



Situation analysis of Mukdahan Special Economic Zone

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คณะผู้วิจัยขอขอบคุณเครือข่ายโครงการพันธมิตรเพื่องานวิจัยด้านการรับมือของเมืองในเอเชียตะวันออกเฉียงใต้ ต่อการเปลี่ยนแปลงสภาพภูมิอากาศ (Urban Climate Resilience in Southeast Asia Partnership: UCRSEA) ที่ให้การสนับสนุนงบประมาณดำเนินงานวิจัยระยะเวลา 5 ปี (พ.ศ.2557-2562) โดยเลือกเขตเศรษฐกิจพิเศษมุกดาหารเป็นหนึ่งในเมืองศึกษานำร่องของประเทศไทย กิจกรรมโครงการดังกล่าวมุ่งเน้นสร้างศักยภาพของงานวิจัยด้านการกลายเป็นเมืองที่มีความเชื่อมโยงกันในระดับภูมิภาคและการเปลี่ยนแปลงสภาพภูมิอากาศ เพื่อเพิ่มความเข้าใจเรื่องความเปราะบางของคนเมือง และเสริมสร้างการรับมือของเมือง ในปีนี้ 2 คณะผู้วิจัยได้ศึกษาบริบทและสถานการณ์ปัจจุบันของเขตเศรษฐกิจพิเศษมุกดาหาร ประกอบด้วยการทำความเข้าใจระบบเมือง การวิเคราะห์ระบบเมือง และการบ่งชี้ประเด็นความเปราะบางต่อการเปลี่ยนแปลงสภาพภูมิอากาศที่สำคัญ รวมถึงการศึกษากิจกรรมการปรับตัวต่อประเด็นเปราะบางดังกล่าว การศึกษานี้ มุ่งเน้นศึกษาจากรายงานราชการ สิ่งพิมพ์ และสื่อ รวมถึงการสัมภาษณ์เชิงลึก และวิเคราะห์ของภาคส่วนที่เกี่ยวข้องผ่านการประชุมเชิงปฏิบัติการ ผลที่ได้จากการศึกษานี้จะใช้ต่อยอดและเป็นกรอบการดำเนินการวิจัยในพื้นที่เขตเศรษฐกิจพิเศษมุกดาหารในปีต่อไป

ผู้วิจัยขอขอบพระคุณหน่วยงานราชการทุกภาคส่วนในจังหวัดมุกดาหาร โดยเฉพาะอย่างยิ่ง พลตำรวจเอก สุรเชษฐ์ ชัยวงศ์ ผู้ว่าราชการจังหวัดมุกดาหาร, คุณไพบุลย์ รัตนะเจริญธรรม ผู้อำนวยการสำนักงานทรัพยากรธรรมชาติและสิ่งแวดล้อม จังหวัดมุกดาหาร และ คุณกฤษฏ์ ภูวการณ์กุล เจ้าหน้าที่สำนักงานอุตสาหกรรม จังหวัดมุกดาหาร ที่ให้ความอนุเคราะห์ช่วยเหลือและเสนอแนะตลอดระยะเวลาการรวบรวมข้อมูลและดำเนินกิจกรรมปีที่ 2 นี้

(ผู้ช่วยศาสตราจารย์ ดร. เอริกา พลตติกิตติ)

ผู้รับผิดชอบโครงการวิจัยเขตเศรษฐกิจพิเศษมุกดาหาร
อาจารย์ประจำคณะสิ่งแวดล้อมและทรัพยากรศาสตร์

Chapter 1

Understanding urban system of the Mukdahan Special Economic Zone

1.1. Introduction to Mukdahan Special Economic Zone

The Mukdahan Special Economic Zone (MSEZ) is a section of the Mukdahan province, lying between 16 – 17°N latitude and 104 – 105°E longitude in Northeast Thailand. The MSEZ comprises three districts and 11 sub-districts, covering an area of 578.5 km² (see Figure 1). The three districts are Muang Mukdahan (5 sub-districts are Sri Boon Rueng, Mukdahan, Kham A-Huan, Na Sri Nuan and Ban Sai Yai), Don Tan (2 sub-districts are Don Tan and Pho Sai) and Kwan Yai (4 sub-districts are Kwan Yai, Pong Kham, Ban Sai Noi and Chanode).

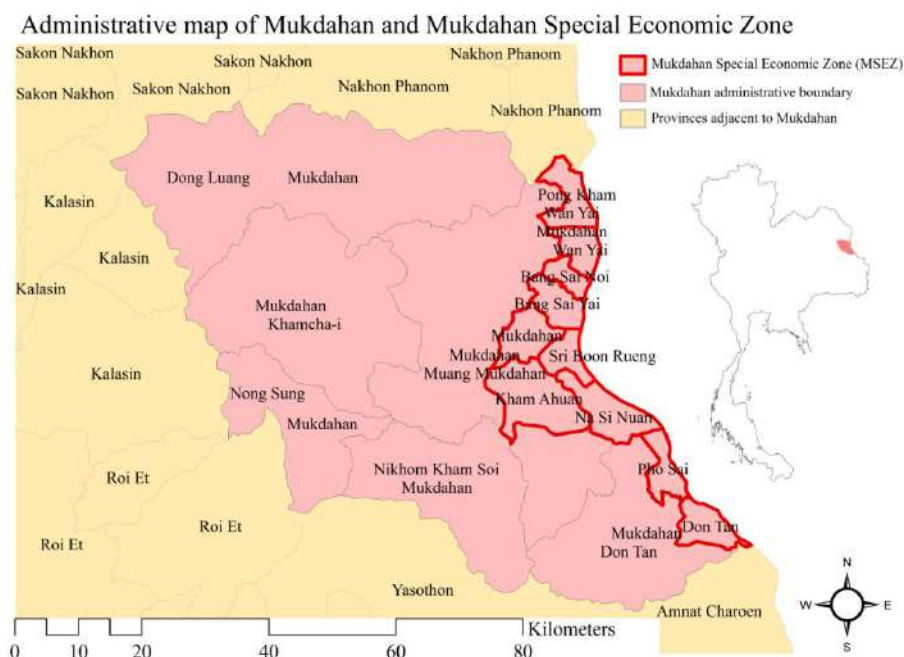


Figure 1 Administrative map of Mukdahan Province and MSEZ

Due to its location on the border with Lao PDR, Mukdahan has a high potential for investors, both in tourism and in border trade. Mukdahan is located in the middle of the East–West Economic Corridor (EWEC), connected to Sawannakhet, Lao PDR by the 2nd Thai-Laos Friendship Bridge. As seen from Figure 2, the EWEC starts in Moh La Mang city in Myanmar, enters Thailand at Mae Sod city, connects Sawannakhet, Lao PDR at Mukdahan, Thailand, passes the Sawan-Seno Special Economic Zone, Lao PDR and the Lao Bao Special Economic Zone, Vietnam, and enters the Southern China Sea at the Da Nang pier, Vietnam. From the Da Nang pier, products can be transferred via cargo ships to arrive at Hanoi, Vietnam and Southern China. With a population of ~100 million people, Nan Ning, China is one of the region's major cities, and could potentially be the key distributor of products from Thailand (Mukdahan Administration Office, 2016).

There are three dimensions of investment targeted in the MSEZ. The first dimension is to offer support manufactures of the products potentially for exported, which are computer hardware, vehicle gears, petrol, plastic wares, etc. The second dimension is to support agricultural-based manufacturing products, including cargoes and industries relating to rice, sugarcane, cassava and Para rubber. Finally the third dimension is to promote tourism investment and give support to service sectors, which includes a plan to increase the number of medical centers, international schools, hotels and housing estates (Mukdahan Administration Office, 2016).

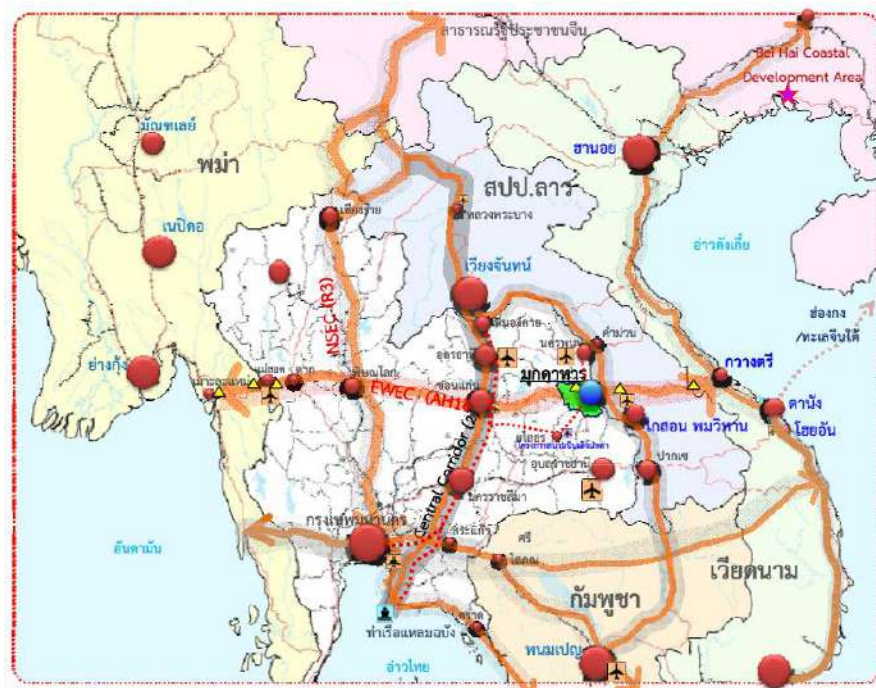


Figure 2 Map of EWEC pathway to the South China Sea and major cities along the roadway

Source: Department of Public Works and Town Planning (2016)

1.2. Geography and land covers

As seen from Figure 1, Mukdahan shares its northern border with the province of Nakhon Panom, connects with the province of Sakon Nakhon to the northwest, and shares its southern border with three provinces of Yasothron, Amnart Charoen and Roi Et. These parts of Mukdahan province are characterized by flat highland (shown in Figure 3). The Western border, connecting to Kalasin province, is dominated by hilly forests while eastern Mukdahan is adjacent to the Sawannakhet Province, Lao PDR, where the border is divided by the Mekong River (Mukdahan Administration Office, 2016).

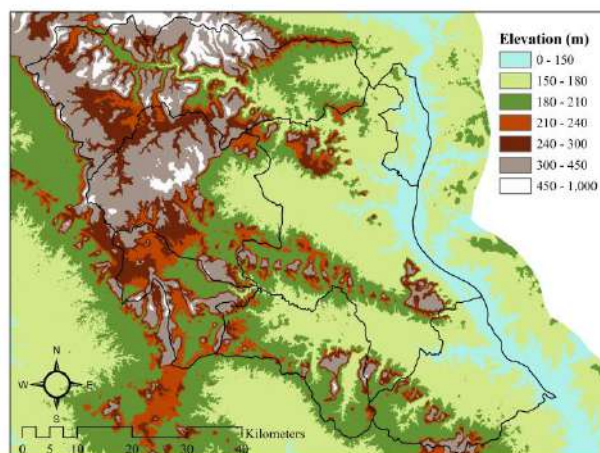


Figure 3 Topological map of Mukdahan

Proposed by the Department of Public Works and Town Planning (2016), land uses and land covers in the MSEZ area of 578.5 km² will consist:

1. Community areas, mainly growing along road networks,
2. National Parks and conserved forests, covering part of both Phu Pha Tupe National Park and Phu Dok Bua National Park,
3. Water resources, including the Mekong River, Huay Bang Sai, Huay Bang Hee etc.,
4. Floodplain areas, exhibiting fertile soil attributed to deposition of river sediment,
5. Agricultural areas for rice cultivation, vegetable farms, croplands and fruit plantations.

