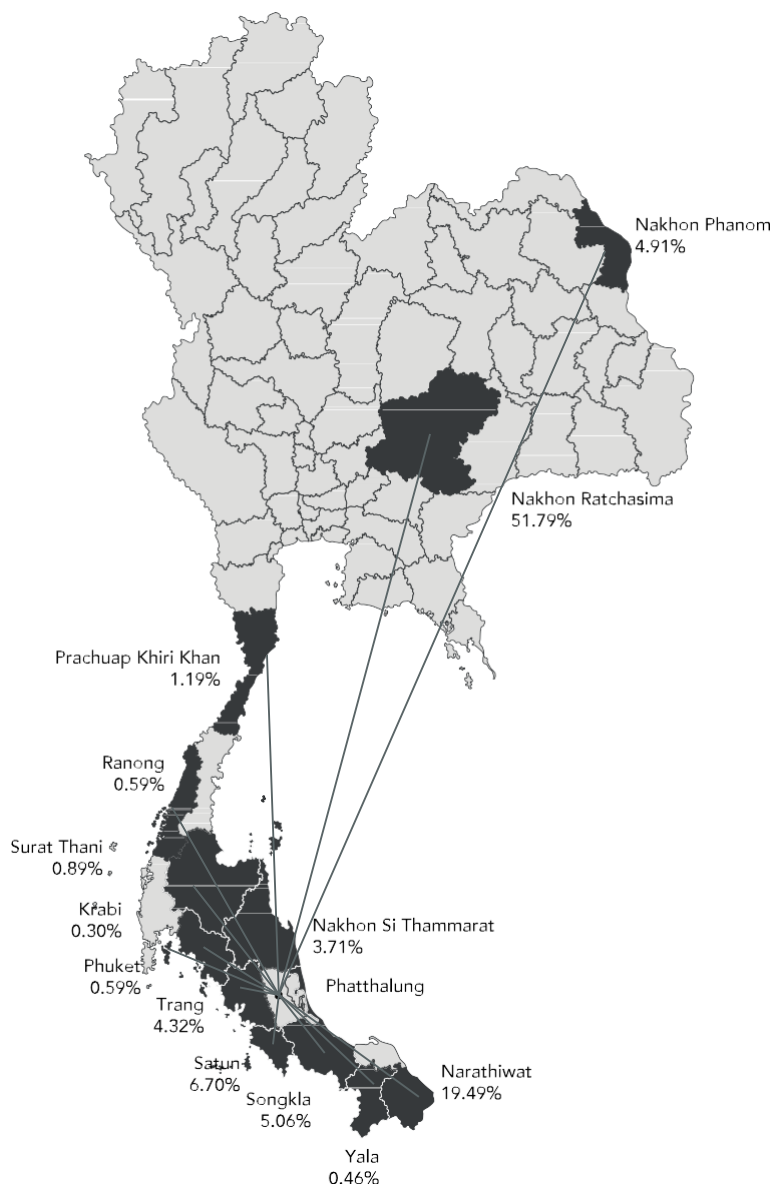


Figure 18 The demonstrates buffalo trade routes during 2017-2019

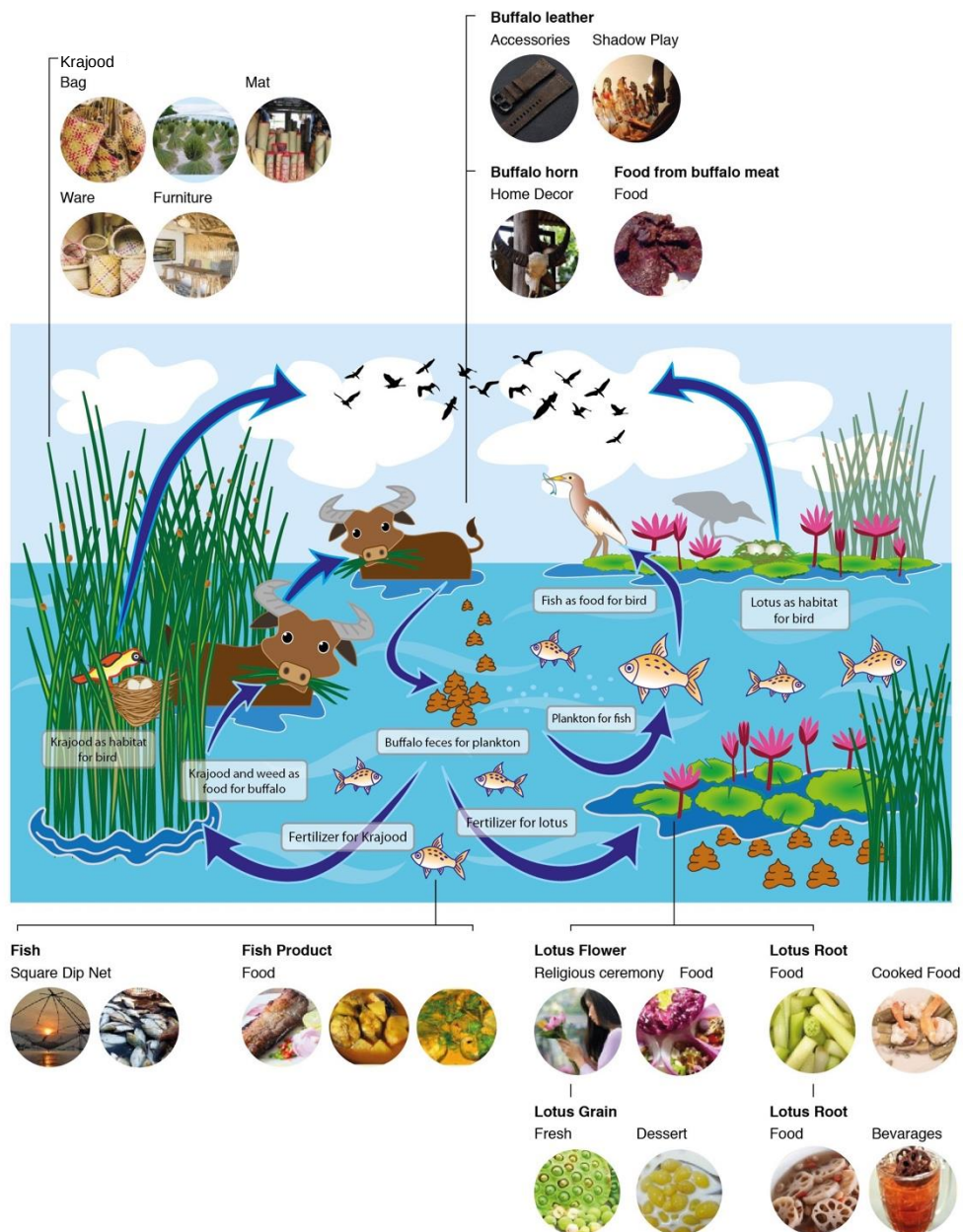


Figure 19 The System provides various food and products

Buffalo pastoralists tend to earn income from several different sources, including, fishermen, krajoed weavers, gathering of forest resources, leading boat tours for visitors and others such as rice farming (in surrounding area of Thale Noi), temporary workers, business owner. On the whole, buffalo pastoralism is a central unifying element within these diversified livelihood strategies (Figure 19).

Rice Farming - Pastoralists are also often paddy rice farmers; 37% of pastoralists indicate that rice agriculture also provides significant household income. With a certain exception discussed below, paddy rice agriculture takes place in dedicated alluvial fields located on surrounding land of the Thale Noi (Figure 20). Many years ago, buffalo were used mainly as agricultural labor power, for example, in ploughing fields, hauling materials, and threshing. Buffalo feces was used to add nutrients to the fields, and buffalo pens were shifted around in order to distribute buffalo feces to different fields. Buffalo husbandry therefore significantly contributed to rice production. Rice is a staple of the local diet and the local varieties of lakebed rice are well-known in the local cuisine for their range of red, purple and black color, their special taste, and their high nutritional value (Figure 21). In general, present rice production requires less help from buffalo. With the buffalo ranging freely for 8-9 months of the year, locals also have time for other livelihood activities.



Figure 20 Paddy rice farming in Tha Chang village, Phanang Tung Sub-district



Figure 21 The traditional organic rice fields (Sang yod rice)

Other crop farming – Some pastoralists also earn income from crops such as vegetables, oil palm etc. At present, nearly half of the local people of Thale Noi generate their income from mixed vegetable farming, accounting for 46.38% (ONEP, 2013) Vegetables mostly grown in household garden include Chili pepper, Asiatic Pennywort, watermelon, and green vegetable.

Oil Palm and Rubber plantation, which are economic cash crops in southern Thailand has recently invaded Thale Noi wetland territory but most are not in the proposed GIAHS site. The invasion has been declined because of their recent unattractive price.

Fisheries - Thale Noi is abundant in aquatic resources with a wide variety of freshwater species such as walking catfish, barb, and snakehead mullet.

Dried fish, pickled fish, and pickled fish stomach are delicacies of the southern provinces and are well-known fish products throughout Thailand. The preserved fish products are famous homemade goods of Thale Noi (Chiramanee et al., 2012, As Thale Noi wetland is part of the Non- hunting Area, fishing activities is allowed but bird hunting and egg collecting are strictly prohibited. Most pastoralists own boats that serve as the primary means of transport around the lake and wetland area. During the monsoon season when fish are abundant (Figure 22), pastoralists become fisherfolk, as a significant portion of their food needs are met by fish. As they are tending to the buffalo, pastoralists/ fisherfolk set a variety of nets designed to take advantage of the diversity of fish species available at different seasons and locations by using traditional fishing gears (lift net, dip net, hurdle, traps, cage, hook- and-line, etc.).

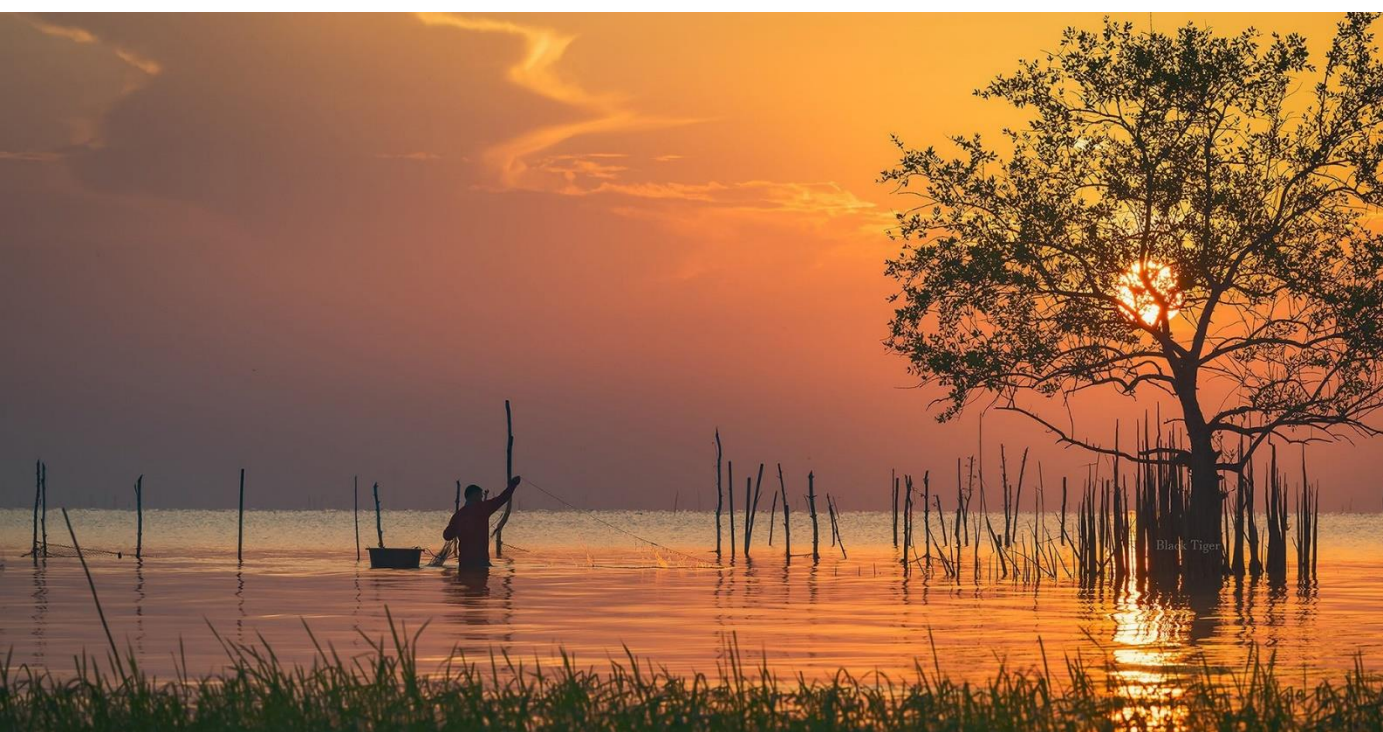


Figure 22 Pastoralists become fisher-folk.

Krajoood Weaving – Grey sedge or Krajoood (*Lepironia articalata* Retz.) is one of the principal plants suitable for weaving found in abundance in Thale Noi. Krajoood can be transformed into various products (e.g. mats, baskets, bags and other handicraft items) to generate extra income for local families in the southern part of Thailand (Wunbua et al., 2012). Krajoood is a valuable water plant that local people collect from swamp forest to make woven products. This specie is intensely harvested by over 1,000 local families (over 70% of working women; Iwasaki and Shaw, 2010). The cultivation of Krajoood in the Thale Noi Non-Hunting Area does not require legal land tenure and little financial outlay, making it an attractive method of earning income especially for poor families; Parr, 1994) (Figure 23). At Khreng sub-district alone, the sale of fresh Krajoood is worth 60 million baht a year.

Mat-making from Krajoood grown in the wetlands is a major industry. Krajoood weaving has become the main and extra source of income for local people in Kreng swamp forest. Krajoood weavers generate an annual income of 19,310.87 Baht (ONEP, 2013). Some cattle owners spend their time collecting Krajoood from Thale Noi at the same time that they tend to the buffalo. This saves them money for buying other products, and the sale of Krajoood products in local markets can even bring extra income.

In addition, about 18.50% of people in Thale Noi wetland are non-timber product collectors. Examples include honey, young paper wasps, wild mushroom, medicinal plants and wild vegetables etc. Average annual income from harvesting wild products is 4,151.69 Baht and mostly for household consumption (ONEP, 2013).



Figure 23 Krajoood harvesting & weaving



Figure 24 Water lily

Non-timber Forest Products - Some pastoralists spend time searching for and gathering other food in the Melaleuca forests and waterways while looking after their cattle. In the dry season, they especially seek red ant eggs, honey, young (pupae) paper wasps and water lily stalks and roots (Figure 24), while in the rainy season they can search for wild mushrooms and several other plants in the Melaleuca forest.

Tourist boats - Most cattle farmers have their own boats, that in the dry season can be used to provide boat tours for tourists (Figure 25). Over 200,000 foreign and local visitors come to Thale Noi every year, and boat tours operate daily. Visitors are charmed by the sight of large herds of water buffalo and calves swimming and diving throughout the lake, grazing the underwater grasses in the expansive flooded area (Figure 26). As guides, buffalo owners are able to provide in-depth information and many stories of buffalo life, and skilled guides and charismatic local storytellers can be well rewarded with tips.





Figure 26 Buffalo are grazing submerged grass.

2. Agro-biodiversity

The site is highly diverse in ecosystem type, wildlife and vegetation. Of terrestrial zones, peat swamp forest (*Melaleuca forest*) is the main vegetation type. Kuan Ki Sian Swamp Forest is an important nesting site for water-birds, both migratory and non-migratory species. The researcher team conducted a literature review of 470 academic documents and articles on biological diversity of Thale Noi wetland ranging from 1977 to present year. Out of 1,170 species of flora and fauna in 298 families (Table 3), 307 species are listed in either wildlife protection, endemic species, new recorded species, or threatened species (Table 4).

Table 3. Lists of flora and fauna in the TLN wetland.

GROUP	SPECIES	FAMILIES	STATUS
Amphibians	15	9	3 species (wildlife protection)
Aquatic insects	42	17	-
Birds	219	56	16 threatened species, 204 (wildlife protection)
Crustaceans	3	3	-
Fish	94	23	24 threatened species
Mammals	57	9	24 threatened species
Phytoplankton	168	29	-
Reptiles	28	11	3 species (wildlife protection)
Shellfish	9	4	
Vascular Plants	293	97	3 endemic species
Zooplankton	242	40	30 new record species
Total	1,170	298	

Table 4. Demonstrates conservation status of important flora and fauna found in TLN Wetland.

Scientific Name	Family	Type	Status
<i>Acylus inquietus</i> Leidy, 1882	Atrochidae	Zooplankton	New Record
<i>Collothaca stephanochaeta</i> Edmondson, 1936	Collothecidae	Zooplankton	New Record
<i>Collotheca campanulata</i> (Dobie, 1849)	Collothecidae	Zooplankton	New Record
<i>Collotheca campanulata</i> var. <i>Longicaudata</i> (Hudson, 1883)	Collothecidae	Zooplankton	New Record
<i>Collotheca heptabrachiata</i> (Schoch, 1869)	Collothecidae	Zooplankton	New Record
<i>Collotheca ornata</i> (Ehrenberg, 1832)	Collothecidae	Zooplankton	New Record
<i>Collotheca tenuilobata</i> (Anderson, 1889)	Collothecidae	Zooplankton	New Record
<i>Collotheca trilobata</i> (Collins, 1872)	Collothecidae	Zooplankton	New Record
<i>Conochilus</i> (<i>Conochilus</i>) <i>hippocrepis</i> (Schränk, 1803)	Conochilidae	Zooplankton	New Record
<i>Floscularia armata</i> Segers, 1997	Floscularidae	Zooplankton	New Record
<i>Floscularia bifida</i> Seger, 1997	Floscularidae	Zooplankton	New Record
<i>Floscularia pedunculata</i> (Joliet, 1883)	Floscularidae	Zooplankton	New Record
<i>Floscularia wallacei</i> Segers & Shiel, 2008	Floscularidae	Zooplankton	New Record
<i>Lacinularis flosculosa</i> (Müller, 1773)	Floscularidae	Zooplankton	New Record
<i>Lacinularoides coloniesis</i> (Colledge, 1918)	Floscularidae	Zooplankton	New Record
<i>Octotrocha speciosa</i> Thorpe, 1893	Floscularidae	Zooplankton	New Record
<i>Pentatrocha gigantea</i> Segers & Shiel, 2008	Floscularidae	Zooplankton	New Record
<i>Ptygura agassizi</i> Edmondson, 1948	Floscularidae	Zooplankton	New Record
<i>Ptygura barbata</i> Edmondson, 1939	Floscularidae	Zooplankton	New Record
<i>Ptygura beauchampi</i> Edmondson, 1940	Floscularidae	Zooplankton	New Record
<i>Ptygura crystallina</i> (Ehrenberg, 1834)	Floscularidae	Zooplankton	New Record
<i>Ptygura ctenoida</i> Koste & Tobias, 1990	Floscularidae	Zooplankton	New Record

Table 4. Demonstrates conservation status of important flora and fauna found in TLN Wetland. (Continued)

Scientific Name	Family	Type	Status
<i>Ptygura longicornis</i> (Davis, 1867)	Floscularidae	Zooplankton	New Record
<i>Ptygura noodti</i> (Koste, 1972)	Floscularidae	Zooplankton	New Record
<i>Ptygura pedunculata</i> Edmondson, 1939	Floscularidae	Zooplankton	New Record
<i>Ptygura tacita</i> Edmondson, 1940	Floscularidae	Zooplankton	New Record
<i>Ptygura thalenoensis</i> Meksuwan, <i>Pholpunthin & Segers</i> , 2011	Floscularidae	Zooplankton	New Record
<i>Ptygura wilsonii</i> (Anderson & Shephard, 1892)	Floscularidae	Zooplankton	New Record
<i>Stephanoceros fimbriatus</i> (Goldfusz, 1820)	Collothecidae	Zooplankton	New Record
<i>Stephanoceros fimbriatus</i> var. <i>millsii</i> (Kellicott, 1885)	Collothecidae	Zooplankton	New Record
<i>Clarias batrachus</i> (Linnaeus, 1758)	Clariidae	Fish	Threatened species
<i>Clarias meladerma</i> (Bleeker, 1846)	Clariidae	Fish	Threatened species
<i>Clarias nieuhofii</i> Valenciennes, 1840	Clariidae	Fish	Threatened species
<i>Acantopsis choirorhynchus</i> (Bleeker, 1854)	Cobitidae	Fish	Threatened species
<i>Lepidocephalichthys berdmorei</i> (Blyth, 1860)	Cobitidae	Fish	Threatened species
<i>Barbonymus altus</i> (Gunther, 1868)	Cyprinidae	Fish	Threatened species
<i>Ctenopharyngodon idella</i> (Valenciennes, 1844)	Cyprinidae	Fish	Threatened species
<i>Hypophthalmichthys molitrix</i> (Valenciennes, 1844)	Cyprinidae	Fish	Threatened species
<i>Cyclocheilichthys heteronema</i> (Bleeker, 1853)	Cyprinidae	Fish	Threatened species
<i>Labiobarbus siamensis</i> (Sauvage, 1881)	Cyprinidae	Fish	Threatened species
<i>Puntioplites bulu</i> (Bleeker, 1851)	Cyprinidae	Fish	Threatened species
<i>Osteochilus melanopleurus</i> (Bleeker, 1852)	Cyprinidae	Fish	Threatened species
<i>Mastacembelus erythrotaenia</i> Bleeker, 1850	Mastacembelidae	Fish	Threatened species
<i>Mastacembelus favus</i> Hora, 1924	Mastacembelidae	Fish	Threatened species

Table 4. Demonstrates conservation status of important flora and fauna found in TLN Wetland. (Continued)

Scientific Name	Family	Type	Status
<i>Mastacembelus armatus</i> (Lacepede, 1800)	Mastacembelidae	Fish	Threatened species
<i>Betta taeniata</i> Regan, 1910	Osphronemidae	Fish	Threatened species
<i>Pangasianodon hypophthalmas</i> (Sauvage, 1878)	Pangasiidae	Fish	Threatened species
<i>Doryichthys martensii</i> (Peter, 1868)	Syngnathidae	Fish	Threatened species
<i>Doryichthys boaja</i> (Bleeker, 1851)	Syngnathidae	Fish	Threatened species
<i>Carinotetraodon lorteti</i> (Tirant, 1885)	Tetraodontidae	Fish	Threatened species
<i>Tetradon palembangensis</i> Bleeker, 1852	Tetraodontidae	Fish	Threatened species
<i>Puntioplites proctozysron</i> (Bleeker, 1865)	Cyprinidae	Fish	Threatened species
<i>Betta imbellis</i> Ladiges, 1975	Osphronemidae	Fish	Threatened species
<i>Clarias macrocephalus</i> Gunther, 1864	Clariidae	Fish	Threatened species
<i>Cuora amboinensis</i> (Rummler & Fritz, 1991)	Geomydidae	Amphibian	Threatened species
<i>Malayemys subtrijuga</i> (Schlegel & Müller, 1829)	Bataguridae	Amphibian	Threatened species*
<i>Heosemys grandis</i> (Gray, 1860)	Geomydidae	Amphibian	Threatened species*
<i>Sarkidiornis melanotos</i>	Anatidae	Bird	Critically Endangered
<i>Ichthyophaga ichthyaetus</i> (Horsfield, 1821)	Accipitridae	Bird	Rare, Near Threatened
<i>Ichthyophaga humilis</i> (Müller, S & Schlegel, 1841)	Accipitridae	Bird	Rare, Near Threatened
<i>Charadrius peronii</i> Schlegel, 1865	Charadriidae	Bird	Rare, Near Threatened
<i>Mycteria leucocephala</i> (Pennant, 1769)	Ciconiidae	Bird	Rare, Near Threatened
<i>Phaenicophaeus diardi</i> (Lesson, 1830)	Cuculidae	Bird	Rare, Near Threatened
<i>Phaenicophaeus sumatranus</i> (Raffles, 1822)	Cuculidae	Bird	Rare, Near Threatened
<i>Oriolus xanthonotus</i> Herfield, 1821	Oriolidae	Bird	Rare, Near Threatened
<i>Pelecanus philippensis</i> Gmelin, 1789	Pelecanidae	Bird	Rare, Near Threatened

Table 4. Demonstrates conservation status of important flora and fauna found in TLN Wetland. (Continued)

Scientific Name	Family	Type	Status
<i>Ploceus hypoxanthus</i> (Sparman, 1788)	Ploceidae	Bird	Rare, Near Threatened
<i>Treron fulvicollis</i> (Wagler, 1827)	Columbidae	Bird	Rare, Near Threatened
<i>Plegadis falcinellus</i> (Linnaeus, 1766)	Threskiornithidae	Bird	Rare, Near Threatened
<i>Threskiornis melanocephalus</i> (Latham, 1790)	Threskiornithidae	Bird	Rare, Near Threatened
<i>Leptoptilos javanicus</i> (Horsfield, 1821)	Ciconiidae	Bird	Vulnerable
<i>Heliopais personatus</i> (Gray, 1849)	Heliornithidae	Bird	Vulnerable
<i>Treron capellei</i> (Temminck, 1823)	Columbidae	Bird	Vulnerable
<i>Prionailurus viverrinus</i> (Bennett, 1833)	Felidae	Mammal	Endangered
<i>Viverra zibetha</i> Linnaeus, 1758	Viverridae	Mammal	Near Threatened
<i>Lutrogale perspicillata</i> (I. Geoffroy Saint-Hilaire, 1826)	Mustelidae	Mammal	Vulnerable
<i>Aonyx cinerea</i> (Illiger, 1815)	Mustelidae	Mammal	Vulnerable
<i>Cymbidium aloifolium</i> Sw.	Orchidaceae	Plant	Endemic
<i>Cymbidium findlaysonianum</i> Lindl.	Orchidaceae	Plant	Endemic
<i>Pandanus immersus</i> Ridl.	Pandannaceae	Plant	Endemic

2.1 Agricultural Biodiversity

Buffalo - Most of the swamp buffalo in Thailand as well as in the site are completely black in color (Figure 27). Only a few of them are white skin. The white buffalo are not albino but the color is due to uncertain genetic effects. The dark color makes buffalo look scary and most ladies are afraid of the buffalo. The dark color also makes buffalo heat intolerant, which is why it must stay near the swamps. Thai buffalo is longevity and prolificacy; female buffalo could have healthy offspring even elder than 20 years old.



Figure 27 Black and white swamp buffalo

In terms of topography and physical condition, Thale Noi wetland area is not suitable for cultivation due to higher risk from seasonal flood, shorter harvest duration, and inferior productivity. Consequently, to develop the wetland in the most sustainable way, emphasis should be placed on maintaining natural and endemic vegetation and fauna, especially aquatic animals, birds, paper bark trees and sedges. These plants and animals are highly valuable for economy and tourism industries (Suwit et.al., 1986).

Rice - The fertile sediment of Thale Noi plain makes it one of the most important rice production and rice species conservation areas in all of southern Thailand. Three hundred fifty-six native species of rice have been found in Songkhla Lake plain, and at least 52 rice varieties were cultivated on Thale Noi plain (Project on Strategic Driver for Organic Rice Farming of Phatthalung, 2017). Of particular note is Sangyod rice of Mueang Phatthalung (Figure 28), the first rice species of Thailand to receive a Geographical Indication (GI) (Sondee et al., 2015). Farmers wisely and carefully selected rice varieties that can withstand changing salinity level of water in Thale Noi and seasonal flooding. Local rice varieties that are often used include Sangyod, Look Da, Look Daeng, Look Khoh, Don Sai, Leb Nok etc (Figure 29).