Within this area, 58.73% of the land have a title deed, 15.53% are in National Parks or conserved forests, 10.42% are agricultural lands issued by the Agricultural Land Reform Office, 8.66% are in cooperative estates, 3.5% are state property lands and 3.26% are other public areas (Mukdahan Industrial Office, 2016).

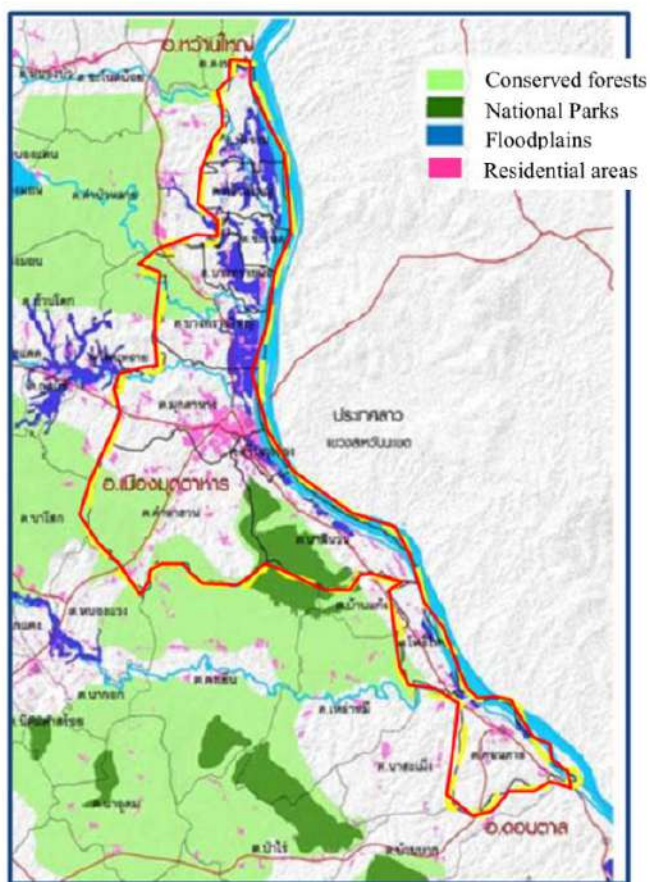


Figure 4 Existing conserved forests, National Parks, community areas and floodplains in MSEZ

Source: Department of Public Works and Town Planning, 2016

The Department of Public Works and Town Planning (2016) delineates conceptual framework for land uses in the MSEZ as illustrated in Figure 5; the framework is described below:

1. Multiple centers to decentralize urbanization from cities to surrounding areas
2. Developing new functioning land uses and supporting existing land uses in order to facilitate economic development.
3. Balance between economic development zones, green areas, cultural preservation areas and high-quality agricultural lands.
4. Interconnection among community centers and outers.

The Department of Public Works and Town Planning (2016) has also set approaches for urban land use planning for three districts in MSEZ; Muang Mukdahan District, Don Tan District, and Kwai Yai District. The details are shown in Figure 6. Muang Mukdahan District aims to be a center of commercial investments, logistics, governance,

training, hotels and services for tourists. Potential functioning land uses in this district are commercial and service zones, including shopping malls and wholesale and retail stores, hotels and resorts, exhibition centers, meeting/conference centers, occupational learning centers, public transportation terminals, residential zones, logistic parks and cargo and eco-industrial centers. Kwan Yai District is potentially a center of logistic and product distribution, as well as ecotourism communities. Functioning land uses in this district could be new residential zones, new commercial zones and services, transportation terminals, hotels/resorts/ guesthouses for tourism purposes, center of fine art and culture, eco-industries and cargo, and retail-sale businesses. Don Tan District is planned to be centers of agricultural productions, household-scale industries and fine products under the “One Tambon One Product (OTOP)” brand. Communities in Don Tan District are lower population density and its functioning land uses are expected to be centers of agricultural products, handicrafts and OTOP, small-scale agriculture-relating industries, community commerce, local-wisdom learning centers, and agricultural development centers (Department of Public Works and Town Planning, 2016).

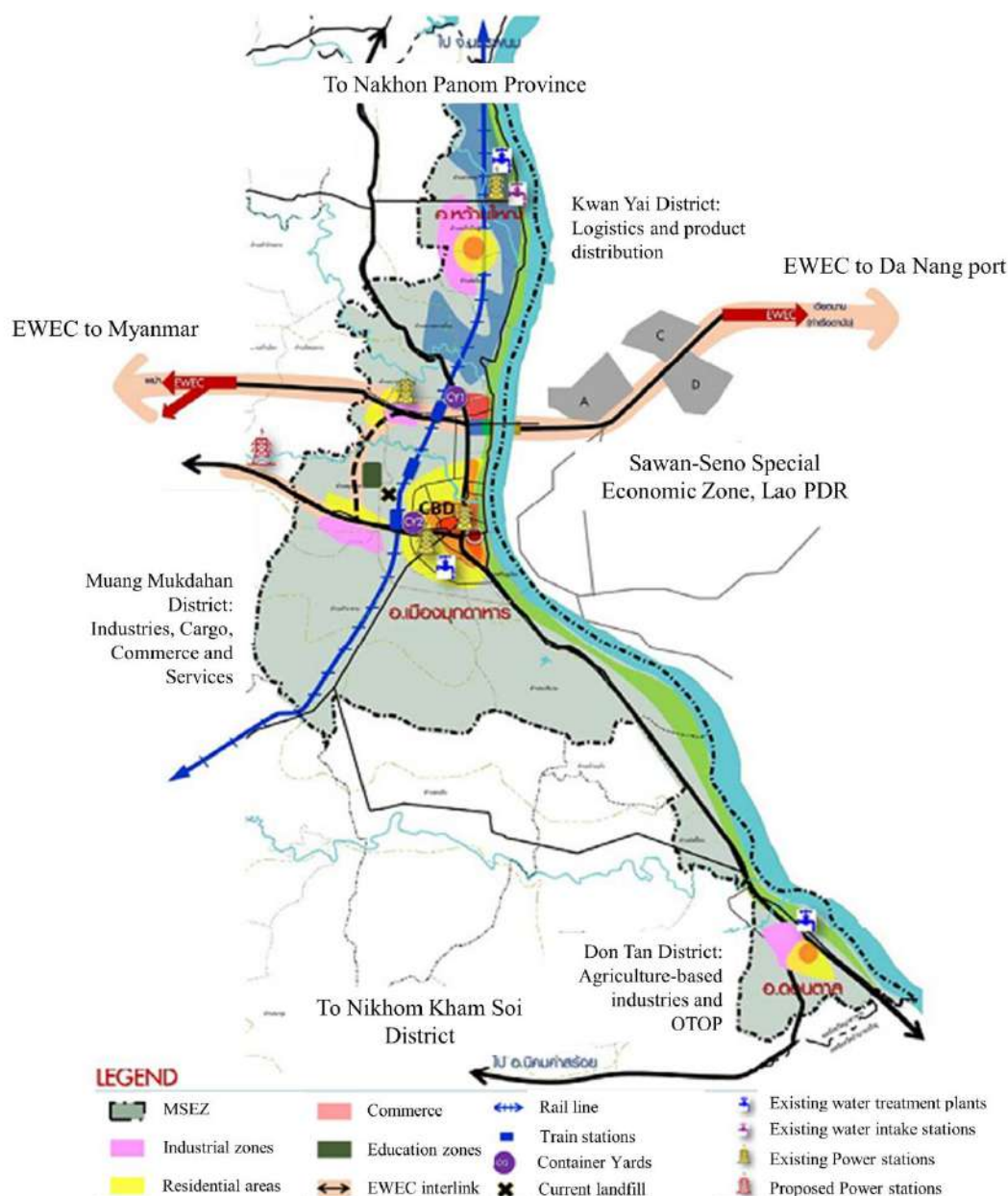


Figure 5 Conceptual framework for MSEZ land use development plan

Source: Department of Public Works and Town Planning (2016)

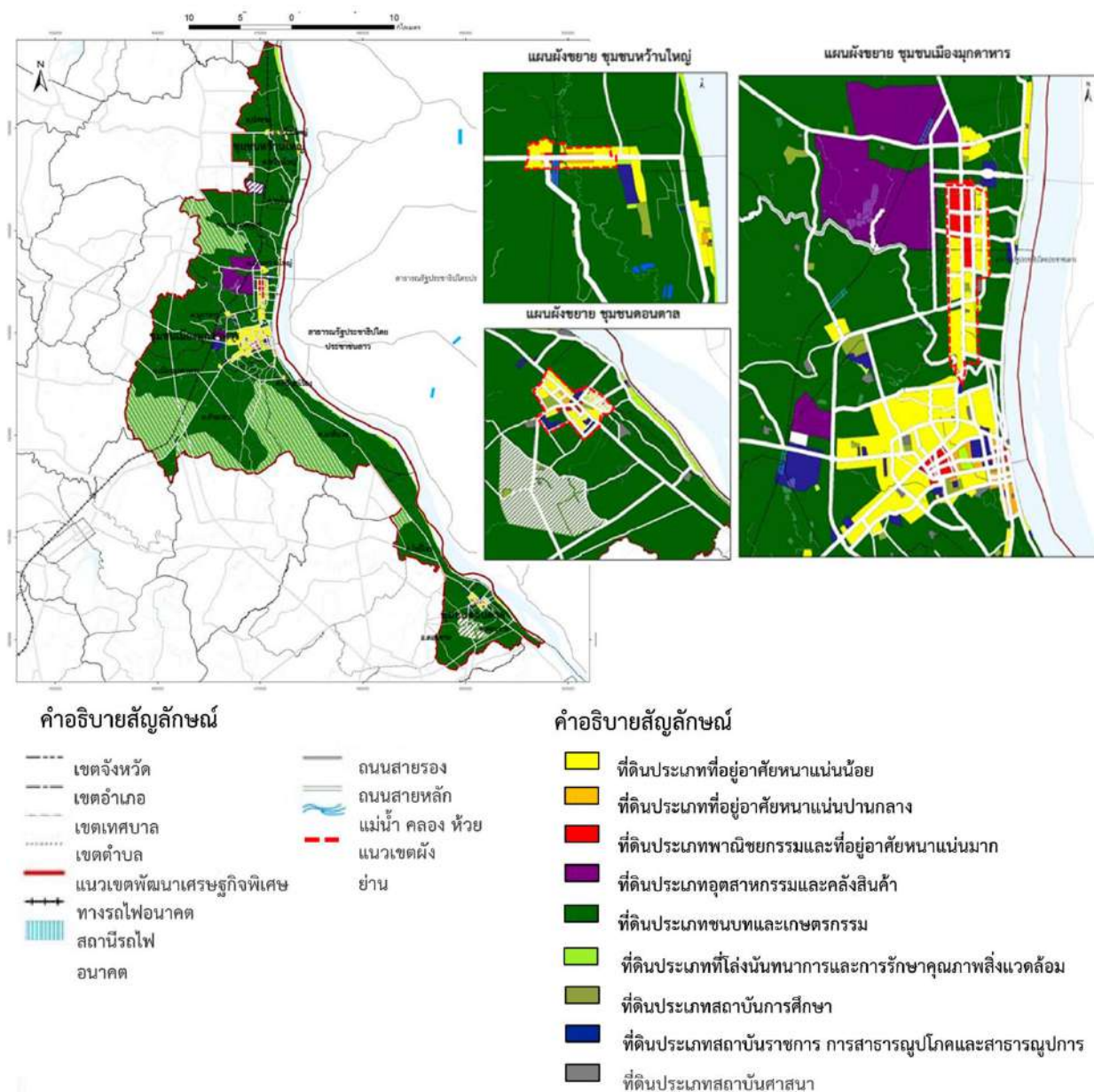


Figure 6 Proposed land use plan for MSEZ

Source: Department of Public Works and Town Planning (2016)

1.3. Demography and administration

As updated in December 2015, the total population in Mukdahan is 348,101, comprised of 174,394 males and 173,707 females. Approximately 38% of the total population is living in Muang Mukdahan. Population growth rate has decreased since 2004, and was at 0.386% as updated in December, 2015. Birth rate is 10.61:1,000 and death rate is 6.18:1,000. The majority of people in the province are Buddhist (96.8%) and are primarily rooted from 8 tribes; which are Phu Thai, Thai Yo, Thai Kha, Thai So, Thai Kaloeng, Thai Sack, Thai Kula, and Thai Isaan (Mukdahan Administration Office, 2016). There are several unique well-known cultural events relating to their faiths both Buddhist and local tribal customs. Furthermore, there has been a significant increase in the number of Thai of Vietnamese decent living in Mukdahan since the Vietnamese War, approximately 70 years ago.