As mentioned above, in the past, buffalo were used to plow, thresh, and haul. Buffalo feces was used as natural fertilizers in rice fields and oil palm plantations. At present, even as buffalo are less directly involved in rice agriculture, they play an important role in supporting the genetic diversity of grasslands and rice agriculture in particular. Their grazing stimulates the growth of wild grasses, including wild relatives of the rice plant, which partially fertilize deliberately planted rice varieties, so maintaining an open, evolving agri-environmental ecosystem.





Figure 28 Sangyod rice of Phatthalung Province, the first rice species of Thailand to receive a Geographical Indication (GI)



Sangyod rice



Dawk pra-yawm rice



Organic Thai brown
indigenous rice



Gaen jan rice

Figure 29 Some native species of rice in the proposed site

Fish - Highly valuable fish species found in the wetland includes *Monopterus albus* (Zuiew,1793) *Pristolepis fasciata* (Bleeker,1851, *Channa striata* (Bloch, 1797) *Notopterus notopterus* (Pallas,1769), *Barbonymus gonionotus* (Bleeker,1850), *Cyclocheilichthysapogon*(Valenciennes,1842), *Osteochilus hasselti* (Valenciennes,1842), *Clarias batrachus* (Linnaeus,1758), *Ompok bimaculatus* (Bloch,1797), and *Hemibagrus filamentus* (Fang & Chaux.,1949) Many fish species are listed endangered and they are hardly found nowadays. Examples are *Osteochilus melanopleurus* (Bleeker,1852), *Puntioplites bulu* (Bleeker,1851)

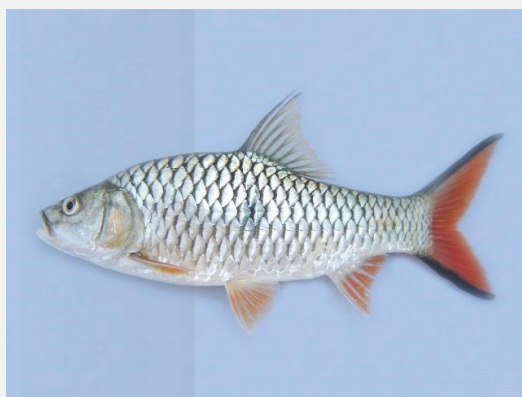
and *Clarias nieuhofii* (Valenciennes,1840), (Marine and Coastal Resources Research, 2009). Ninety species of fishes are recorded in the site, 46 out of which are founded in Thale Noi freshwater lake alone. (Survey of Fish Population in Thale Noi, Phatthalung Province (from October 2017 to July 2018) by Phatthalung Inland Fisheries Research and Development Center, Phatthalung Provincial Fisheries Office). Nine species of shellfish and three species of crustacean are also founded in the proposed site.



a. Indian river barb



b. Banded leaf fish



c. Bar barb



d. Broadhead catfish

The Fisheries Department reported that in 2019, the amount of fish and other aquatic animals harvested from Thale Noi and Cha-uat are in decline, comparing to the previous year catch. The principal reason for the declination of marine creatures is the use of illegal fishing gears, especially electrofishing and fish poisoning (Table 5).

Table 5. Status of economically valuable fish caught in the wetland.

SCIENTIFIC NAME	FAMILY	FREQUENCY (%)	STATUS
<i>Anabas testudineus</i> (Bloch, 1792)	Anabantidae	63.64	Least Concern
<i>Arius maculatus</i> (Thunberg, 1792)	Ariidae	63.64	Least Concern
<i>Barbonymus schwanenfeldii</i> (Bleeker, 1850)	Cyprinidae	18.18	Least Concern
<i>Barbonymus gonionotus</i> (Bleeker, 1850)	Cyprinidae	100	Least Concern
<i>Channa lucius</i> (Cuvier, 1831)	Channidae	18.18	Least Concern
<i>Channa striata</i> (Bloch, 1793)	Channidae	54.55	Least Concern
<i>Cirrhinus cirrhosus</i> (Bloch, 1795)	Cyprinidae	18.18	Vulnerable
<i>Clarias macrocephalus</i> (Günther, 1864)	Clariidae	72.73	Near Threatened
<i>Cyclocheilichthys apogon</i> (Valenciennes, 1842)	Cyprinidae	100	NE
<i>Dermogenys pusilla</i> (Kuhl&Van Hasselt, 1823)	Hemiramphidae	100	NE
<i>Doryichthys boaja</i> (Bleeker, 1851)	Syngnathidae	100	Data Deficient
<i>Hampala macrolepidota</i> (Kuhl&Van Hasselt, 1823)	Cyprinidae	100	Least Concern
<i>Labeo rohita</i> (F. Hamilton, 1822)	Cyprinidae	100	Least Concern
<i>Macrognathus</i> (Roberts, 1986)	Mastacembelidae	54.55	NE
<i>Macrognathus semiocellatus</i> (Roberts, 1986)	Mastacembelidae	72.73	Least Concern
<i>Monopterus albus</i> (Zuiew, 1793)	Synbranchidae	36.36	Least Concern
<i>Mystus cavasius</i> (Hamilton, 1822)	Bagridae	100	Least Concern
<i>Mystus gulio</i> (Hamilton, 1822)	Bagridae	100	Least Concern
<i>Mystus nemurus</i> (Valenciennes, 1840)	Bagridae	100	Least Concern
<i>Nandus nebulosus</i> (Gray, 1835)	Nandidae	100	Least Concern
<i>Notopterus notopterus</i> (Pallas, 1769)	Notopteridae	100	Least Concern
<i>Ompok bimaculatus</i> (Bloch, 1794)	Siluridae	100	Near Threatened
<i>Oreochromis niloticus</i> (Linnaeus, 1758)	Cichlidae	36.36	Least Concern
<i>Osteochilus hasselti</i> (Valenciennes, 1842)	Cyprinidae	100	Least Concern
<i>Osteochilus melanopleurus</i> (Bleeker, 1852)	Cyprinidae	27.27	Threatened species
<i>Oxyeleotris marmorata</i> (Bleeker, 1852)	Eleotridae	72.73	Least Concern
<i>Parachela siamensis</i> (Günther, 1868)	Cyprinidae	100	Least Concern
<i>Parambassis ranga</i> (Hamilton, 1882)	Chandidae	100	Least Concern
<i>Pristolepis fasciata</i> (Bleeker, 1851)	Nandidae	100	Least Concern
<i>Puntius orphoides</i> (Valenciennes, 1842)	Cyprinidae	90.91	NE
<i>Puntius partipentazona</i> (Fowler, 1934)	Cyprinidae	54.55	Least Concern
<i>Rasbora dusonensis</i> (Bleeker, 1850)	Cyprinidae	72.73	NE
<i>Setipinna melanochir</i> (Bleeker, 1849)	Engraulidae	81.82	Data Deficient
<i>Tetraodon Leiurus</i> (Steindachner, 1866)	Tetraodontidae	100	Least Concern
<i>Toxotes chatareus</i> (Hamilton, 1882)	Toxotidae	18.18	Least Concern
<i>Trichogaster microlepis</i> (Günther, 1861)	Belontiidae	43.45	NE
<i>Trichogaster pectoralis</i> (Regan, 1910)	Belontiidae	18.18	NE
<i>Trichogaster trichopterus</i> (Pallas, 1770)	Belontiidae	45.45	NE
<i>Xenentodon cancila</i> (Bleeker, 1853)	Belonidae	100	Least Concern

Forestry – A total of 103 species of flora and fauna, accounting for 8.8% of all species in Thale Noi wetlands, have been used by local community either for their nutritious diet, medicinal quality, and general use of timber as shown in Table 6.

Table 6. Calendar of Non-timber forest products (NTFPs) harvesting in Thale Noi Wetland.

SCIENTIFIC NAME	FAMILY	TYPE	MONTH											
			1	2	3	4	5	6	7	8	9	10	11	12
<i>A. testudineus</i>	Anabantidae	Fish	x	x*	x*	x*	x	x	x	x	x	x	x	x
<i>A. zerumbet</i>	Zingiberaceae	Plant	x	x	x	x	x	x	x	x	x	x	x	x
<i>B. grandis</i>	Emydidae	Turtle	x	x	x	x	x	x	x	x	x	x	x	x
<i>B. griseipurpureus</i>	Boletaceae	Mushroom						x	x*	x*	x	x		
<i>C. amboinensis</i>	Geoemydidae	Turtle	x	x	x	x	x	x	x	x	x	x	x	x
<i>C. batrachus</i>	Clariidae	Fish	x	x	x*	x*	x	x	x	x	x	x	x	x
<i>C. lucius</i>	Channidae	Fish	x	x	x	x	x	x	x	x	x	x	x	x
<i>C. micropeltes</i>	Channidae	Fish	x*	x*	x*	x	x	x	x	x	x	x	x	x*
<i>C. mitis</i>	Arecaceae	Turtle	x	x	x	x	x	x	x	x	x	x	x	x
<i>C. nieuhoftii</i>	Clariidae	Fish										x*	x	
<i>C. striata</i>	Channidae	Fish	x	x	x	x	x	x	x	x				
<i>D. porviflorum</i>	Myrtaceae	Plant	x	x	x	x	x	x	x	x				
<i>F. martensi</i>	Viviparidae	Shell	x	x	x	x	x	x	x	x	x	x	x	x
<i>G. anymonier</i>	Apoidea	Insect						x*	x*	x				
<i>G. gallus</i>	Phasianidae	Bird	x	x	x	x	x	x	x	x	x	x	x	x
<i>G. littorale</i>	Phyllanthaceae	Plant	x	x	x	x	x	x	x	x	x	x	x	x
<i>H. annandalei</i>	Geoemydidae	Turtle	x	x	x	x	x	x	x	x	x	x	x	x
<i>H. indus</i>	Acciptridae	Bird		x	x	x				x	x			
<i>H. malayana</i>	Hanganaceae	Plant	x	x	x	x	x	x	x	x	x	x	x	x
<i>Horsfieldia sp.</i>	Myristicaceae	Plant	x	x	x	x	x	x	x	x	x	x	x	x
<i>L. articulata</i>	Cyperaceae	Plant	x	x	x	x	x	x	x	x	x*	x	x	x
<i>M. albus</i>	Synbranchidae	Fish	x	x	x	x	x	x	x	x	x	x	x	x
<i>M. cajuputi</i>	Myrtaceae	Plant	x	x	x	x	x	x	x	x	x	x	x	x
<i>M. nemurus</i>	Bagridae	Fish	x										x*	x
<i>M. nigriceps</i>	Bagridae	Fish	x										x*	x
<i>M. vaginalis</i>	Pontederiaceae	Plant	x	x	x	x	x	x	x	x	x	x	x	x
<i>N. ampla</i>	Nymphaeaceae	Plant	x	x	x	x	x	x	x	x	x	x	x	x
<i>N. gracillis</i>	Nepenthaceae	Plant	x	x	x	x	x	x	x	x	x	x	x	x
<i>N. lotus</i>	Nymphaeaceae	Plant	x	x	x	x	x	x	x	x	x	x	x	x
<i>N. notopterus</i>	Notopteridae	Fish								x*	x			

Table 6. Calendar of Non-timber forest products (NTFPs) harvesting in Thale Noi Wetland. (Continued)

SCIENTIFIC NAME	FAMILY	TYPE	MONTH											
			1	2	3	4	5	6	7	8	9	10	11	12
<i>N. notopterus</i>	Notopteridae	Fish	x	x	x	x	x	x	x	x	x	x	x	x
<i>O. hasselti</i>	Cyprinidae	Fish	x	x	x	x	x	x	x	x	x	x	x	x
<i>O. smaragdina</i>	Formicidae	Ant							x*					
<i>O. vittatus</i>	Cuprinidae	Fish	x	x	x	x	x	x	x	x	x	x	x	x
<i>O. bimaculatus</i>	Siluridae	Fish	x*	x										x*
<i>P. canaliculata</i>	Ampullariidae	Shell	x	x	x	x	x	x	x	x	x	x	x	x
<i>P. fasciata</i>	Pristolepididae	Fish	x	x	x	x	x	x	x	x	x	x	x	x
<i>R. trilineata</i>	Cyprinidae	Fish											x*	x
<i>S. crassicolis</i>	Geoemydidae	Turtle	x	x	x	x	x	x	x	x	x	x	x	x
<i>S. palustris</i>	Pteridaceae	Plant	x	x	x	x	x	x	x	x	x	x	x	x
<i>S. siamea</i>	Leguminosae	Plant	x	x	x	x	x	x	x	x	x*	x*	x*	x
<i>S. poaeformis</i>	Cyperaceae	Plant	x	x	x	x	x	x	x	x	x	x	x	x
<i>S. crassicolis</i>	Geoemydidae	Turtle	x	x	x	x	x	x	x	x	x	x	x	x
<i>T. pectoralis</i>	Osphronemidae	Fish		x*	x									
<i>Trichopodus spp.</i>	Luciocephalinae	Fish	x	x	x	x	x	x	x	x	x	x	x*	xx
<i>V. affinis</i>	Vespidae	Insect	x	x	x	x	x	x	x	x*	x*	x	x	x

*abundant

2.2 Associated biodiversity

Birds -Thale Noi is a renowned water bird conservation zone in southern Thailand. From the survey mentioned earlier, 219 species of birds were recorded, both migratory (i.e. *Ardea cinerea*, *Nycticorax nycticorax*, *Ixobrychus flavicollis*, *Mycteria leucocephala*, *Gallinula chloropus*) and non-migratory (i.e. *Elanus caeruleus*, *Phaenicophaeus tristis*, *Centropus Sinensis*, *Passer montanus*, *Hirundo tahitica*).



Figure 31 knob-billed duck and Masked Finfoot

The latest record revealed that sixteen species of birds are threatened or endangered (one critically endangered bird species, three vulnerable and 12 threatened species). The endangered bird species is *Sarkidiornis melanotos*, The *Heliopais personatus* and *Leptoptilos javanicus* are vulnerable species. The *Pelecanus philippensis* is an example for near threatened bird species.



Others – A lot of amphibians, aquatic insects, mammals, reptiles, phytoplankton, vascular plants and zooplankton were also founded in the areas, such as a threatened species of amphibian (*Malayemys subtrijuga*, Schlegel & Müller, 1829), an endangered species of mammal (*Prionailurus viverrinus*, Bennett, 1833)



a.) *Malayemys subtrijuga*



b.) *Prionailurus viverrinus*

3. Local and Traditional Knowledge Systems

The knowledge and practice of buffalo grazing have been passed down from the ancestors to the present generation. Evidence appears in “Bud Book”, a guidebook containing local wisdom for a treatment of buffalo diseases that has been transferred from generation to generation. (Figure 32). For more than two centuries, buffalo grazing in Thale Noi still makes ingenious use of naturally-available resources, evidence of local peoples’ care to conduct their activity for the wellbeing of the buffalo and conservation of local environments for future generations.



Figure 32 Bud Book, a guidebook containing local wisdom for a treatment of buffalo diseases.

3.1 Buffalo husbandry practices using resource-sharing as group system

a) Buffalo Husbandry System

The method of breeding and rearing buffalo varies from one location to another. The pastoralist has to make practical use of the given knowledge and adapt it to the particular topography, weather conditions, the socio-cultural context, as well as eventual time constraints and the knowledge transfer from one generation to the next. Each generation is likely to change their way of living according to what they perceive as their present-time way of doing things. As a consequence, the local wisdom with regard to buffalo husbandry of one community may well be different from another community. For instance, the buffalo breeders of Thale Noi let their herds go about grazing freely during the dry season, but they will attentively care for the herds and follow them during the rainy season, when the water levels are higher. To do so, they need to use their boats to closely follow the herds and round them up in the late afternoon to have them spend the night in the safety of their shelters. In contrast, the buffalo breeders in the North or the Central region let their herds roam freely to search for food in their natural habitat during the rainy season, whereas in the dry season they follow the herds closely.

The traditional buffalo breeders of the Thale Noi community always had to possess various skills to be a successful professional. This accumulated knowledge and experience was inherited from their ancestors and put into practice,

while at the same time it was further developed to meet the requirements of the topographical features of the area, as well as the meteorological conditions of the seasons. Taking good care of the buffalo is essential in breeding and rearing them, and the herder has to protect the animals from harm, injury, catching disease or falling dead. The pastoralist must have acquired the necessary knowledge and ability to be able to look well after his buffalo herd, just the way his elders have taught him to do. By the valuable advice given and through extended practice can he in time gain the expertise required for this profession.

With regard to the characteristics of herding their buffalo, the pastoralists of the Thale Noi community employ 2 distinct ways of doing so, that is either herding the buffalo by forming a group of 2 to over 10 members who are sharing their common resources, such as the common manpower of the group, the pens and the common pasture, as well as capturing buffalo for sale, arranging for their buffalo's health care or looking after the buffalo during severe inundations. The members of a group can be kinsfolk, friends or persons who trust each other. In this community the majority of all pastoralists, or about 66.25%, are herding their animals in such a group. At present there are 19 groups.

The remaining pastoralists that account for about one third are herding their buffalo individually, taking care of their buffalo on their own. Nevertheless, they are still keeping in touch with the other herders who are arranged in groups, as all of them commonly share the same location and the same pasture together.

A key factor in pastoralism in the area around the Thale Noi is the change of seasons. The Thale Noi is affected by two seasons, namely the dry season and the rainy season, both of which influence the characteristics of how the pastoralists go about rearing the buffalo. The raising practice of the buffalo in this area is classified in to two periods: In the dry season (Figure 33)



Figure 33 View of the buffalo rearing area in the dry season

During the annual dry season from March to October the pastoralists practice herding their buffalo in two ways, firstly by following the herd and using pens to shelter them at night time. Every day in the early morning the herders go looking after the buffalo and opening the pens, so that they can roam and graze the pasture undisturbed. In the later afternoon at about 16.00 h – 17.00 h. the herders guide the buffalo back to their pens as a daily routine. The second way of herding them is by letting them graze the pasture freely on their own, without providing any pens.

21% of the pastoralists are herding their animals by opening the pens in the morning, letting the buffalo out to go about grazing, and guide them back to the pens in the afternoon of every day. Another 61% of pastoralists are going to look after their buffalo just once a week, whereby they assign representatives of their group to alternately carry out this task. Mostly they belong to the herders who are organized in groups. The remaining 18% pastoralists are looking after their buffalo every 7 - 20 days, depending on the distance between the actual grazing location and their home base, and also depending on each pastoralist's second profession.

The herders, who are looking after the buffalo just once a week, do so to find out where they are, and whether their number has increased or decreased. Observing the buffalo has to be done from a safe distance of about 100 meters, as they no longer are the tame animals they used to be, after spending months in the freedom of nature.



Figure 34 View of the buffalo rearing area in the rainy season





During the annual rainy season from November through to February the water-plain of Thale Noi becomes wider and deeper, and thus also changing the way of life of the pastoralists. Every morning they go to open the pens to have the buffalo get out in search for food, except for younger, small calves, older buffalo or some who are sick and are kept in the pen, as the water is now rather deep, and these animals may not have the strength to swim and find food. They would be exposed to danger.

During this period of flooding the pastoralists practice the herding uniquely by closely following the buffalo every day, because this is also the time when villagers go about catching aquatic animals. Thus, the pastoralists have to prevent the buffalo from damaging the fishing equipment of the villagers. As the usual routes leading through the pasture are inundated, some buffalo might go astray and get lost or harmed. Then the herders always are in close proximity of the herd and can come quickly to the rescue of the lost animal. from Red Ants' nests. The herders also cut and collect some grass on their boat to feed the weaker buffalo that have remained in their pens. The herders of the buffalo need to depend on their boats to closely attend to the herds during the rains, as at this time, the only possible transport ways remaining are the boat routes over the waters. They also need the boats to transport grass to feed some buffalo who weren't able to join the herds, due to sickness or because they just had given birth. The herders also might use the opportunity to gather Krajoed, the grey sedge, a water-born plant used by their families to do some weaving works, or go about fishing or gathering the eggs

The grazing areas around Thale Noi are the same in both the dry and the rainy season. However, during the rains the feeding ground is mostly inundated, and thus the buffalo change their habit and graze while swimming (Figure 35). Moreover, they also dive below the water surface in their search for edible food, as the grass is now inundated. Some of the edible plants are disappearing from the area during the flooding, thus during the rainy season the available food source for the buffalo is more restricted than in the dry season. Since they are swimming a lot during the rains, they use a great deal of energy for this activity and thus the animals appear leaner and skinnier during this time. Whereas during the dry season the grazing area is much larger and the buffalo can feed in a circular pattern, which is when the pasture in one part is eaten up they will move on to the next neighboring part to continue their grazing and so on. And thus, the buffalo can feed on a great variety of grass or other plants, such as *Cynodon dactylon* L. Pers., *Hymenachne acutigluma* (Steudel) Gilliland., *Leersia hexandra* SW.), *Oryza rufipogon*, *Panicum repens* Linn., (*Ischaemum aristatum* Linn., *Eleocharis ochrostachys* Steud., *Cyperus pulcherrimus* Willd. ex Kunth. (Figure 36)







a. *Cynodon dactylon* (L.) Pers.



b. *Hymenachne acutigluma*
(Steudel) Gilliland



c. *Leersia hexandra* SW.



d. *Oryza rufipogon*

Figure 36 Some species of grasses found in Thale Noi wetlands for buffalo grassing.



e. *Panicum repens* Linn.



f. *Ischaemum aristatum* Linn



g. *Cyperus pulcherrimus* Willd.



h. *Eleocharis ochrostachys* Steud.

b) Setting up of buffalo pen, which conforms to the local conditions of the area and harmonizes with nature

Since the local conditions of the area used for buffalo husbandry consist of aquatic areas, peat swamp forests and flat plains, once the rains come in the rainy season, almost the whole area will disappear below the water level. This forces the buffalo pastoralists to adjust their method of rearing the animals according to the prevalent seasonal circumstances. The pens for the buffalo have to be set up considering the seasonal change. The pen has to be located on a slightly elevated area, and its size must be able to take in the whole herd of buffalo during the rains. The pen may have a roof of galvanized iron sheets to shelter the animals,

whereas the floor can be the bare earthen ground, or in the case of a permanent pen with an immovable cement concrete floor (Figure 37). The pen features a space for the buffalo and apart from it another area for the herders. If the pen has no roof it can readily be removed to another place (Figure 38). Both types of pen are mostly using locally available wood for their construction, which consist of one main pillar that has 2 - 4 large holes about 2 feet apart, for insertion of the horizontal wooden rods. The other vertical pillars are set at a distance of approximately 3 meters.



Figure 37 Pen with roof



Figure 38 Pen without roof

c) Traditional Technique for controlling the herd and communication

Buffalo pastoralists spend a lot of time around the herd and develop a special sensitivity to the behaviour of the herd, even developing a special set of commands in order to communicate with the animals directly. The language have developed uses a strong, sharp, loud snapping tone to convey clear messages to the buffalo. Some buffalo are addressed directly by name. This is often the case with the eldest female buffalo, which is always the herd leader. As the pastoralist herds the buffalo across the land scape, sometimes from considerable distances, he will call out “Siem Siem” when he wants the herd to stop; “Hui Hui” to indicate the herd should continue forward; “Tang Tang” tells the buffalo to walk along a certain path; “Kok Kok” is the command to return to the pen.

d) Treatment of common diseases in buffalo with medicinal plants

In order to treat the diseases in buffalo by using the readily available medicinal plants of the Thale Noi area,

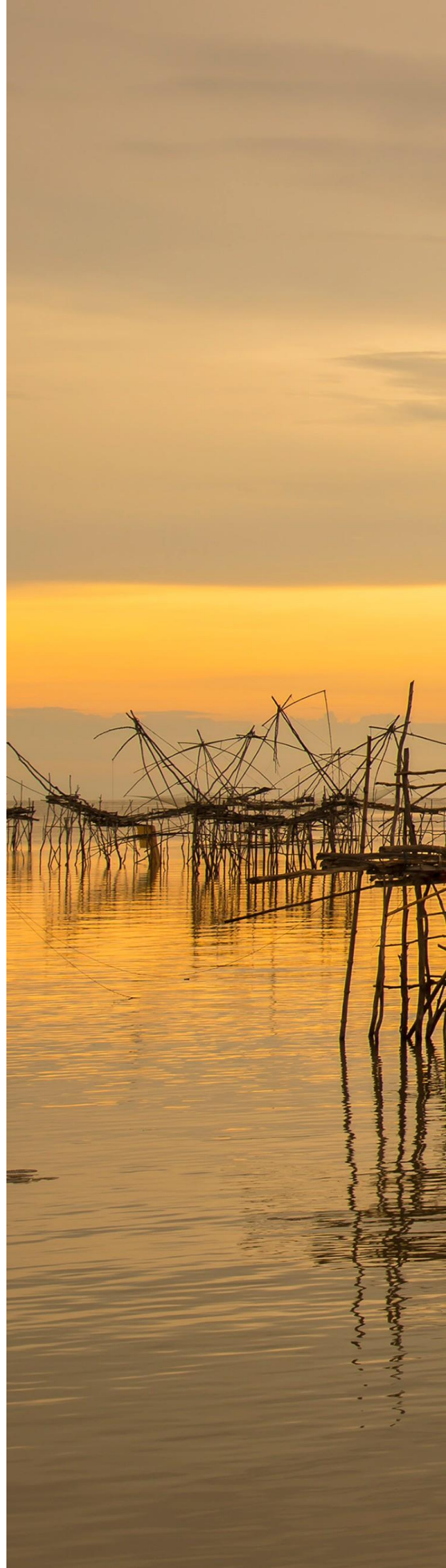
one can rely on the knowledge and experience of the local buffalo pastoralists who have been rearing buffalo here forever and have passed on this knowledge from generation to generation. The owner of a sick buffalo is capable to make a diagnosis of its sickness by looking for symptoms in behavior or appearance, as well as the condition of the nasal mucus and the saliva. He is equally knowledgeable about the names of the medicinal plants, and what parts of a plant are most suitable for the treatment of the sick animal. For instance, “Boraphet” (Heart-leaved Moonseed) is used to treat illnesses caused by parasites, or to rid the body of such parasites. Or many kinds of lotuses can be used for intestinal discomfort or diarrhea, or as a bodily tonic. However, nowadays the pastoralists are only seldom using the herbal medicinal plants anymore and instead go for antibiotics as the preferred cure for most diseases. The gathering of the medicinal plants seems too cumbersome and the success of treatment is quite slow for them.