Major household careers in urban area of Mukdahan are labor (21.66%), followed by trader (17.51%); whereas the major careers in the suburbs are rice farmer (55.44%) and labor (10.73%). Among three districts in MSEZ, Muang Mukdahan District has proportionally fewer agricultural sectors (47.7%); whereas both Don Tan District and Kwan Yai District have agricultural households as the majority (~78%). Average annual income of people in MSEZ is 87,499 baht per capita for those in Muang Mukdahan District, and much lesser in Kwan Yai District (66,136 baht per capita) and Don Tan District (63,169 baht per capita) (Mukdahan Administration Office, 2016).

Thai governance structure can be divided into two systems, provincial administration and local administration. The provincial administration includes both province and district, while typical local administration comprises municipality, sub-district administration organization (SAO) and provincial administration organization (PAO). The provincial administration of Mukdahan Province is comprised of 7 districts, as detailed in Table 1. The local administration of Mukdahan Province governs 24 municipalities and 30 SAOs (Mukdahan Industrial Office, 2016).

Table 1 Mukdahan administration

District	Area (km ²)	Distance to Town Hall, km	Population *, capita	Town Municipality	Sub-district Municipality	Sub-district Administration Organization
Khamcha-I	1,235	33	47,289	1	9	3
Dong Luang	377	55	37,259	-	2	6
Don Tan	85	33	42,729	-	2	2
Nikhom Kham Soi	511	28	42,887	-	3	5
Muang Mukdahan	713	3.5	130,077	-	1	9
Nong Sung	410	50	20,771	-	3	2
Kwan Yai	1,076	35	18,824	-	3	3
Total			339,836	1	23	30

Source: Mukdahan Industrial Office (2016)

* updated in September 30, 2011

1.4. Economics

Mukdahan's economy relies heavily on agricultural-related sectors and the distribution of products/services. The MSEZ development is currently focusing on both industrial and transportation sectors; whereas tourism and infrastructure sectors are growing slowly. Gross provincial production (GPP) of Mukdahan is largely from non-agricultural sectors (75.81% in 2013), including wholesale and retail stores (16.65% in 2013) and that of industries (15.05%). The key products are wholesale foods and clothes (19.55% in 2013), automobiles (26.85%), petrol (18.73%) and goods sold in shopping malls (6.66%). The key industrial sectors in 2013 were Para rubber-derived productions (10.03% in 2013), food and beverage industries (78.78%), including rice mills (28.07%) and sugarcane production (33.88%). In 2013, the agricultural sectors accounted for 24.19% of the total GPP in Mukdahan, largely from rice (42.86%), followed by Para rubber (20.81%), cassava (14.81%) and sugarcane (12.40%) (Mukdahan Industrial Office, 2016). GPP growth in infrastructure sectors (water supply and power) highly fluctuates, depending upon international power trading policy (Mukdahan Industrial Office, 2016).

In the year 2012, border trade was valued at 109,566.46 million baht, of which 64,336.64 million baht was from exported products, primarily electronic appliances, computer devices, vehicle gears and petrol. The majority of imported product was pure copper sheet. In the year 2013, border trade value decreased to 67,790.8 million baht, resulting from the opening of the 3rd Thai-Laos Friendship Bridge in Nakhon Panom Province. (Mukdahan Administration Office, 2016). Not only in Mukdahan but also in other provinces located along the national borderline, local people do not gain much benefit from the border trade since the majority of trading products do not come from the Northeast Region. The Mukdahan Chamber of Commerce suggests adding value to local agricultural products, focusing on organic agricultures, and the promoting of cultural-based tourism (PRACHACHART TURAKIT, 25-28 February, 2016).

Tourism industries, including hotels and restaurants, were only accounting for 1.42% of the GPP (in 2013) and have been growing slowly. Tourism industries generated 1,811.59 million baht in 2013. Several of the major visiting spots of the province are historical landmarks (temples and monuments), national parks (the Mekong River, Phu Pha Tupe National Park, Taad Toon Waterfall, Manopirom Beach, Huay Kee Lek Reservoir, etc.). There are also several artificial visiting spots, such as the 2nd Thai-Laos friendship bridge, the Indochina market and cultural villages, etc.

As a part of tourism, each district develops their own signature products under the “One-Tambon-One-Product, OTOP” brand, which include woven-bamboo products, naturally-dyed scarves, handmade shirts, mud-dyed textile and plastic-woven baskets. The OTOP however, only accounted for less than 1% of total GPP in 2013 (Mukdahan Administration Office, 2016).

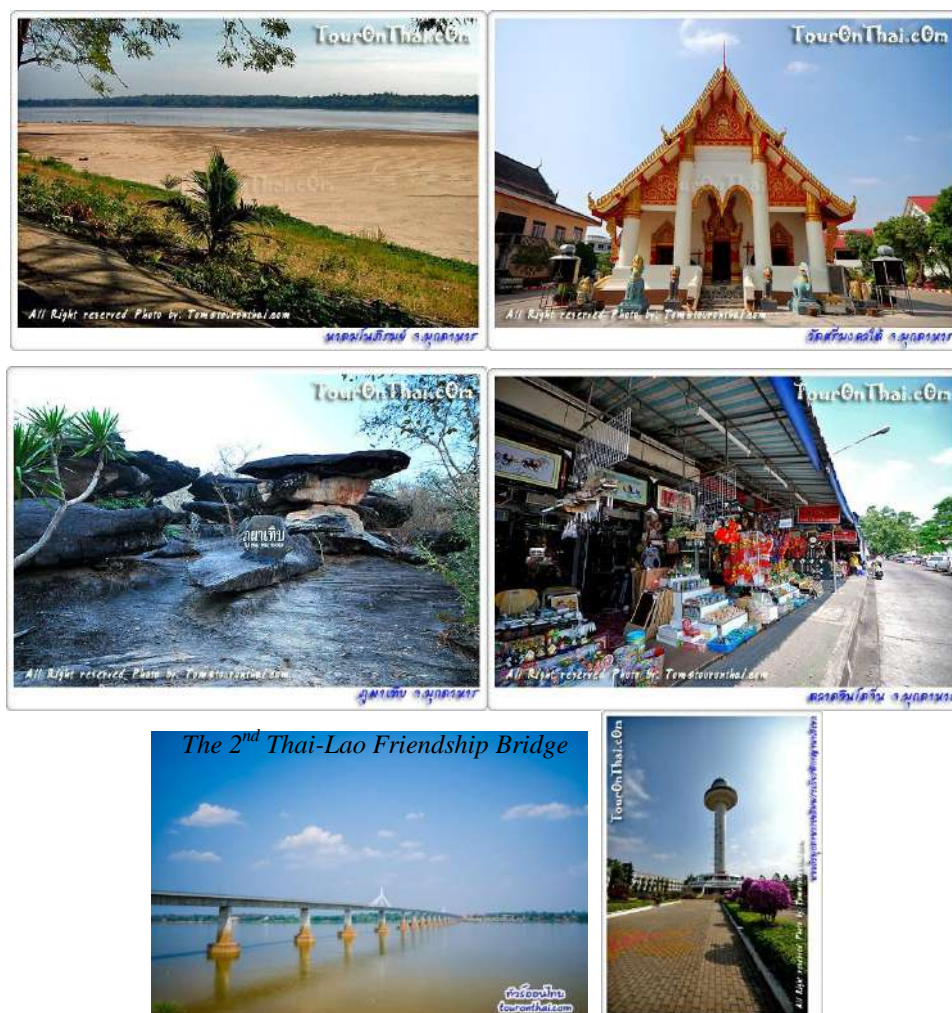


Figure 7 Some tourist attractions in Mukdahan

Source: <http://www.touronthai.com/>

1.5. Infrastructure

To meet the set goals for MSEZ, large infrastructure development projects are currently ongoing, such as an extension of highway No. 12 and a construction of twin-trail train line, linking Khon Kaen (Ban Pai district), Mahasarakham, Roi Et, Mukdahan and Nakhon Panom. In the long term, the government plans to extend highway No. 212 from Kwan Yai (Mukdahan) to Nakhon Panom and to improve city road networks, as well as to establish transportation terminals. The MSEZ transportation plan proposed by the Department of Public Works and Town Planning (2016) is shown in Figure 8. In years 2015 to 2016, The Thai government aims to spend 1,889 M THB for the development of transportation systems (806 million THB), checkpoints/customhouses (100 million THB), an industrial estate (15 million THB) and public utilities (968 million THB). Currently there are two national airports adjacent to Mukdahan, which are Sakhon Nakhon and Nakhon Panom. Furthermore, Mukdahan Commercial Chamber is proposing for the renovation of old Leong Nok Tha military airport in Yasothorn Province to become commercial airport in order to support high population influx and greater economic development (DAILYNEWS, 29th April 2016).