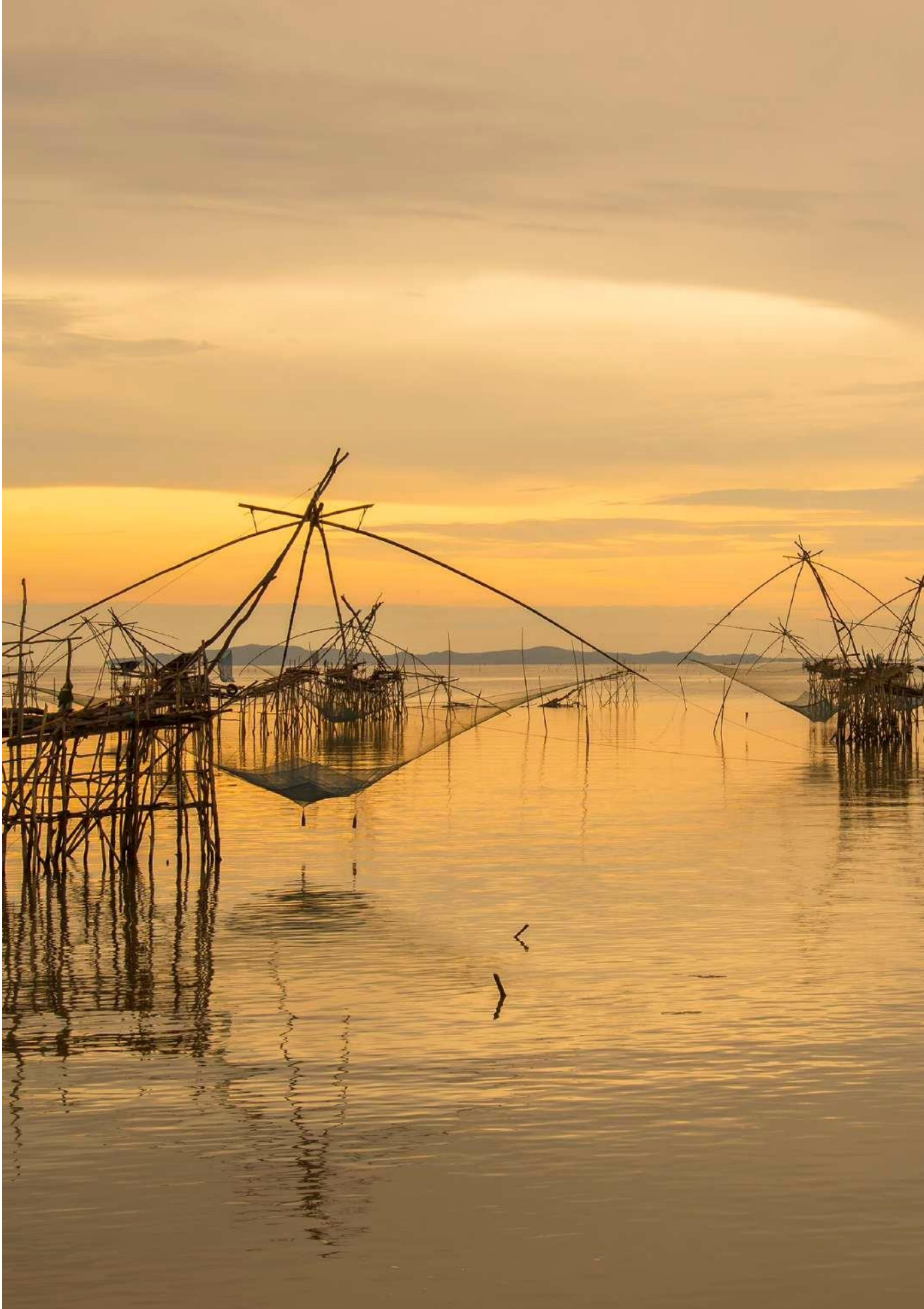


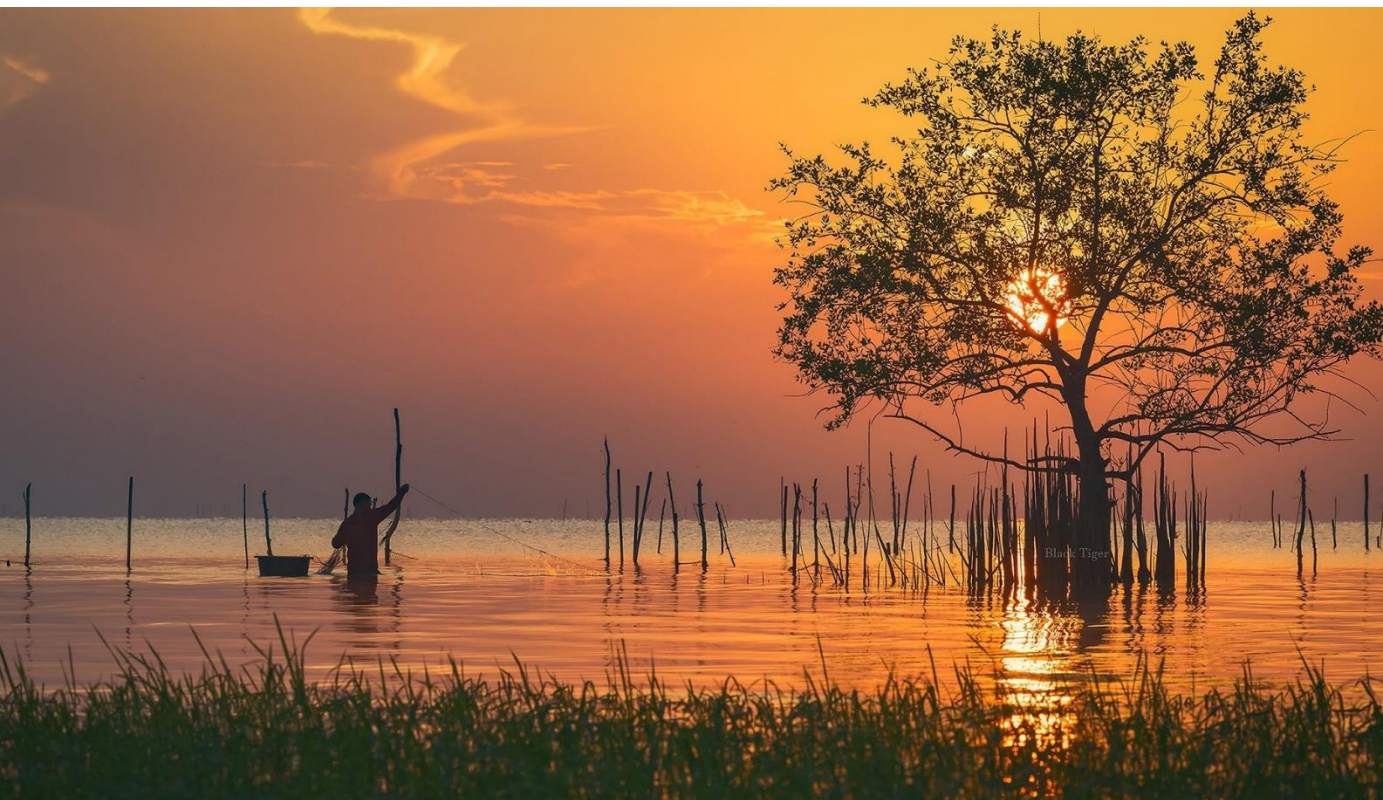


3.2 Creation and installation of fishing equipment (“Yok Yo / Yo Yak”)

The “Yo Yak” or giant net (Figure 39) is a very particular equipment used for catching aquatic animals, which is unique due to its exceeding weight and size. It features a large square net that is suspended at its four corners from bamboo rods which are joined together at the center of the long suspension arm of the “Yo”. This arm is made of local wood well known by the craftsmen, who have to exactly calculate the force of gravity so that the suspended net can bend down exactly to the water surface, no matter how low the water level will be. For this a 20-meter-long balance beam is fixed to the suspension arm of the “Yo”. Consequently, and notwithstanding its size and heavy weight, the “Yo” can be lifted up with surprising ease, which is solely due to the local villagers’ knowledge and their clever concept that utilizes sort of a wheel to guide the rope or a wire hoisting the large net. This not only echoes the deep bond between the abundant water treasures and the Thale Noi villagers, but also stands as a memorial of art amidst the lake that celebrates the striking beauty of this architectural construction. Apart from this “Yok Yo” the villagers also use other different devices they have created to catch fish, which prove their ingenuity, such as the casting of their cast nets, the use of fishing rods, and the setting up of fish traps (Figure 40).







cast net



fish trap



cast net



fish trap

3.3 Outstanding local knowledge of preserving food (fermented catfish)

“Pladuk Ra” or fermented catfish is a particularity in the way the catfish is preserved, which is unique to the province of Phatthalung, or to be more exact, to the local population of Thale Noi sub-district in Khuan Khanun district of Phatthalung province. Over generations the locals have kept alive the traditional knowledge of producing this fermented catfish, till it got a reputation and was known and liked everywhere. The reason for the success of this “Pladuk Ra” lies in its unique approach to fermentation. (Figure 41) Notwithstanding the fact that the “Pladuk Ra” from the Thale Noi community has a similar characteristic to the common salted fish, it possesses a unique flavor profile that sets it apart, which is the unique combination of saltiness and sweetness enhanced with the fragrance of fermentation. Its color is rather dark when fried or grilled, but this fermented catfish has a very appetizing flavor. And if you squeeze some lime juice over it and add the garnish of some fresh chilies and slices of red shallots, then you will fully appreciate the exquisite taste of this fermented catfish. Pladuk ra has been registered as geographical indication (GI) product of Thailand on 3 May 2019. **This product become one of well-known souvenir of Phattalung Provice. Fried Pladuk Ra is popular local menu of the province.**

The catfish is abundant in the Thale Noi Non-Hunting area, and it is a high source of protein. Many people may not like catfish because of the fishy smell of its mucus present. Interestingly, the fishy smell of in Pladuk Ra is reduced and replaced with good aroma due to its fermentation with brown sugar. It is traditionally dried under the sunshine.



Figure 41 Fermented catfish process



Production process

1. Get some catfish at the size of 4 - 6 pcs. /kg. Remove the head and all entrails and mucus, then clean the abdominal cavity thoroughly by rubbing it with some salt and rinse with water.
2. Dry the fish in an airy cupboard protected from flies for about 2 - 3 hours, and then put them in a shadowy cool place.
3. Mix some salt and a little brown sugar and rub into the inside and outside of the fish.
4. Now layer the fish neatly into an empty water container and sprinkle each layer with a little water so that the salt and sugar will better stick to the skin of the fish. Then put the cover onto the container and fix it firmly so that to protect it from insects or foreign substances. Let ferment the catfish overnight.

5. In the morning spread the fermented fish one by one onto a metal grid and expose them to the sunshine for 2 - 3 hours. Then let them cool down in the shadow.

6. Prepare the fish for the second fermentation, but add only a little brown sugar between the layers of catfish. Again, firmly secure the cover of the container and let ferment for another night.

7. The next morning again lay out the fermented fish under the sunlight for another 2 - 3 hours and then let them cool down in the shadow.

8. Now the Pladuk Ra (fermented catfish) is neatly packed for sale. It can be kept for months.

d) Indigenous Weaving Krajoed Handicraft of the Thale Noi Community

The indigenous knowledge of the Thale Noi community for making Krajoed (Grey Sedge) handicraft is closely related to the natural environment and the livelihood of community members with their distinct culture and has been passed down through the generations. As such, the Krajoed weaving products are environmentally friendly. The Krajoed stems are made into baskets, mats, bags, boxes, some furniture & decoration and the like.

Krajoed or Grey Sedge is a rush like weed commonly found in peatland in Southern Thailand. As a so-called “weed”, this sedge is regarded as worthless by many, but definitely not by the local residents of the site. Every day, the locals go to the peat swamps bordering the Thale Noi lake choosing good-quality Krajoed sedge plants. Fully grown plants are about 2 – 3 years old with hollow stems and nodes resembling those of bamboo. The harvesting can be performed throughout the year, but the best quality is harvested after the rainy season when the Krajoed plants are tall, durable and flexible at the same time, and can be flattened and stripped with ease. Manually cropping the Krajoed stems ensures that the Krajoed plants remain healthy and can further develop to be cultivated for many years.

After the selection of good-quality Krajoed plants, trim both ends of the stem to get an appropriate length of 2 – 3 meters for weaving. Wash and clean the stems. Prepare the mud (white clay) mix it with water and soak the stems in it (Figure 42) till the clay covers the surface of stem so that it won't shrivel nor break easily when exposed to the sun for drying. This will prevent the Krajoed from turning reddish and getting brittle.

To dry the stems on a flat surface, take a bunch of stems put them vertically, straight down and spread the stems in a circle so that the bunch looks like a bell-shape standing on the flat surface (Figure 43 and 43a). If there is strong sunshine, the drying process will take only 2 – 3 days and the dry stems will still be covered with a dusting of the white clay in order to protect them from fungi. This is an ingenious technique and eco-friendly method of the local community. Then they are moved and kept in the shadow of a place such as below the floor of a house on stilts.

To flatten the stems, prepare a flat area and a wooden, pestle-like tool to pound the Krajoood stems till all parts of them are level. Nowadays, a concrete roller is commonly used to flatten the stems to get a smooth, level surface (Figure 44). So, the thin covering skin of the stem can be pulled off. Then remove the remaining white dust with a damp cloth to clean the stems in preparation for the dyeing. After dyeing the stems are put once more to dry under the sun before they can be woven into the desired shapes that people want to buy (Figure 45). The final touch is coating the goods with urethane to make them shiny and long-lasting (Figure 46,47).



Figure 42. Steeping krajoood in mud



Figure 43. Krajoood dyeing in the sun



Figure 44. Flattening Krajoood



Figure 45. Weaving the krajoood



Figure 46. The finished products for sale



Figure 43a 1st step of dying process: making Krajood bunch look like a bell shape standing under the sun



Figure 47 container, one type of the finished products for sale

4. Cultures, Value Systems and Social Organisations

Buffalo pastoralism is deeply involved in the local wisdom and lore of the area, in which buffalo spirits also are important presences. Local people communicate their buffalo knowledge and beliefs from generation to generation, especially as they relate to the proper way of living and use of natural resources. This shared experience plays a significant role in holding the spirit of the villagers together with the natural environment.