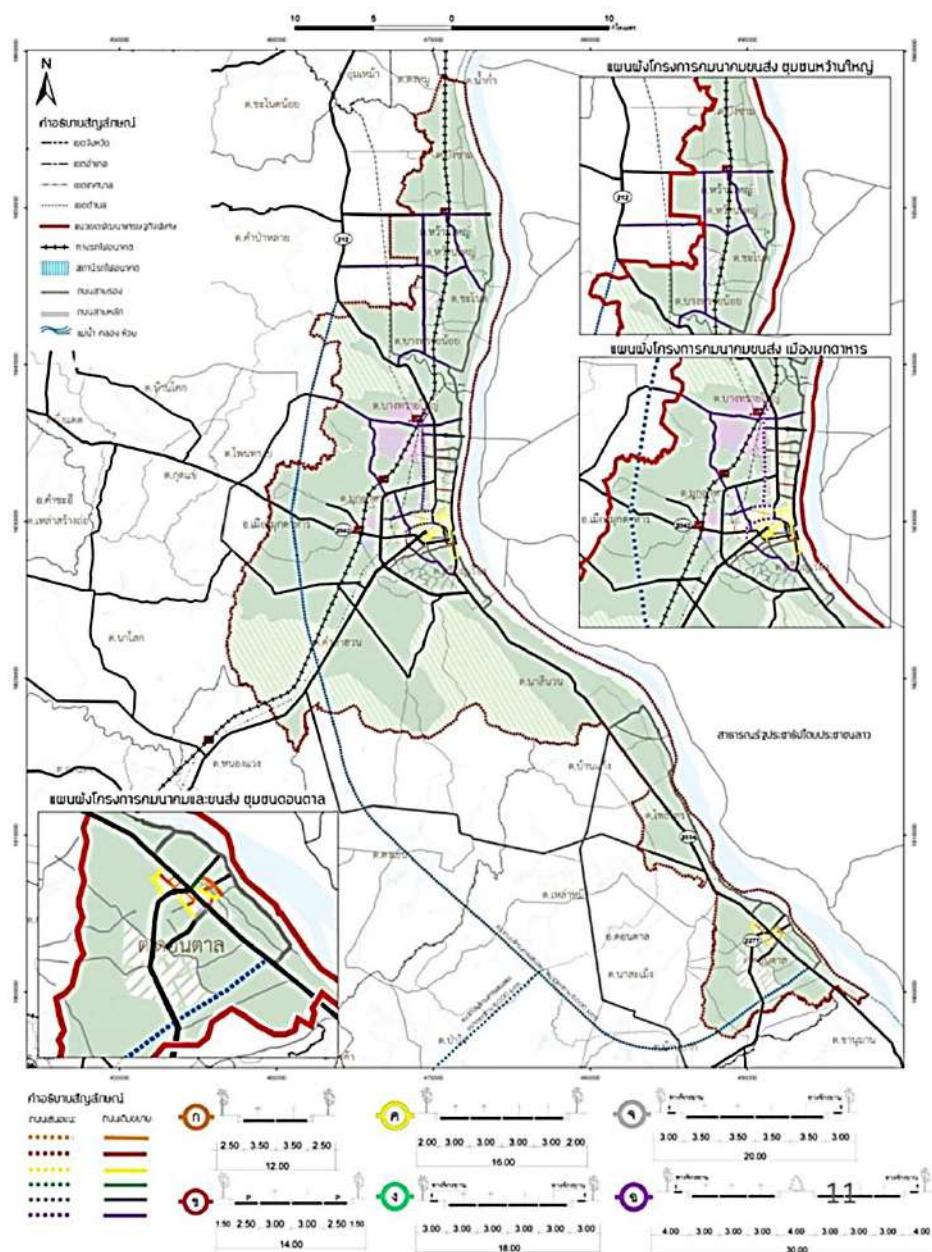


Figure 8 Proposed transportation plan for MSEZ

Note: dash lines represent proposed road lines and solid lines represent existing road lines

Source: Department of Public Works and Town Planning (2016)

The Electricity Generating Authority of Thailand has currently two high-voltage (22,000 volt) power stations in the Mukdahan, producing approximately 40 million watt day⁻¹ of which 10 million watt day⁻¹ comes from the biomass power plant, using biomass residues from the Saharuean sugarcane industry. Power supply in MSEZ is claimed to be sufficient due to a current surplus of power generation (Mukdahan Administration Office, 2016).

The Provincial Water Work Authority (PAAW) is the major water provider in Mukdahan province, taking the raw water supply from the Mekong River. Total production rate of the PAAW is 1,070 m³ hr⁻¹, which service to 12,569 peoples (Mukdahan Administration Office, 2016). This water supply is not sufficient for MSEZ development. PAAW is searching for land of approximately 2.4 ha near the 2nd Thai-Lao friendship bridge for the construction of

a new water supply plant, and also has a plan for an expansion of the old water plant in fiscal year 2016 (Mukdahan Industrial Office, 2016).

There are 18 man-made reservoirs with a total retention volume of 82.42 million m³ and a total surface area of 74.3 km² (Mukdahan Administration Office, 2016). These reservoirs are servicing approximately 215.25 km² of irrigated area. Furthermore, 345 groundwater wells have been registered, 56% of which are located in Muang Mukdahan District, primarily used for domestic consumption (59%) (Mukdahan Administration Office, 2016). Estimated public demands for water utilization in Mukdahan are detailed in Table 2.

Table 2 Estimated water utilizations in Mukdahan (unit: million m³ year⁻¹)

Mekong River and its tributaries	Domestic consumption and tourism		Industries		Agriculture	
	Year 2011	Year 2025	Year 2011	Year 2025	Year 2011	Year 2025
Mekong River Section 9	1.14	1.31	0.04	0.05	47.60	62.66
Huay Ban Sai	1.75	2.44	0.04	0.05	35.22	55.41
Huay Muk	5.17	5.95		0.42	0.52	41.22
Huay Bang Hee	2.15	2.45		0.07	0.08	26.98
Lower Mekong River	5.89	2.27		0.21	0.26	105.79
						293.28

Source: Office of National Resources and Environment (2016)

1.6. Natural Resources

Mukdahan province is rich in mountains and forest. The Phupan Range is in the eastern part of the province and the West-Southwest is mainly flat highlands alternating with hilly terrain. These areas are covered with deciduous and dry dipterocarp forests (43.75% of the total area), and the area includes 3 national parks, 13 conserved forests and other small parks including a wildlife sanctuary, a botanical garden and a non-hunting area (Mukdahan Administration Office, 2016). Map of major forest resources in the MSEZ are illustrated in Figure 9. The Forestry Cooperative Center, Mukdahan is working to restore and expand community forests. This type of forest has a role to play in cultural preservation and social well-being for the local communities. The forests are located adjacent to communities and could be used as foods and fuel resources, as well as sources of wood for housing construction and cemetery land.

Sediment soil in Mukdahan province is in the Korat soil series, comprising of sandstone with minor silt, clayey and salt layers on the top. Besides this, there are low-grade copper ore resources scattered over the area. The majority of top soil texture in Mukdahan is loam to sandy loam with medium to low nutrients (45%), found in the flat highlands. This soil can be appropriated for cultivating dry crops. Thirty three percent is steep hilly terrain, not appropriate for cropping due to a risk of ecosystem deterioration. Twenty percent is poor drainage soil, suitably used for rice cultivation (Mukdahan Administration Office, 2016). Rice fields and field croplands; such as corn, sugarcane and cassava, are the primary agricultural land covers in Mukdahan. Agricultural land proportions are shown in Figure 10. Approximately 75% of the total 4,339.83 km² of soil found in Mukdahan Province has been identified as acidic soil, 11.9% of which is in complex steep terrain, and 3.8% being infertile gravel land, which results in low productive yield (Office of Agriculture and Cooperative, 2016).

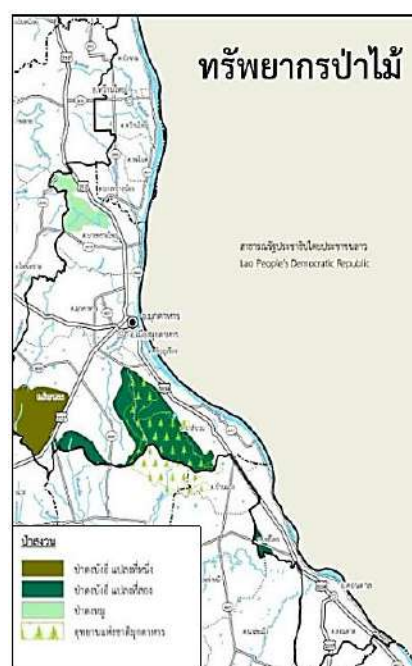


Figure 9 Areas of community forests by district

Source: Department of Public Works and Town Planning (2016)

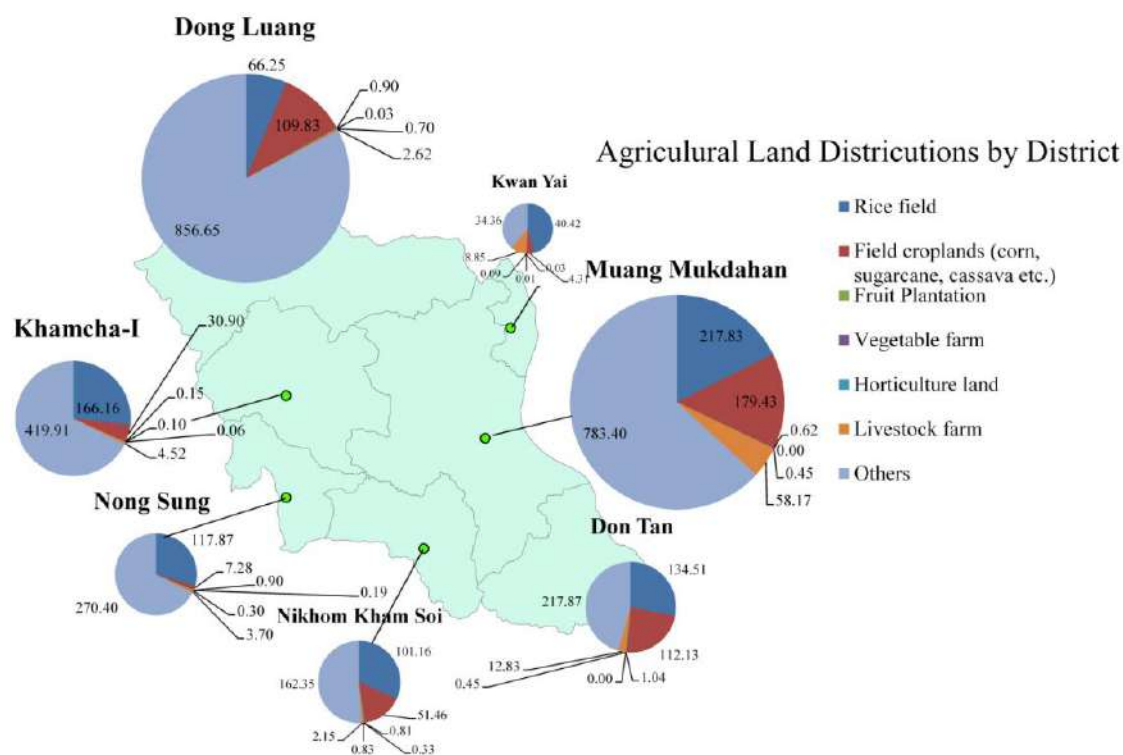


Figure 10 Agricultural land covers by district

Source: Office of Agriculture and Cooperative (2016)

Average rainfall in Mukdahan is $1,740 \text{ m}^3 \text{ year}^{-1}$ and surface runoff is 12.65 to $15.08 \text{ l sec}^{-1} \text{ km}^2$ on average. The Mekong River is the major water supply in Mukdahan, passing three districts; Muang Mukdahan, Kwan Yai and Don Tan. Its tributaries are Huay Muk, Huay Bang Sai, Huay Bang Hee and Huay Cha Node (see Figure 11). These water resources are used in agricultural production and domestic consumption, as well as in fisheries, tourism, transportation, and river sand suction industries. Mukdahan has an abundance of freshwater wetlands, including 539 riverine wetlands, 4 lake wetlands and 229 swamps (Office of National Resources and Environment, 2016). Besides the natural water resources, there are large agricultural areas receiving irrigation service from artificial reservoirs and electric pumping stations along the Mekong River. These reservoirs include Huay Khee Lek Reservoir in the Nikhom Kham Soi District ($23.37 \text{ million m}^3$), Huay Cha Node Reservoir in the Dong Luang District (18.4 million m^3) and Huay Muk Reservoir in the Khamcha-I District (4.2 million m^3). There are also 21 small reservoirs and check dams, and 33 water pumping stations functioning as agricultural irrigation. A summary of these water resources and areas are detailed in Table 3.

Table 3 Water resources and serviced areas by district

District	Natural water land cover, km^2	Irrigated areas under serviced by artificial water resources, km^2	
		Reservoirs and Check Dams	Electrical water pumping stations
Khamcha-I	0.968	3.690	-
Dong Luang	5.461	48.400	2.080
Don Tan	3.294	1.920	22.688
Nikhom Kham Soi	1.451	16.040	-
Muang Mukdahan	3.323	6.880	19.216
Nong Sung	0.550	-	-
Kwan Yai	0.157	-	24.544
	15.204	76.930	68.528

Source: Office of Agriculture and Cooperative (2016)

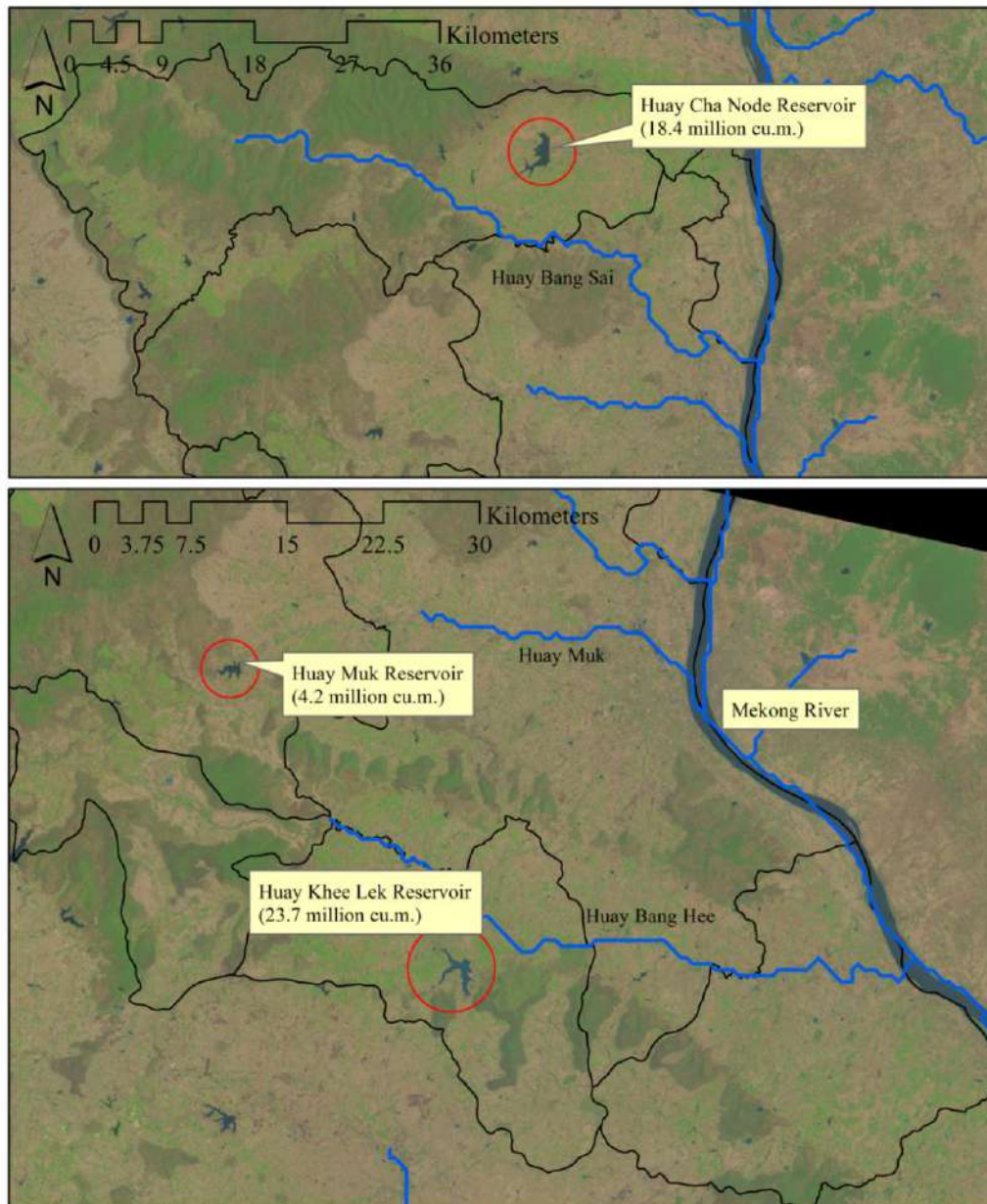


Figure 11 The Mekong River, its tributaries and major reservoirs

Mukdahan's climate is classified as tropical wet and dry or savanna climate (*Aw*), based on the Köppen climate classification system. These climates have a pronounced dry season, with the driest month having precipitation less than 60 mm and less than 1/25 of the total annual precipitation. Its summer season starts anywhere from mid-February to mid-May while the rainy season is from mid-May to mid-October, and the winter season is from mid-October to mid-February. The average annual temperature here is 26.3 °C. Annual precipitation averages 1,456 mm (Climate-Data.org, 2016). The driest month in Mukdahan is December, having average rainfall of 2 mm and the wettest month is August (316 mm) (Climate-Data.org, 2016).

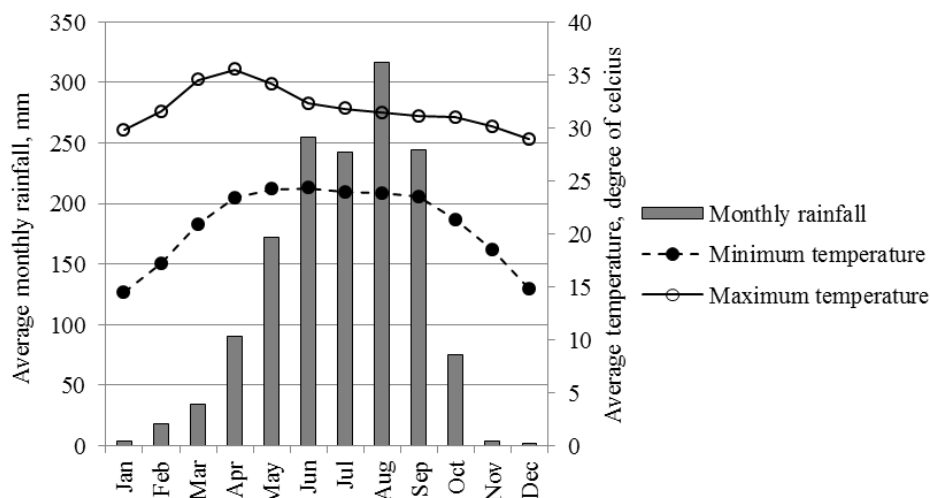


Figure 12 Average rainfall and temperature for Mukdahan

Adapted from Climate-Data.org (2016)

1.7. Environmental situation

Average solid waste produced by Mukdahan's households is $0.6 \text{ kg person}^{-1} \text{ day}^{-1}$, and the total solid waste generation is approximately $212.2 \text{ ton day}^{-1}$. These solid wastes comprise of organic waste (60%), paper (9.4%), plastic (9.4%), glass (3.0%), metals (5.4%) and other. In Mukdahan Province, there is only one sanitary landfill at Sri Pattana community, Mukdahan Sub-District, Muang Mukdahan District, approximately 5 km from the city center (see Figure 5). Only 30 tons of solid waste per day from Muang Mukdahan District and five municipalities is disposed into this sanitary landfill. Other municipalities are either burning wastes in open fields (14 municipalities) or sending wastes to non-sanitary landfills (4 municipalities) (Office of Natural Resources and Environment, 2016). Furthermore, Mukdahan is currently searching for a new sanitary landfill to dispose of solid waste, the amount of which has been significantly increasing along with MSEZ development (Mukdahan Administration Office, 2016).

The Office of Natural Resources and Environment (Mukdahan), together with the Regional Environment Office in Ubonratchathani, is responsible for natural water and air quality monitoring. The water quality (reported in 2014) in the Mekong River, Huay Cha Node, Huay Bang Hee, Huay Bang Sai was classified as Type 3 freshwater, appropriately used as raw water for domestic water supply. However, water quality in the Huay Muk and Huay Khee, receiving wastewater from Muang Mukdahan's communities, has been classified as poor to very poor quality (Type 4–5 freshwater), exhibiting low levels of dissolve oxygen ($<4 \text{ mg l}^{-1}$), high coliform bacteria ($> 4,000 \text{ MPN per } 100 \text{ ml}$) and high ammonia ($> 0.5 \text{ mg l}^{-1}$). These poor water qualities result from direct discharge of domestic wastewater from communities and lack of public knowledge on water quality management. Currently, there is one wastewater treatment plant (using a stabilization pond system) located in Muang Mukdahan District. The wastewater collection grid, however, does not cover the entirety of Muang Mukdahan. The air quality in Mukdahan is within acceptable levels. Traffic emissions are the major source of air pollution in the city of Mukdahan, while open biomass burning is the major contributor from the agricultural zones (Office of Natural Resources and Environment, 2016).

Significant problems for environment and natural resources in Mukdahan are broken into four major fields, which are 1) soil and land uses, 2) forest resources, 3) solid waste and 4) water resource (Office of Natural Resources and Environment, 2016). Problems resulting from soil and land uses are infertile soil, soil erosion along riverbanks, and contamination of toxic agricultural chemicals into the soil. These problems are predominant in agricultural lands and in the Mekong River's bank in Muang Mukdahan, Kwan Yai and Don Tan Districts. Problems affecting forest resources include forest degradation, deforestation, cutting of trees, forest land conversion, forest fires, and illegal hunting of wildlife animals and the harvesting of wild plants. Affected forest areas are found in 13 national conserved forests, 3 national parks, Phu Sri Than Wildlife Sanctuary, Pha Nam Thip Cave Non-Hunting Area, Dong Bang Hee Forest Park, Dong Bang Hee Botanical Garden, as well as in community forests. Solid waste problems are found at all municipality scales. The problems include high solid waste generation and accumulation, non-sanitary solid waste disposal systems, public objection to construction of a solid waste disposal plant, poor public

participation in solid waste management, and inappropriate disposal of infected wastes. Problems affecting water resources include degradation of surface water quality, insufficient water for domestic consumption and agriculture, flood resulting from a poor drainage system, lack of public participation, and ineffective water management.

1.8. Security issues

Drug use is one of the major security issues present in Mukdahan. In 2011, there are 1,792 suspects involved in cases of drug use (35.2% of all on-going cases), and 2,796 suspects involved in the cases during 2011 (40%). Drug use prevention and drug control became the first priority in the provincial security plan. Implementation programs include empowerment of communities, medicating of drug-addicted victims, prevention of drugs in schools, enforcement of drug-related regulations, and collaboration with Lao PDR to control the trans-boundary drug trades. (Mukdahan Administration Office, 2016).

The illegal trans-boundary trade between Mukdahan and Sawannakhet in Lao PDR comprises mainly of agricultural products, such as garlic and onion from China. Due to the long borderline (72 km) along the Mekong River and many unofficial piers, it is difficult to control the illegal trade across the country boundary (Mukdahan Administration Office, 2016).

Due to limited labor forces in Mukdahan, alien labor is in high demand. As updated in July 2013, the total number of registered alien laborers in Mukdahan is 746, of which 640 are from Lao PDR, 33 from Myanmar and 1 from Cambodia. There are also, however, a significant number of illegal laborers entering Thailand from both Lao PDR and Myanmar. Some of these alien laborers were also victims of human trafficking (Mukdahan Administration Office, 2016).

1.9. Strategic Plans and Policies

Mukdahan Development Plan for years 2014 to 2018

Mukdahan's governor envisioned the latest development plan of Mukdahan as one that would see it becomes "the city of commerce, agriculture and Mekong's tourism, connecting with ASEAN" and three key goals have been defined as follow;

1. to promote economic growth by increasing competencies in agriculture, border trade and tourism,
2. to improve quality of life by reinforcing social security along the borderline, and
3. to conserve and restore natural resources and environment and promote power security.

The following table outlines the goals with the set indicators for year 2019 (Mukdahan Administration Office, 2016).