4.1 Culture and Value Systems

Buffalo pastoralists believe that there are ancestor guardians in their grazing area who take care of the buffalo and the owners, and so the community in general. Ancestor worship is thus an important dimension of communal life, including the people's sense of the life of their place and landscape.

The 'ancestor' spirits of the buffalo are also present, as buffalo skulls are prominently displayed in houses, showing gratitude to the buffalo and calling their spirits to protect the living from harm.

The life of the buffalo is also integrated into the life of the local communities. Buffalo owners and villagers worship the sacred guardians of Thale Noi. These practices have been passed down from their ancestors, as have many legends and folktales of special encounters of particular community members. The spiritual dimension of life is very important. Buffalo pastoralists worship many locally known sacred guardians such as Kuan Ki Sian's great grandmother, Khun Dam grandfather (Figure 48), Chi-Kiew grandmother, Bao Noi, In-Kaew grandfather, Ki Ma great grandfather, and Nai Tam. These guardians are thought to have watched over the community for a long time.



Figure 48 Ta Khun Dam grandfather, a sacred guardian

Buffalo themselves are the key totemic figures of the area, and have an important spiritual presence in local villages. Buffalo skulls are often hung on the wall of the family house in order to honor them, and as clear recognition of their contribution to family and community livelihood. There are also many traditional cultural ceremonies conducted by Thale Noi buffalo herders, though some of these, such as the buffalo slaughtering ceremony and the gifting of a buffalo to newly wedded couples, which rarely practiced in these days. Anthropologists at the College of Local Wisdom, Thaksin University have conducted ethnographical and ethno-historical studies of local ceremonies, and together with the Phatthalung Provincial Office of Tourism and Sport are devising strategies to support the important and long-standing cultural dimensions of the Wetland-Buffalo pastoral livelihood.

Buffalo also appear in important rituals and symbolic forms throughout local culture. Buffalo skin is traditionally used to make drums that are the central feature in inter-community drumming festival (Phon Lak Phra Festival), in which different communities compete to create the loudest, and most powerful and compelling drum rhythms. Buffalo skin is also used as material in traditional Ta-lung shadow-puppet theatre (Figure 49). Buffalo horns are used to make “hang hong” (a decorative tail wing) to decorate the dress of traditional Manorah dancers (Figure 50). The southerns believe that the manohra dance is good for untying bad luck, bringing good luck and curing health problem. The Mahnorah dance choreography used to be delivered in families from generation to generation. The manorah dancers believe that the Manohra old generation dancers still protect them for peaceful lives.

Buffalo skulls and horns are often hung as decoration on the walls of houses as reminders of the ancestors and gestures of gratitude toward the buffalo (Figure 51).

Figure 49 Ta-lung shadow-puppet plays also employ buffalo materials







Figure 50 Hang hong using as a decoration for Norah costume



Figure 51 Buffalo horns decorated on the walls of the house

The College of Local Wisdom at Thaksin University and the Phatthalung Office of Commercial Affairs have coordinated a product development project in Thale Noi to support and stimulate local craft and commercial skills in processing buffalo skins and horns. The project has helped to develop many prized souvenirs made from buffalo parts and other local resources. Local shops in Thale Noi now offer jewelry and various decorative and utilitarian household items made of buffalo horn, which also serves very well for earrings, rings, bracelets, necklaces, hairpins, combs, knife handles, and so on. Local merchants also offer buffalo pictures, buffalo figurines, and tours to see buffalo and birds of the wetlands.

FESTIVALS AND EVENTS

Phon Lak Phra Festival

Phon Lak Phra, a noisy colorful festival that combines religious tradition with folklore, is a grand festival of Phatthalung province. This popular Buddhist tradition is held on the full moon of the eleventh month (every October) according to the Thai Lunar calendar to celebrate the ending of the Buddhist Lent. The traditional drum called “phon” which made from buffalo skin, is an important musical instrument for the Buddha image procession.

When a procession from one temple passes another temple, the procession participants will challenge the temple people to come out and see who can beat drums to give the best rhythm. In addition to the colored parades, various culture events take place like; drumming contests between the shrines, boat procession contest, folk plays, religious ceremonies, water sports contests, various exhibitions and cultural demonstrations, and so on (Figure 52).



Figure 52 Phon Lak Phra festival

Long Rua-Lae Nok Thale Noi Festival (Thale Noi Bird-watching Festival)

Long Rua-Lae Nok Thale Noi Festival was first held in 1998 as a special activity to mark the Amazing Thailand project and promote the most important tourist destination of Phatthalung. The festival consists of eco-tourism activities lasting one month (14 February-15 March) when there are plenty of birds and Thale Noi is at its most beautiful. The festival takes place in the Thale Noi Non-hunting area. Daily activities include boating on long-tailed boats to observe flora and fauna (Figure 53), local performances, agricultural produce for sale, demonstrations of native life, and an assortment of local products for sale.



4.2 Social Organization

The tradition of exchanging knowledge and benefits which boost the unity among the community members. In terms of land use, individual pastoralists typically own less than 10 rais (~4 ha) of land, an area not to sufficient support more than a few individual buffalo. As a consequence, survival of the human and animal buffalo community over the centuries has depended on shared access to the Thale Noi Non-Hunting Area wetlands. The need for common use of these lands has bound local peoples together in community associations that distribute collective responsibility for the maintenance of natural resources on which all depend. These associations also serve as knowledge networks, keeping the local ecological knowledge of buffalo agriculture alive. In general, there are commonly-agreed rules and regulations that provide general guidelines to which all should comply. For instance, each herd is confined to its own grazing area; buffalo owners must not take other buffalo that do not belong to them; and all must keep watch on the buffalo according to an agreed schedule and as they go about their other activities. (Figure 54) In addition, natural resources are shared, as is the construction, maintenance and use of shared pens, and maintenance of common grasslands. Members even work together in selling and delivering buffalo to market, managing health of individual buffalo, and dealing with risks of flood. There is considerable danger during the flooding season, especially for recently born calves, and buffalo owners get together with their relatives and close friends in order to provide food and safe shelter for the buffalo.

Sometimes a particular caregiver is asked to care for another member's buffalo, often in exchange for a newly born calf. Such negotiations, collaborations and reciprocities enhance community interaction and sense of shared purpose. In addition, pastoralists work together specifically for fire protection to preserve the wetland ecosystem. Forest fire can have a severe impact on wetland ecosystem and its surrounding community (Figure 55). Burning of forest significantly reduces 77.50% of forest usage value comparing with the value of non-burning forest (ONEP, 2013).

As a whole, then, the operational system of buffalo owners in Thale Noi is horizontal. There are no formal group leaders, but instead a team mentality. There are many informal talks among members, who are often relatives and close friends who have known each other for a long time. There are also some interactions between different community groups, for example when male buffalo are rent for breeding, or in the case of selling or buying buffalo.



Figure 54 Small boats are the main transport for pastoralist looking after buffalo



Figure 55 Fire-damaged peat swamp forest.

Local dishes created by the System

There are many unique local dishes made from various products in Thale Noi wetland area, especially lotus, such as Kaeng lueang pla chon sai bua (a spicy, soup-like curry made with snakehead and lotus stems). There is also Sai bua tom kathi kung (lotus stems and prawns stewed in coconut cream), Som tam sai bua (spicy thai salad with lotus runners), and Pladuk ra tod (fried fermented catfish) which is the most famous dish in the area (Figure 56).



a. Kaeng lueang pla chon sai bua



b. Sai bua tom kathi kung



c. Pladuk ra tod



d. Som tam sai bua

Figure 56 Local dishes in Thale Noi wetlands

5. Landscapes and Seascapes Features

The biophysical structure and functional relationships of the Thale Noi wetland are overwhelmingly determined by flooding associated with the annual Asian monsoon. Nearly completely inundated with water for five months out of the year, the Thale Noi wetland is a highly dynamic ecosystem, with high biodiversity and primary productivity, and yet it remains, year after year, amenable to a diverse set of human livelihoods and ways of life. It is also a highly scenic landscape increasingly known as a high value destination for eco-tourism.

Thale Noi wetland scenery changes with the seasons and is a valuable tourism resource. In particular, when migratory birds migrate to Thale Noi from October to March, while thousands of lotuses and water lilies are in full bloom from March to April. Birds are seen everywhere flying overhead, running across floating islands and lily pads, perched in trees, and resting discretely amidst the grasses and channels (Figure 57). Observation of local avian life is a high value option in the area. Even non-specialists are amazed at the number and diversity of bird life in the Thale Noi.



Figure 57 The flowers of water lilies in Thale Noi



Figure 58 Buffalo swimming in Thale Noi



At the same time, the herds of swimming buffalo present an impressive spectacle, and increasingly attract a growing number of eco-tourists to the community (Figure 58). Viewed from specially-created roadside viewpoints, or else touring by private boat, visitors are charmed and fascinated by the nimbleness of such large creatures as they dive down to consume the grasses underwater. Since the boats are often hired from buffalo pastoralists themselves, visitors have the benefit of expert guides on buffalo life and interaction with people. It is also possible to observe many different everyday activities on the lake, including different fishing techniques adapted to different fish species, and visitors can see the local fisherfolk at work and speak to them directly as they set or check their nets.

The extraordinary scenery of “Yor Yak” (giant fishing net) is an additional attraction to the area, providing a beautiful backdrop for sunrise in the morning to the new trend of eco-tourism that has become a new aspiration for the Thale-Noi area (Figure 59).



Figure 59 Beautiful Yo Yak (Giant net) in the morning



V. ACTION PLAN FOR THE DYNAMIC CONSERVATION

Land Use Changes in Thale Noi wetlands

Due to the population and economic growth, urban sprawl, and the quick expansion of industrial and agricultural activities, land use has experienced enormous changes over a century in Thale Noi wetlands. After the installation of sluice gates by the Royal Irrigation Department to prevent salt water intrusion (1955), the disappearance of Borneo pygmy elephant (1963) and the designation of Thale Noi wetland as the Non-Hunting Area (1975) (Figure 60), buffalo have played an essential role in preserving and restoring Thale Noi wetland ecosystem. Particularly, grassland ecosystem has been significantly restored. Some species of birds, including Painted stork and Knob-billed duck (Figure 61), have returned to the wetland after 20 years of disappearance.

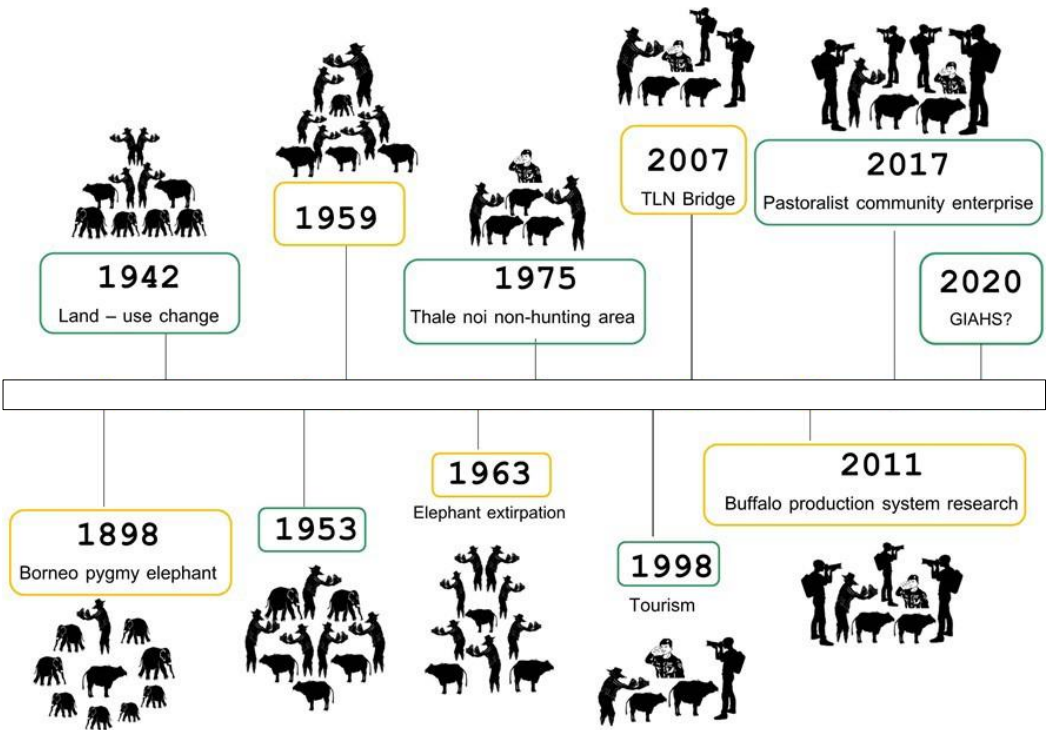
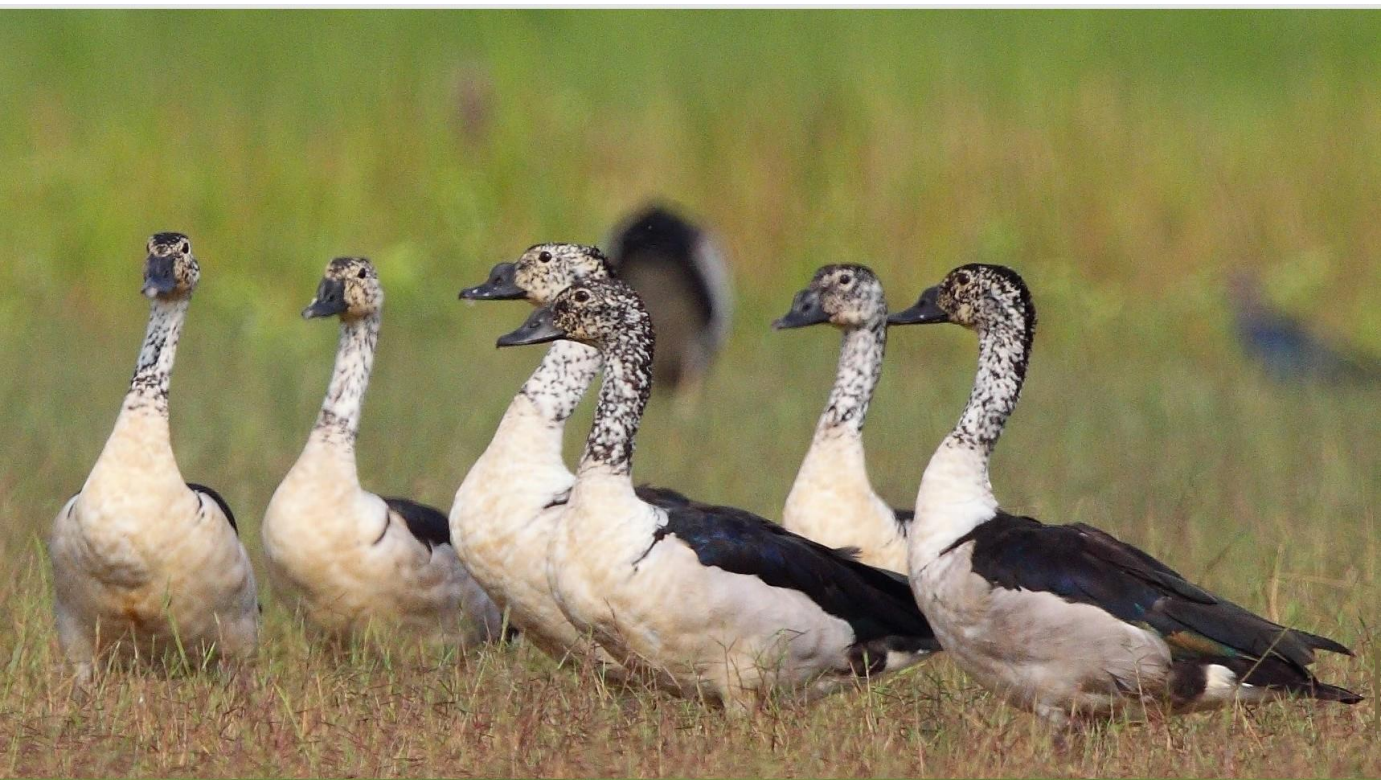