Table 4 Goals and indicators set in Mukdahan development plan

Goals	Indicators (by year 2019)
To promote economic growth by increasing competencies in agriculture, border trade and tourism	GPP increase of 20%
	GPP from agricultural sector increased by 20%
	International trade value increase of 28% (7% per year)
	Tourism income increase of 20% (5% per year)
To improve quality of life by reinforcing social security along the borderline	Deprivation ratio decreased to 7%
	Average academic achievement increased to 10 years of schooling
	Average O-NET score increased to 50% and up for all levels
	Death rate for firstborn baby decreased to < 4 per 1000 babies
To conserve and restore natural resources and environment and promote power security	Forest cover increased by at least 1%

The following strategies are defined to assisting in achieve the goals:

1. Development of agriculture and agriculture-based industries

2. Commercial gate connecting ASEAN to worldwide markets
3. Development of tourism business to promote community incomes
4. Human and social development to improve quality of life
5. Natural resource protection and environmental management
6. Reinforcement of social security

Provincial Industrial Strategic Plan for 2016 to 2021

Mukdahan's industrial plan is currently looking towards green industries, sustainability and the targeting of ASEAN Plus markets (ASEAN countries + China, Japan, and South Korea). The plan aims to increase the capabilities and competencies of medium-and small-scale industries, as well as community-based industries, and to boost investments in concordance with industrial developments in the neighboring AEC countries (Mukdahan Industrial Office, 2016). High land selling prices of approximately 7 to 10 million baht per rai (1rai = 0.0016 km²) results in lower attraction to investors and be one of the major obstacles for MSEZ development. To resolve this problem, central government will establish an investment zone in Kham A-Huan Sub-district, Muang District, covering an area of 1.736 km² (1,085.5 rai).



Figure 13 Kham A-Huan Investment Zone

Source: Rhitsorakhai (2015)

The Broad of Investment (BOI) envisions the MSEZ as a “Center of wholesale and retail stores, and logistics,” and has set for the MSEZ 10 BOI-targeted industries. These are 1) agriculture, animal foods and fisheries, 2) electrical appliances and electronics, 3) industrial estates, 4) logistic services (including cargo, terminal and vehicle), 5) metals-based structures for construction or industries, 6) construction devices, equipment, and reinforced concrete products for public works (excluding ceramic products), 7) printing services, 8) cosmetics and body-care products, 9) plastic wares for households and 10) pulp-derived products. Under the MSEZ development plan, government will provide essential infrastructure in the MSEZ, including roads, train lines, airport, truck terminals, power grid and supply, water supply and treatment, public works, communication facilities, custom checkpoints, borderline infrastructure, environmental management, and city landscape and tourism spots. Furthermore, the BOI offers several advantages for those investors and industries settling in MSEZ. The advantages include the granting of tax subsidies, and tax exemptions, the skilled labor registration for aliens, and land and property rights.

Department of Industrial Works (2016) is currently conducting a study for an “MSEZ Eco-Industrial Park Master Plan.” The results of this study show two prerequisites needed for the Eco-Industry. The first requirement is a gathering database, which are in accordance with Eco-Industry regulations for conducting material and energy mass balances. The second requirement is a defining of spatial-specific business models and conducted activities or projects carried out in response to the Eco-Industrial Development Indicators. The working committees in charge of the “MSEZ Eco-Industrial Park Master Plan” have primarily agreed to drive forward on 6 strategies under the Eco-Industrial Park Master Plan (Department of Industrial Works, 2016).

1. Conduct surveys of appropriate land uses/city layouts for different areas (which are dense industrial area, developing industrial area and special economic zone).
2. Improve essential infrastructure to support socio-economic development
3. Improve environmental management and safety

4. Development of connection between community bases and industries in the area
5. Improve social and public well-being
6. Develop systems for knowledge dissemination and human resource development

Provincial Natural Resources and Environmental Management Plan for years 2016 to 2021

Mukdahan's plan for natural resource and environmental management is divided into three major sectors, which are the 1) natural resource sector, 2) inland water resource sector and 3) environmental problem sector. For natural resources, the forest resource is the most important in terms of severity and urgent requirements for execution, followed by soil and land uses, wildlife, biodiversity and wetlands. For the inland water sector, the most important problem is degradation of the freshwater ecosystem, followed by that of insufficient water for domestic consumption and agriculture. For environmental problems, the most important issues are solid wastes, followed by hazardous wastes, poor water quality and air pollution, respectively.

There are several governmental agencies tackling these problems in MSEZ.

- The Forestry Cooperative Center, Mukdahan, and the Office of Forest Resource Management (Region 7, Khon Kaen) are responsible for multiple afforestation projects in MSEZ public areas, including those in urban zones and community forests. These projects aim to increase green spaces, improve public well-being and raise public awareness on the topic of forest resource conservation.
- Among the eleven Sub-District Municipalities in MSEZ, Na Sri Nuan Sub-district Municipality (in Muang Mukdahan District) and Kwan Yai Sub-District Municipality (in Kwan Yai District) play vital roles in conserving community forests and water resources in their areas of responsibility. The Na Sri Nuan Sub-District Municipality leads projects on dissemination of forest conservation knowledge, afforestation in areas of degraded forests, and training for fire-fighting volunteers. The Municipality also plans to promote bio-friendly agriculture to minimize chemical use and also spend budget for new solid waste incineration technology and a wastewater collection system. Similar forest conservation projects have been conducted in Kwan Yai Sub-District under the Royal initiative of Her Majesty the Queen. The Kwan Yai Sub-District also leads several urban green projects, including improving green landscapes and integrated solid waste management, focusing on public participation. Biogas technology is one of the solid waste management options in the realm of the Municipality's projects. Furthermore, the Kwan Yai Sub-District Municipality is also interested in using wind power as an alternative energy for agricultural water translocation.
- The Office of Natural Resources and Environment, Mukdahan, and the Office of Environment Region 12 have been responsible for several projects, collaborating among multiple stakeholders, such as schools, navy, and all Sub-District Municipalities. The project activities include 1) long-term water quality monitoring, focusing in the Mekong River and its tributaries, 2) long-term air pollution monitoring in the Muang Mukdahan District, 3) Raising public awareness on global warming and 4) long-term monitoring on effects of in-river sand suction businesses.

Provincial Agricultural and Cooperative Development Plan for years 2013 to 2016

Mukdahan has set its vision on provincial agricultural development, aspiring towards "self-reliant farmers, quality production, safe foods, and the ASEAN market." To achieve these goals, four strategies have been implemented. First strategy involves strengthening farmers and farmer organizations to become smart farmers by means of knowledge dissemination, hygienic foods promotion, and the assisting of local farmer organizations. The second strategy is to increase efficiency in agricultural production, focus on the increasing number of quality-approved farms, and maximize productive yields. Developing approaches under this strategy are the promoting of green and organic products, development of logistic systems for agricultural product distribution, promotion of agricultural ecotourism, and the arranging of exhibitions for Thai agricultural products both in the country and abroad. The third strategy is to build up market-driving agricultural production, which would add value to local agricultural products, as well as minimize wastes from production excess of market demand. The last strategy involves an increased focus on the development of is agricultural resources for ultimate productivity and sustainability. Goals under this strategy include the improvement of agricultural soil quality, expansion of irrigated areas, the minimizing of chemical use in farming, and an increased capacity in production of organic fertilizers. (Office of Agriculture and Cooperative, 2016).

Chapter 2

SWOT analysis for Mukdahan

Source: Mukdahan Administration Office (2016), Mukdahan Industrial Office (2016) and Office of Agriculture and Cooperative (2016)

2.1. Local civilian's reflection on problems and urgent needs

From the people's reflections concerning urgent needs and key problems (listed in Table 1), the major concerns in this province are those of insufficient water supply for consumption, a poor local transportation network, and a poor system of irrigation. With the planned development of the MSEZ and an extension of the transportation network, it is undeniable that Mukdahan will be experiencing an influx in population.

2.2. SWOT analysis

Strengths

- Location in East-West Economic Corridor and closing proximity to the 2nd Thai-Lao Friendship Bridge, give ease of accessibility to foreign markets
- Abundance of agricultural supplies which are; rice, cassava, Para rubber, sugarcane, livestock, and freshwater aquatic life
- Variety of potential visiting sites, ideal for growth in tourism
- Unique and varied culture combining local art and wisdom
- High economic growth rate. Its Gross Provincial Product (GPP) is the second highest in the country, which has been attributed to an expansion of border trade
- Potential to be a major distribution center, Indo-China market is well-known to both investors and tourists
- Strong cooperation exists between government sectors and people sector, used to drive eco-industries/business towards sustainability of environment and resources

Weakness

- Insufficient infrastructure, especially in terms of transportation, including poor community roads
- Lack of confidence in the ability to properly manage resources with an increasing rate of deforestation
- Lack of efficient management for solid waste management, water resources and relevant institutions
- Lack of agricultural technology/innovation and integrated agricultural industries. The ratio of certified farms (43.67%) is below the national average (45.1%)
- Lack of systematic product distribution center/hub
- Security problems associated with illegal laborers, human trafficking and smuggled goods.
- Poor accessibility to information technology
- Inefficient public health service (only one certified hospital and only 4.9% of population is in the health insurance system) and limited access to education past elementary school
- Insufficient skilled labor as the majority of the local labor works in the agricultural sector
- No local academic institution that would supply the job market with engineers
- Lack of information and advisory centers that would help investors by informing them the laws and regulations of the neighboring countries
- Lack of packaging development for community products, i.e. OTOP.
- Poor land zoning administration

- High land prices
- No Generalized System of Preferences (GSP) rights from USA and EU. This is not advantageous for exporters as compared to those products from Lao PDR.

Opportunities

- Historically, Mukdahan has had a close relationship with the people of Sawannakhet, Lao PDR, as both groups derive from same ethnicity and share similar traditions. Mukdahan also established a memorandum of understanding with Sawannakhet, Lao PDR (since 2004), Kwang Tri, Vietnam (since 2008) and Tong Juan, Nan Ning, China (since 2011) to fortify their relationships (Mukdahan Administration Office, 2016).
- Government policy to support and promote interlinks with neighboring countries in the Great Mekong Sub-Region (GMS), Ayeyawady-Chao Phraya-Mekong Economic Cooperation Strategy (ACMECS) and ASEAN+ (including ASEAN countries, China, Japan and South Korea).
- Economic Community (AEC) policy
- Government policy on infrastructure development
- Government policy on MSEZ
- Government policy on safe and organic agriculture
- Similar culture and language among communities on both sides of the Mekong River.
- Strong reputation among neighboring countries regarding Thailand's high-quality products

Threats to Success

- Different laws and regulations among ASEAN countries
- Severe natural disasters attributed to climate changes
- Effects from regional and global economics
- High competition with low-cost products from China and neighboring countries

Table 5 List of urgent needs and key problems identified through research which involved local people in each district in Mukdahan

Significance order	Mukdahan districts						
	Muang Mukdahan	Khamcha-I	Nikhom Kham Soi	Don Tan	Dong Luang	Nong Sung	Kwan Yai
1	Scarcity of water supply for public consumption during dry season	Scarcity of water supply for public consumption	Poor service in delivering water for public consumption	Scarcity of water supply for public consumption during dry season	Scarcity of water supply for public consumption	Scarcity of and poor quality water supply for public consumption during dry season	Poor road conditions
2	Shallow waterways, low water retention capacity	Poor road conditions, resulting in transportation problems and accidents	Insufficient irrigation infrastructure, especially waterways and dams	Lack of waterways for irrigation	Insufficient water resources and waterways for agriculture	Shallow waterways, low water retention capacity	Oversupply of agricultural products to market
3	Insufficient water resources for agriculture due to improper water resource development	Illegal loans, debts	Shallow waterways and reservoirs	Poor road conditions, resulting in transportation problems and accidents	Households require the certificate of ownership on their lands	Lack of water resources for agriculture and insufficient irrigation infrastructure, especially waterways and dams	Illegal loans, debts
4		Lack of market management skill and no investment money	Poor road conditions, resulting in transportation problems and accidents, especially during rainy season	Low agricultural yields	Poor road conditions, resulting in transportation problems and accidents	Poor road conditions, resulting in transportation problems and accidents	
5		Lack of careers available for new pundits	Unsatisfactory community water supply systems and lack of raw water	Illegal loans, Debts	Insufficient road networks in agricultural lands	Insufficient power supply to some remote agricultural villages	
6		No sports programs available at technical schools or the undergraduate levels of university		No secondary school and university/college	Low agricultural yields and costly fertilizers		
7		Risk of disease outbreaks		Widespread use of drugs	Illegal loans, debts		
8		Deforestation		Dengue outbreak during rainy season	Lack of investment money for secondary incomes		
9				Power inaccessibility in remote areas	High unemployment rate for new pundits		
10					Widespread use of drugs		
11					Lack of knowledge on issues of public health		

Source: Mukdahan Administration Office (2016)

Chapter 3

Key Issues of Vulnerability to Climate Change and Adaptive Actions

Shared Learning Dialogues (SLD) have been recommended by Thailand Environment Institute (TEI) to access in-depth information on urban systems. This approach had been used in this study to assess climate-change patterns experienced by local people in MSEZ. There were 43 representatives from 24 organizations participating in the SLD which took place on 24 May, 2016. The following is a list of these organizations in attendance:

1. Kwan Yai District Office
2. The Association of Tourism Industry, Mukdahan
3. Office of Tourism and Sports, Mukdahan
4. Office of Agriculture, Mukdahan
5. The Federation of Industries, Mukdahan
6. Office of Treasury, Mukdahan
7. Office of Labor, Mukdahan
8. Huay Khee Lover Group
9. Office of Natural Resources and Environment, Mukdahan
10. Office of Transportation, Mukdahan
11. Office of Energy, Mukdahan
12. Office of Meteorological Department, Mukdahan
13. Office of Commerce, Mukdahan
14. Chamber of Commerce, Mukdahan
15. Mukdahan Industrial Office, Mukdahan
16. Natural Resources and Environmental Protection Volunteer, Muang Mukdahan District, Mukdahan
17. District-Chief Officer (Muang Mukdahan)
18. Provincial Administration Organization
19. Office of Local Administration Promotion, Mukdahan
20. Phu Pha Tupe National Park, Mukdahan
21. Forestry Cooperative Center, Mukdahan
22. Provincial Water Work Authority, Mukdahan
23. Office of Public Works and Town Planning, Mukdahan
24. Mukdahan Media Presses

From the SLD, participants described and forecasted climate change patterns as summarized in Table 6. The public opinion was well in agreement with the results obtained from long-term meteorological data analysis. Linear regression analysis (shown in Figure 15) reveals significant ($p < 0.05$) declines in number of rainy days in the early summer monsoon (March and May); whereas there is an increase in rainy days in winter season (January). Air temperature during monsoon season also tends to be warmer. Minimum temperature is increasing in May, June and November and maximum temperature is also increasing in June and July. Strong winds are subject to be found anywhere between the months of January and September. Furthermore, from the study of International Centre for Environmental Management (ICEM), shown in Figure 16, on changes in hydrological pattern associated with the projected climate change in the Lower Mekong River, the result shows relatively increasing water level and flow rate of the Mekong River at Mukdahan station due to the impact of climate change (ICEM, 2016). These findings

could imply that climate and hydrological change in MSEZ are developing and its impacts potentially exacerbate in the future.



Figure 14 Mukdahan SLD in 24th May, 2016

Table 6 Summary on Climate change patterns from the SLD

Past (30 year ago)	Current	Future (30 year ago)
<ul style="list-style-type: none"> Season changed periodically with predictable pattern Hydrological pattern of the Mekong River periodically changed with predictable pattern Summer: could live with air conditioning Rainy: flooding was experienced repeatedly due to poor drainage system 	<ul style="list-style-type: none"> Season shift and the Mekong River's hydrological changes are unpredictable Summer: unbearable heat, severe summer storms Winter: short-term, found with rainy and warm days Rainy: unpredictable, severe winter storms 	More severe weather

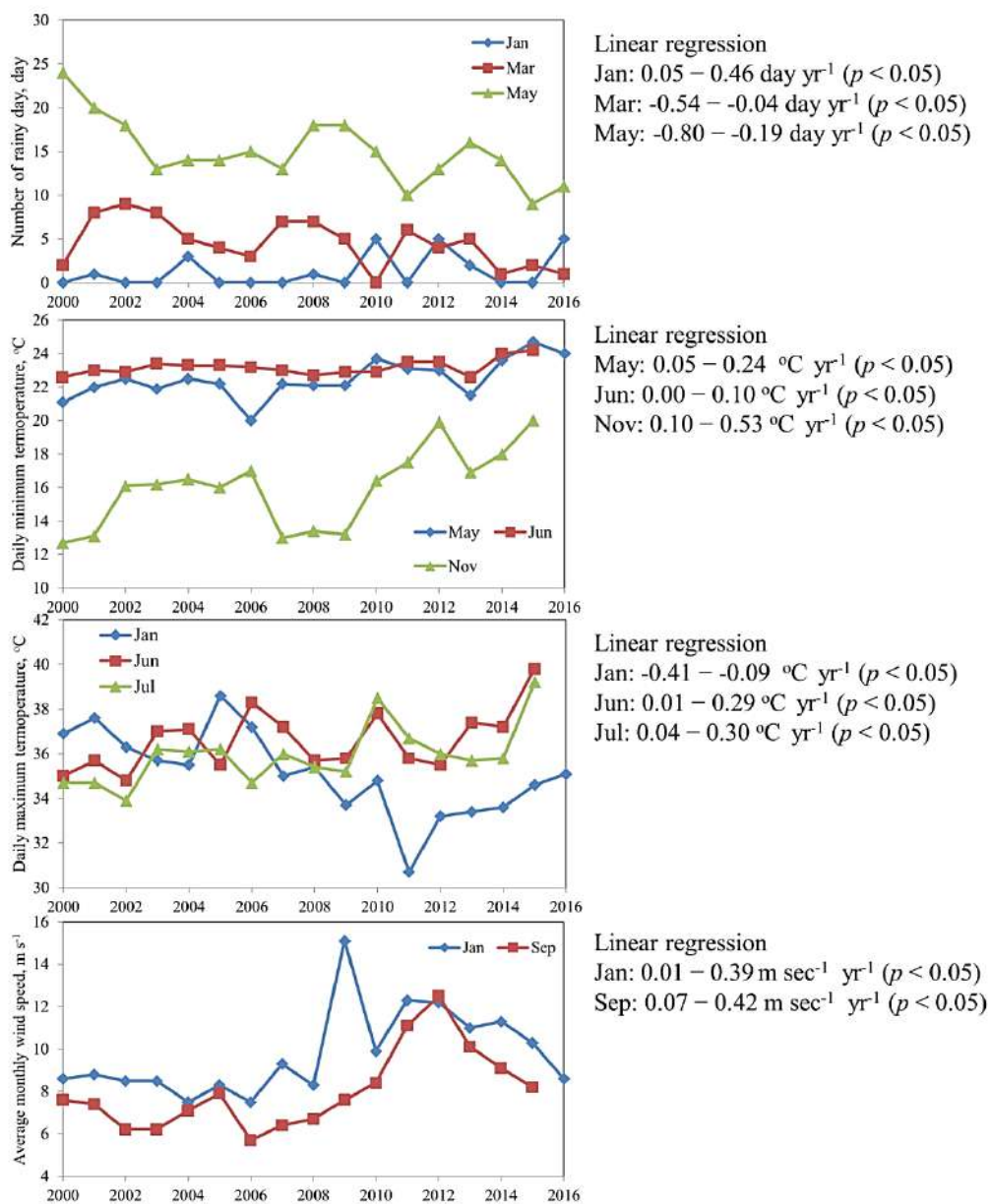


Figure 15 Significant linear regression of monthly meteorology from years 2000 to 2016

Source: Meteorological data acquired from Thailand Meteorological Department

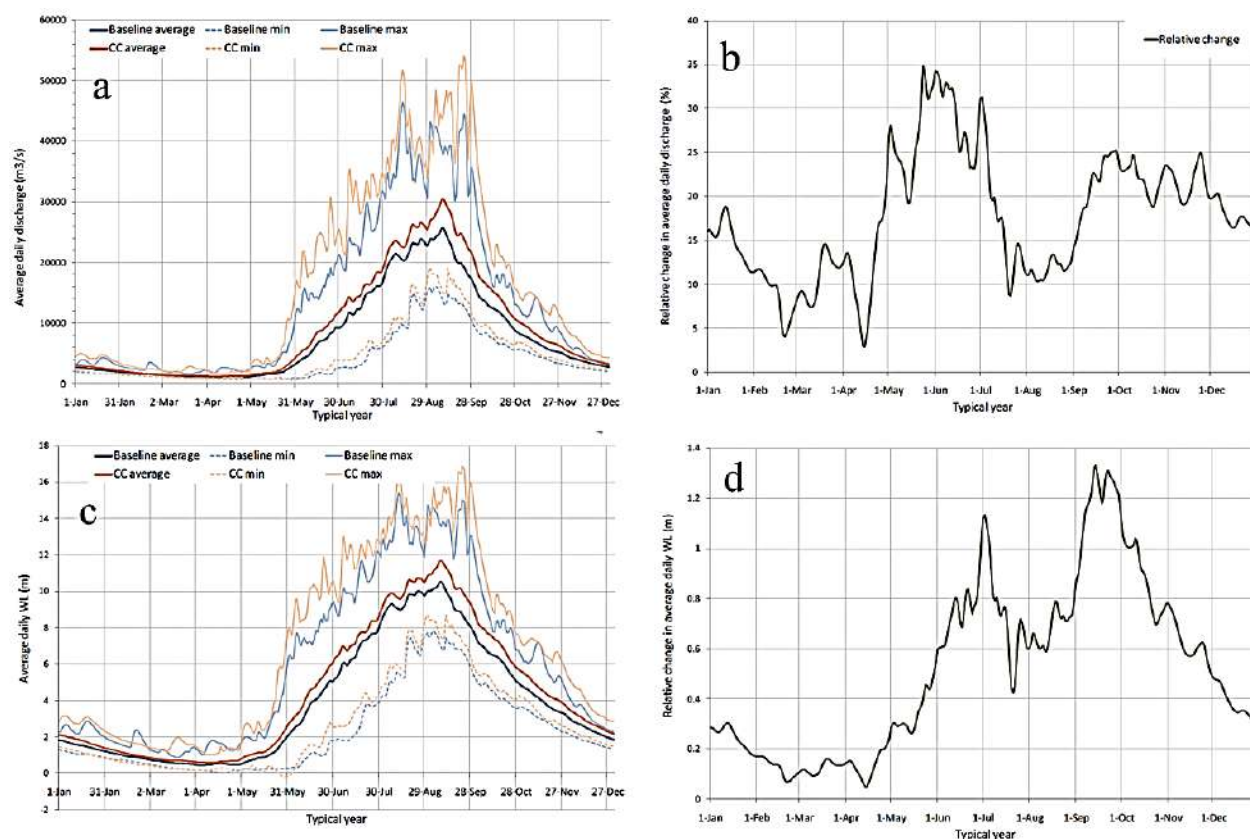


Figure 16 Hydrological changes associated with climate change (CC) in average daily discharge (a) and water level (c) in the Lower Mekong River at Mukdahan station and their relative changes (b and d, respectively)

Source: ICEM (2016)

Potential issues of vulnerability and their associated levels of significance and severity were discussed among SLD participants. Key issues of vulnerability to climate change were assessed using a score-based analysis. The levels of significance and severity each range from 0 (low) to 10 (high), judged by the agreement of all group members. Both current severity and future severity were estimated. The scores were then estimated by multiplying the level of significance with the level of severity. Key issues of vulnerability were chosen from those exhibiting high significance and severity. Based on this assessment, a list of the key issues of vulnerability obtained from three SLD groups is detailed in the following Table 7. In summary, three key issues of vulnerability were agreed upon the SLD groups, which are 1) deforestation and forest land conversion, 2) outspreads of drug use and related crime, 3) degraded water ecosystems and insufficient raw water during dry season.