Figure 60 Timeline for Major Land Use Change in Thale Noi Wetland.



To this day, the Thale Noi Wetland Pastoral Buffalo Agro-ecosystems is a system that has been maintained for several centuries. This system involves a diverse system of a central unique cultural of buffalo pastoralism, with inter-related local livelihood strategies, socio-economic, and ecological constituent in the whole cultural landscape.

As a whole, buffalo plays a significant role in balancing the wetland ecosystem which provides harmony, stability, and sustainability of the wetland ecosystem services (provisioning services, regulating services, supporting services and cultural services). At the same time, overfishing, illegal hunting of wildlife and encroachment by oil palm plantation remain serious problems, as according to local estimates almost 30% of the swamp forest in Thale Noi Non-Hunting Area is at high risk. Overgrazing is another contemporary issue, as is overgrowth of aquatic weeds and algae in the waterways and lake associated with run-off of agricultural pesticides (from fixed rice paddies in surrounding lands) and domestic pollution. These issues are attracting the attention of local administrative offices and universities, which, together with local communities, are discussing mechanisms to maintain the historically productive interactions between the local ecology and socioeconomic realms of activity. Due to several of threats to affect the Wetland-Buffalo pastoral system such as environmental problems, aging farm population, buffalo inbreeding etc., therefore, establishing themes of action plans as:

- 1. Maintenance, conservation and management of the agricultural environment**
- 2. Understanding and transmission of the knowledge system**
- 3. Promotion and exchange of values found in Wetland-Buffalo pastoral system**

1. Maintenance, conservation, and management of the agricultural environment

The farmer having been raise a buffalo to leave for living in the natural area especially around the Thale Noi wetland. The buffalo also have played an essential role in the local way of life surrounding the Thale Noi Ramsar Site, so creating and maintaining one of Thailand's most important wetland conservation zones. However, there are various threats to touch the natural, ecological, and environmental around this area, such as 1) a dependence on agricultural chemicals and fertilizers lead to increase environmental pollutions specially water pollution, 2) the impacts of climate change on biodiversity, agricultural, livestock, food, flood, drought, and livelihood, 3) a rising of illegal fishing, 4) soil erosion, 5) an overgrazing of buffalo, 6) an inbreeding of the buffalo, and 7) land use change particularly an increase in abandoned, uncultivated fields, palm field, and cut down the forest.

Based on conservation of biodiversity and landscape within the agricultural heritage, all the physical environment and climate change impacts needed to keep up and manage.

To end up of these problems, a support system must be created and aligned to methodically approach the conservation management of the agricultural heritage area. Moreover, its importance is managing farming system with on wetland ecosystems in terms of the need to pass down resilience to deal with global climate change.

The main target of this action plan are 1) to form practices for restoration of environment and management to protect and conserve the values that biodiversity and scenery of the buffalo habitat in particular the Thale Noi Ramsar site, 2) to arrange a system to monitor changes in plants and animals habitat, and landscape in the purpose area, and 3) to find the alternate way to mitigate and adapt from the impacts of climate change based on the sustainable development.

2. Understanding and transmission of the knowledge system

As a no cost job for the most farmer for a long time, Wetland-Buffalo Pastoral System of Phatthalung Province has built its own knowledge system in historical circumstance as such how to take care the buffalo when it sick? Including how to catch the buffalo to sale. This traditional knowledge system is to be carried on together by experience of the masters to the new one with in the households or family. Moreover, there are fears about erode of the food culture due to increasing externalization of dietary habits and the shift to nuclear households.

Recently, the Wetland-buffalo pastoral system is directly facing a risk of losing labor force and the shortage of successors become more pronounced. Because of the average age of farmer is more than 45 years old who received knowledge system from their family. While people who are lower than 45 years old mostly change their occupancy as administrative, employee, seller, local guide, or work in the city, there is a lack of continuity of knowledge transfer, understanding the value of passing down the wisdom is undermined. Including, the new generation changed their life-style to work in the company than work as the farmer, then it will face to losing labor soon.

Therefore, the action plan encourages the social attention on the Wetland- Buffalo Pastoral System and promotes the cultural transmission and integrated use. In particular, it seeks to strengthen of younger resident's capability as the main agent of transmission activities.

The action plans aim to 1) discover contents and set up databases on the trends of Wetland-buffalo pastoral system knowledge by harvesting data from documents, working groups with local people, etc. to more recent researches, to educate people then to pass on and preserve the knowledge, 2) implement on-site education for farmers, younger people, new generations to reinforce management competencies of buffalo pastoral system wisdom, 3) create the education system to promote activities that related to transmission of unique wisdom of buffalo pastoral system, and 4) establish the mechanism to increase the labor or the farmer in order to continue this precious system.

3. Promotion and exchange of values found in Wetland-Buffalo pastoral system

Buffalo is the saving money of farmer in the Wetland-buffalo pastoral system of Phatthalung, because of it's no cost to raise, easy to sell. For example, in the past farmer will sell their buffalo when they want money urgent by just told the middleman. As for the situation of buffalo market system in recent years as 1) lacking of the middleman to do this business, 2) lacking of the standard slaughterhouse, 3) lacking of highly skilled buffalo catchers, 4) limited market of who love to have buffalo meat, and 5) customers changed their consumption behavior without consume buffalo meat because of the strong smell. Thus, to deal with these issues, the action plan suggests to creation of high added-values of buffalo meat system.

Furthermore, Thale Noi Ramsar site is the significance tourist site seeing of Phatthalung province. There have been famous for bird watching and water plant especially water lily and lotus where is tourist take a boat to explore around the lake.

However, since the sky road where set up across the lake finished, the buffalo became the main thing attracting people to visit Thale Noi Ramsar site recently (if search on google about what's thing we have to do in Phatthalung, buffalo watching is the second search here. Thus, the experiential tourism and promotion of the GIAHS site, the Wetland-buffalo pastoral system, this is the exit way in order to support farmer and continuing the precious agricultural system and the magnificent Ramsar site to sustainability.

This action plan goals to 1) set the market system to support and promote the values of buffalo meat to broader market and sustainability, and 2) develop and run the professional tourism programs by using the unique system, experience program, and wonderful scenery of agricultural heritage regions.

Table 7. Theme of action plan, efforts to address, and specific approaches.

Theme of action plan	Threats and issues	Efforts to address (Action Plan)	Specific approaches/ Initiatives
1. Maintenance, conservation, and management of the agricultural environment	Increasing Water pollution and environmental pollutions	1.1 Conservation management of Buffalo habitat and Thale Noi Ramsar site 1.2 Support for conservation of pastoral methods	1.1.1 Monitor environmental pollution, landscape, and biodiversity 1.1.2 Support conservation of landscape (land use) 1.1.3 Create strategic plans or rules to protect the environment
	Soil erosion		1.2.1 Establish a management system for wetland-buffalo pastoral system areas in the designate agricultural heritage area that need protection and management
	Land use change		1.2.2 Improving the system and increasing the awareness on conservation
	Increasing of illegal fishing		1.3.1 Support for the conservation of genetic resources and diversification of buffalo
	Overgrazing	1.3 Management farming system	1.3.2 Limiting carrying capacity
	Decrease in genetic diversity (buffalo inbreeding)		1.3.3 Develop an efficient farming system
	Climate change impacts to food, flooding, disaster, biodiversity, agriculture, livestock, and livelihood security	1.4 Assessment the impacts and finding the mitigation and adaptation options	1.4.1 Determining and assessing the impacts of climate change on food, flooding, disaster, biodiversity, agriculture, livestock, and livelihood security 1.4.2 Establishment of a Mitigation and Adaptation action plan
2. Understanding and transmission of the knowledge system	Lack of young farmers and knowledge transfer	2.1 Compilation of the knowledge 2.2 Transmission of knowledge methods 2.3 Capability enhancement of wisdom from experts to new agricultural workers	2.1.1 Accumulate and publish the wetland-buffalo pastoral system methods 2.1.2 Support for the establishment of community-run pastoral system 2.1.3 Carrying out of a comprehensive survey and utilization of buffalo in the educational system 2.2.1 Operate an education system on the wetland-buffalo pastoral system 2.2.2 Increase pride in the career as buffalo farmer 2.3.1 Set up a fostering and designation system of farmer experts 2.3.2 Securing and training of new farmers
3. Promotion and exchange of values found in Wetland-	Limited market	3.1 Establishment of standardize and professional market system	3.1.1 Set up and management the standardize of slaughterhouse 3.1.2 Expanding the market to other regions and international

Table 7. Theme of action plan, efforts to address, and specific approaches. (Continued)

Theme of action plan	Threats and issues	Efforts to address (Action Plan)	Specific approaches/ Initiatives
Buffalo pastoral system		3.2 Creation of high added-values from the buffalo pastoral system	3.1.3 Develop the market system to easy and convenience for both farmer, middleman, seller, and customers 3.2.1 Develop various products and support distribution market 3.2.2 Develop own brands and using high added value
	Opportunity of tourism market	3.3 Supporting and promoting the unique and precious tourism system on the agricultural heritage site	3.3.1 Discover tourism contents and added values of the wetland-buffalo pastoral system 3.3.2 Training the farmer and stakeholder to be the professional hosts 3.3.3 Operate and honor program for conservation of wetland-buffalo pastoral system 3.3.4 Operate an experiential program with the homestay and farmer experiences

Table 8. Implementation of Maintenance, conservation, and management of the agricultural environment.

Theme	Action Plan	Initiative	Implementing Organization	Implementation period				
				2021	2022	2023	2024	2025
1. Maintenance, conservation, and management of the agricultural environment	1.1 Conservation management of Buffalo habitat and Thale Noi Ramsar site	1.1.1 Monitor environmental pollution, landscape, and biodiversity	Natural Resources and Environment, Agriculture and cooperative, Committee, University, Community enterprise of Thale Noi's Buffalo farmer	x	x	x	x	x
		1.1.2 Support conservation of landscape (land use)			x	x	x	x
		1.1.3 Create strategic plans or rules to protect the environment	Office of the National Economic and Social Development Council, Natural Resources and Environment, Agriculture and cooperative, Provincial government, Municipality, Committee,			x	x	x

Table 8. Implementation of Maintenance, conservation, and management of the agricultural environment. (Continued)

Theme	Action Plan	Initiative	Implementing Organization,	Implementation period				
			Municipality Committee,	2021	2022	2023	2024	2025
	1.2 Support for conservation of pastoral methods	1.2.1 Establish a management system for wetland-buffalo pastoral system areas in the designate agricultural heritage area that need protection and management	Committee, University, Community enterprise of Thale Noi's Buffalo farmer	x	x	x		
		1.2.2 Improving the system and increasing the awareness on conservation		x	x	x	x	
	1.3 Management farming system	1.3.1 Support for the conservation of genetic resources and diversify of buffalo		x	x	x		
		1.3.2 Limiting carrying capacity			x	x	x	
		1.3.3 Develop an efficient farming system			x	x	x	
	1.4 Assessment the impacts and finding the mitigation and adaptation options	1.4.1 Determining and assessing the impacts of climate change on food, flooding disaster, biodiversity, agriculture, livestock, and livelihood security	Natural Resources and Environment, Agriculture and cooperative, Committee, University, Community enterprise of Thale Noi's Buffalo farmer	x	x	x		
		1.4.2 Establishment of a Mitigation and Adaptation action plan	Office of the National Economic and Social Development Council, Ministry of Interior, Natural Resources and Environment, Agriculture and cooperative, Office of Natural Resources and Environmental Policy and Planning, Thailand Greenhouse gas Management Organization, Provincial government, Municipality, Committee			x	x	x

Table 8. Implementation of Maintenance, conservation, and management of the agricultural environment. (Continued)

Theme	Action Plan	Initiative	Implementing Organization,	Implementation period				
			Municipality Committee,	2021	2022	2023	2024	2025
2. Understanding and transmission of the knowledge system	2.1 Compilation of the knowledge	2.1.1 Accumulate and publish the wetland-buffalo pastoral system methods	Committee, University, Community enterprise of Thale Noi's Buffalo farmer, Local medicinal doctor club	x	x	x		
		2.1.2 Support for the establishment of community-run pastoral system				x	x	x
		2.1.3 Carrying out of a comprehensive survey and utilization of buffalo in the educational system	Ministry of Education, Committee, University, Community enterprise of Thale Noi's Buffalo farmer, Provincial government, Municipality		x	x	x	
	2.2 Transmission of knowledge methods	2.2.1 Operate an education system on the wetland-buffalo pastoral system				x	x	x
		2.2.2 Increase pride in the career as buffalo farmer			x	x	x	
	2.3 Capability enhancement of wisdom from experts to new agricultural workers	2.3.1 Set up a fostering and designation system of farmer experts	Committee, University, Community enterprise of Thale Noi's Buffalo farmer		x	x	x	
		2.3.2 Securing and training of new farmers				x	x	x
3. Promotion and exchange of values found in Wetland-Buffalo pastoral system	3.1 Establishment of standardize and professional market system	3.1.1 Set up and management the standardize of slaughterhouse	Ministry Agriculture and cooperative, Ministry of Commerce, Ministry of Industry, Provincial government, Municipality, Committee,	x	x	x		

Theme	Action Plan	Initiative	Implementing Organization,	Implementation period				
			Municipality Committee,	2021	2022	2023	2024	2025
values found in Wetland- Buffalo pastoral system	3.1 Establishment of standardize and professional market system	3.1.2 Expanding the market to other regions and international	Community enterprise of Thale Noi's Buffalo farmer, Phatthalung Farmers Council, Phatthalung Chamber of Commerce, Community organizations development institute, committee		x	x	x	x
		3.1.3 Develop the market system to easy and convenience for both farmers, middleman, seller, and customers			x	x	x	x
	3.2 Creation of high added-values from the buffalo pastoral system	3.2.1 Develop various products and support distribution market		x	x	x	x	
		3.2.2 Develop own brands and using high added value				x	x	x
	3.3 Supporting and promoting the unique and precious tourism system on the agricultural heritage site	3.3.1 Discover tourism contents and added values of the wetland-buffalo pastoral system	Ministry of Tourism and Sports, Ministry of Commerce, Provincial government, Phatthalung guide club, Phatthalung Chamber of Commerce, Community organizations development institute, Tourism council of Phatthalung, Thale Noi boat driver club, University, Community enterprise of Thale Noi's Buffalo farmer, committee	x	x	x	x	x
		3.3.2 Training the farmer and stakeholder to be the professional hosts		x	x	x		
		3.3.3 Operate and honor program for conservation of wetland-buffalo pastoral system				x	x	x
		3.3.4 Operate an experiential program with the homestay and farmer experiences				x	x	x

ATTACHMENTS

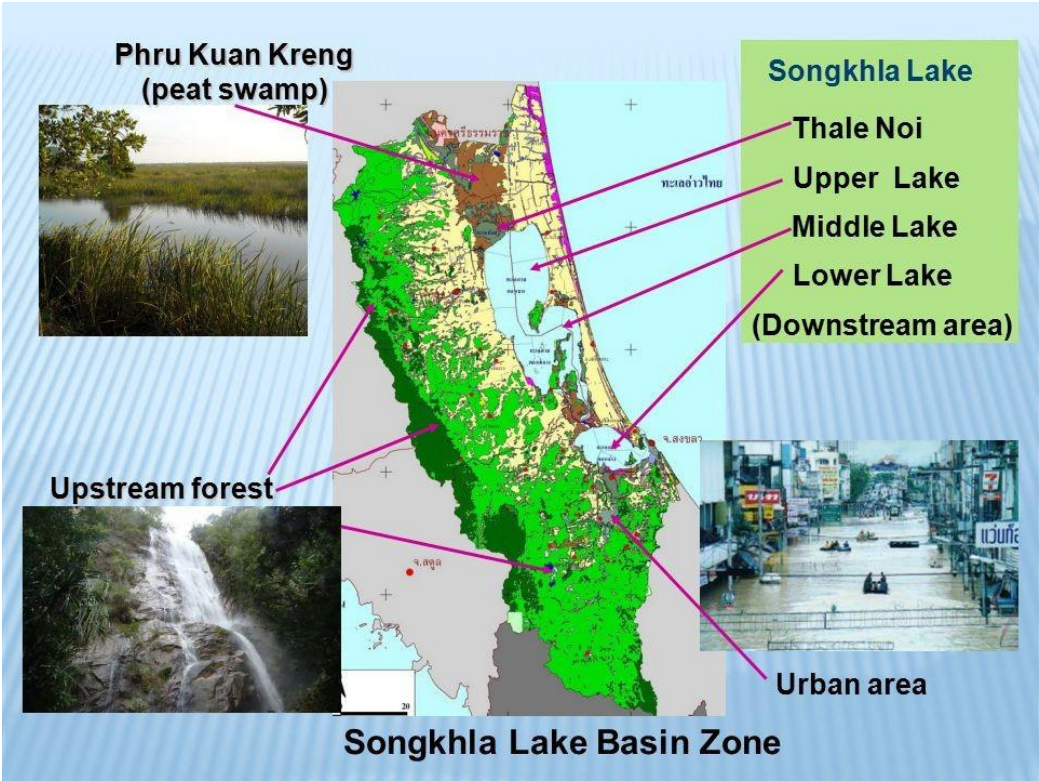
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<https://www.facebook.com/watch/?v=329679861091904>

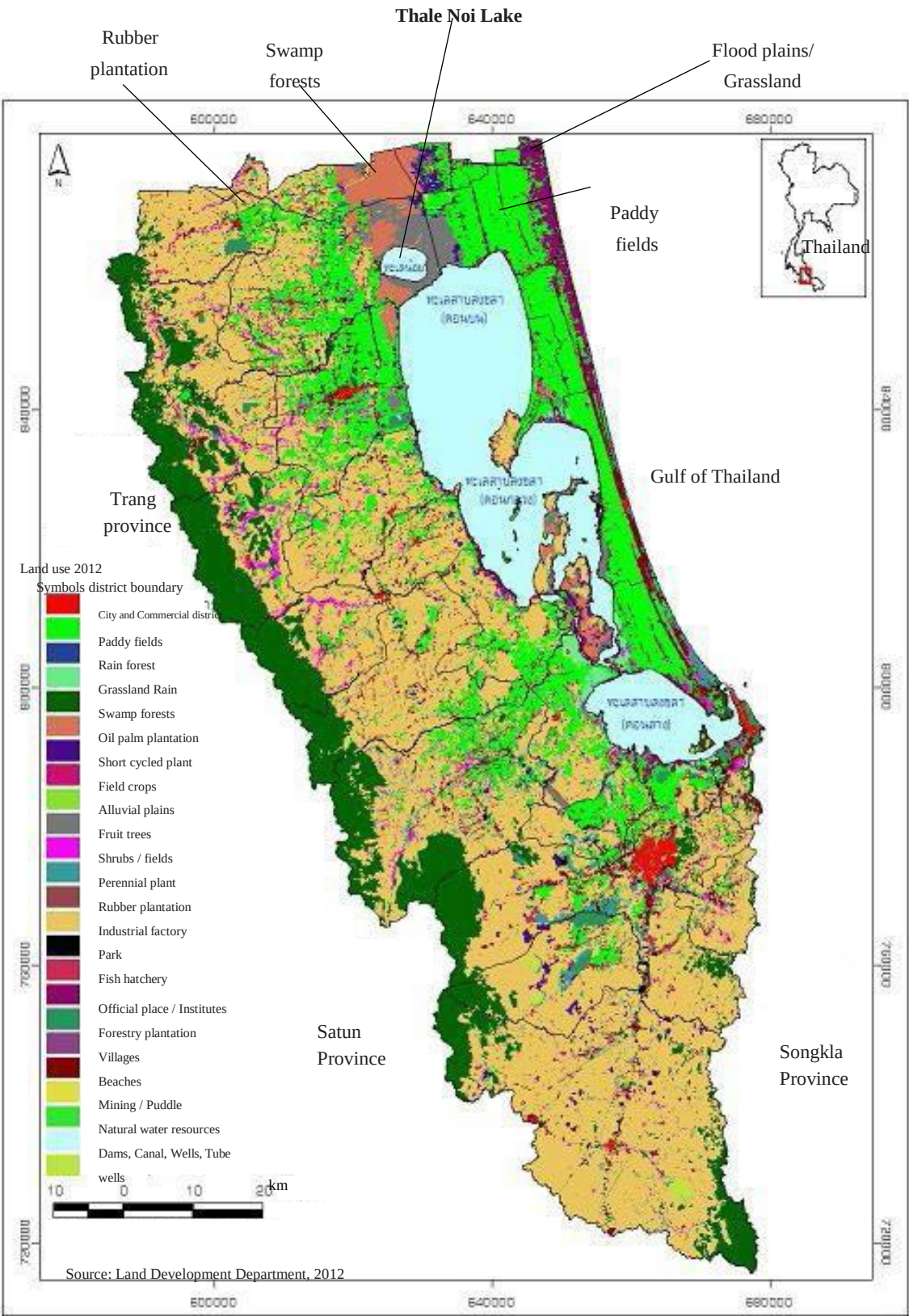
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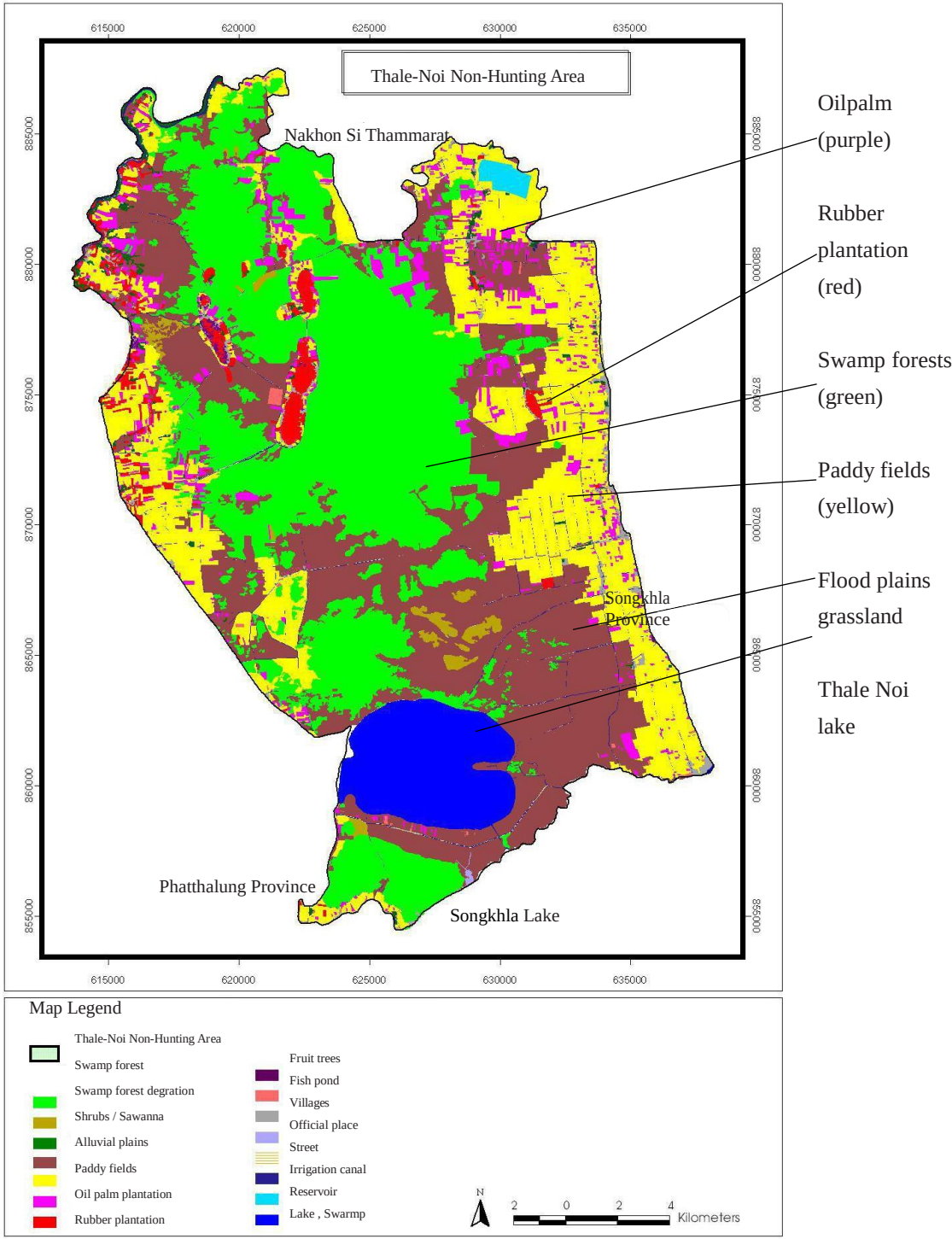
Annex 2. Land use maps



Annex 2. Land use maps (Continued)



Annex 2. Land use maps (Continued)



Annex 3. Satellite image of the Thale Noi lake



GIAHS PROPOSAL	THALE NOI WETLAND PASTORAL BUFFALO AGRO-ECOSYSTEM		SEPTEMBER 2021
	PHATTALUNG	SONG KHLA	NAKHON SI THAMMARAT