Table 7 Matrix on significance and severity of potential issues of vulnerability in MSEZ

Potential issues of vulnerability	Significance (10)	Current severity (10)	Future severity under climate changes(10)	Significance × Current severity (100)	Significance × Future severity (100)
SLD Group 1					
1. Shallow natural waterways due to estate development	10	10	10	100	100
2. Degraded water quality due to toxic substance contamination	10	10	10	100	100
3. Deforestation	10	10	10	100	100
4. Outspread of drug use, especially in labor sector	10	10	10	100	100
5. Burglary	10	8	10	80	100
6. Chemical contamination in ecosystem	10	10	10	100	100
7. Insufficient traffic volume	8	8	10	64	80
8. Flooding due to poor drainage system	8	8	8	64	64
9. Poor road conditions	5	5	7	25	35
10. Reduced agricultural areas due to conversion to community area	8	8	10	64	80
11. Poor waste collection system	10	8	9	80	90
12. No space for landfill extension	10	5	9	50	90
13. Construction works block waterways	8	8	10	64	80
14. Odor problem from industries	5	5	7	25	35
15. Noise pollution from night clubs	5	5	5	25	25
16. Relocation in search of higher education	8	5	5	40	40
17. Poor traffic light system	7	7	8	35	56
SLD Group 2					
1. Insufficient water for agriculture	10	5	8	50	80
2. Deforestation, Forest conversion	10	7	8	70	80
3. Crime relating to influxes of alien laborers	8	4	8	32	64
SLD Group 3					
1. Traffic jam	10	6	8	60	80
2. Solid waste overload	10	6	8	60	80
3. Crime/Increased drug use	10	7	8	70	80
4. Rising land price	10	5	10	50	100
5. High market competition	10	8	10	80	100
6. High living cost/ Debt	10	10	10	100	100

Participants were further consulted on current actions, obstacles and expected actions in responding to these key issues of vulnerability. The details are described in Table 8.

Table 8 Summary on current actions, obstacles and recommendations of future works for the key issues of vulnerability

Issues of Vulnerability	Present actions	Obstacles	What to do?
Deforestation and Forest land conversion	<p>Various agencies (including Office of Public Works and Town Planning and Office of Labor) arrange tree planting campaigns to raise public awareness for natural conservation and improve public landscape</p> <p>People sector (Huay Khee Lover Group~10 participants): arrange conservation campaign for Yang trees (<i>Dipterocarpus alatus</i> Roxb.) along the Mekong River, focusing on those trees in temples (Wat Pa Suthathum, Wat Sripatham, Wat Sriboonreang)</p> <p>Department of Natural Resources and Environment: Work on community forests (30% success). Current actions are:</p> <ul style="list-style-type: none"> • Prescribed burning in the protected zone • Building check dams • Arranging Youth camp to raising natural conservation awareness • Assessment of economical values from the forests • Arranging forest patrol team • Collecting database of community forests <p>These activities are focusing on community involvement. Pu Kwang community receives Green Globe award and Pu Mark Khet receives both Green Globe award and Chang Sam Sean award.</p> <p>Department of Forest: Focusing on public involvement. Current actions are:</p> <ul style="list-style-type: none"> • Setting up a group of forest guardians from local volunteers • Disseminate forest information to villagers • Raise awareness to youth in local schools • Promote tree planting projects • Promote sufficient economy practices • Enforce Laws and Regulations 	<p>Many trees die due to insufficient water during dry season.</p> <p>Lack of supporting budget</p> <p>Lack of volunteers</p> <p>Limited agricultural lands for all villagers resulting to forest conversion into agricultural lands</p>	<p>Ask land owner to taking care of planted tree</p> <p>Publicize for more number of participants</p> <p>Join with public health agencies to monitoring water quality</p> <p>Clarify the boundaries of the conservation zone</p> <p>Raise public awareness towards their community's forests</p> <p>Focusing on public involvement</p>
Drug and crime	<p>People sector: Arranging Dharma courses for people in jail, as it has been found that 90% of poisoners are using or addicted to drugs.</p> <p>Local administration sector: Setting up youth camp for spreading information of drugs to targeted youths.</p>	<p>Lack of public attention</p> <p>Long boundary to Mekong River facilitating the spread of illegal transboundary drug trade</p>	<p>Regulation enforcement (hard power)</p> <p>Raise public awareness (soft power)</p>

Issues of Vulnerability	Present actions	Obstacles	What to do?
	Police: Setting up drug check points along the main roads.	from Lao PDR	Strengthen social institutes. Establish rehabilitation center for drug users.
Degraded water ecosystems and insufficient raw water in dry season	<p>People sector (Huay Khee Canal Lover Group~10 participants)</p> <ol style="list-style-type: none"> 1. Monitoring along Huay Khee Canal 2. Arranging multiple events to raise public participations (currently 3 communities joined) 3. Regularly monitoring water health by collaborating with Community College <p>Public Health – Environment Program</p> <ul style="list-style-type: none"> • Monitoring qualities of natural water and tap water to use as baseline for MSEZ <p>Public Health – Occupational Medicine program</p> <ul style="list-style-type: none"> • Collaboration among various industrial sectors to monitor environmental systems <p>Office of Water Resource: Studying effects of Chaiyaburi Dam to Mekong River watershed ecosystem (led by Kasetsart University)</p> <p>Office of Natural Resources and Environment Region 4 (Ubonratchathani): Monitoring water quality at 5 sites, which are 1) the Mekong River, 2) Huay Muk, 3) Huay Bung Hee, 4) Huay Bang Sai, 5) Huay Cha Node. Parameters used in monitoring are BOD, COD, Coliform bacteria, Heavy Metals.</p> <p>Office of Public Works and Town Planning enforces regulations relating to the constructions along the River (control buffer zone)</p> <p>Dredging waterways</p>	<p>Piggery farm releases wastewater to small streams, resulting in dead fishes</p> <p>Eucalyptus plantation causes degraded ecosystem</p> <p>Ineffective regulation enforcement in Public Works and Town & Country Planning</p> <p>Cutting down trees for dredging</p>	<p>Encourage communities involvement in the building and maintenance of check dams along the local streams for used in agriculture</p> <p>Raise public awareness</p> <p>Collect waste tax</p> <p>Arrange Pre- and Post-water quality databases</p> <p>Disseminate actual and accurate information on ecosystem degradation to the public</p> <p>Monitor water quality along Mekong River</p> <p>Research on the effects of Eucalyptus tree on soil quality</p>

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Appendices

- In-depth interview
- SLD gallery



Faculty of Environment and Resource Studies

Mahasarakham University Thailand

A Premier Academy for ASEAN Environmental Professionals

Briefing Note: Thailand UCRSEA Project Year 2, Mukdahan Province

WHEN: 17th March 2016

WHERE: Mukdahan Provincial Industrial Office

WHO: Mr. Kusol Punwaraporn คุณกุศล พูวกรณ์กุล, puwise@gmail.com

Summary

1) What are the progresses/expectations/constraints of the planned Mukdahan Special Economic Zone (MSEZ)?

Current situation

Mukdahan is not industrial but since the establishment of the 2nd Thai-Laos friendship bridge rather service oriented, such as in tourism sector, health care, education and commerce. These sectors cover about 60 percent of the Gross Provincial Product (GPP), followed by the agricultural sector with 20 percent of the GPP (primarily sugarcane, rice, Para rubber and livestock) and the industrial sector with 8 percent of the GPP. After the opening of the bridge in 2007, the GPP increased by 15 percent.

The Sawan-Seno SEZ in Lao PDR already attracted many industrial investors but require raw materials, machines as well as skilled labor from Thailand. With more than one million people, the city Sawannakhet, has a high consumption demand, mainly on produces and products from Mukdahan. For instance, when the Thai wholesale store “Makro” was established in Mukdahan and the business was able to pay back the credit within its first year of operation. More department stores from Bangkok are expected to follow soon.

The imported products from Sawan-Seno SEZ pass the Mukdahan checkpoint and are further distributed to the international market through the Leam Chabung seaport in Eastern Thailand. However, under this current situation, Mukdahan barely takes any economic advantages from being the international gateway.



Figure 1: The 2nd Thai-Lao friendship bridge between Mukdahan, Thailand and Sawannakhet, Lao PDR

Expectations

Mukdahan's industrial development is expected to move towards green production which is less-labor intensive and based on local-material and small/medium-size industries, including medical capsule production from high-grade starch, carton production, serving industries in Sawan-Seno SEZ and OTOP production. Hence, electronic goods production seems to be less feasible in Mukdahan as the local demands, needs and capacities are different. The Department of Industrial Work is currently working on a feasibility study on the concept of Mukdahan as an "Eco-Industrial Town", aiming at the promotion of industries with level-II and-III green production certificates.

Mukdahan is currently exporting agricultural products, such as high-grade jasmine rice, to Lao PDR and Vietnam. It is expected, however, that Mukdahan will attract more new markets, for instance Southern China.

Due to disagreements between the central government and the municipality of Mukdahan regarding the MSEZ and its plan, the Industrial Estate Department moved the implementation of the MSEZ from phase I to phase II in the national SEZ development plan but is still welcoming potential investors for the whole area of the 1,085 rai at Kamarkuan sub-district, Muang district. The negotiations still need to be finalized.

Constraints

1. Different international trading regulations: Transporters from Thailand are not allowed to pass through the Vietnamese border to reach the pier in order to distribute their products to Southern China. Furthermore, tax policies in China vary from province-to-province as provincial governors are authorized to develop their own international tax regulation.
2. The Board of Investment (BOI) provides a loan to attract industries to develop new products and access new markets. This incentive, however, is not competitive with GSP rights from USA and EU given to Lao PDR.
3. Mukdahan has only limited skilled labor forces: The Department of Labor in Mukdahan is currently in cooperation with entrepreneurs from the industrial sector developing an unemployment database, aiming to train skilled labor that should serve the industries in Mukdahan and Sawannakhet.
4. The water supply for the current industrial production for cassava starch and rubber is insufficient: The water from the Huey Muk River which empties into the Mekong River in the wet season cannot be retained for industrial consumption during the dry season as there is no water gate to store the needed supply. Since the Mekong River is a regional river, crossing several countries, any decision on further water projects for both the Mekong River and its tributaries have to be agreed among all affected Mekong countries. Furthermore, there is no problem to handle the wastewater from the industries as there is a plant to treat wastewater in Mukdahan.
5. Rapid real estate property price increases: Since the planning of the MSEZ, land prices in Mukdahan province have increased tenfold. This could be a major obstacle to promote Mukdahan as a national logistic hub.

2) Do you see problems in attracting investors?

According to Mr. Kusol it is difficult to attract investors as there is high lack of skilled labor and raw water for production as well as high land prices, high minimum wages and no Free Trade Agreement (FTA) incentives for less developed countries. In view of these problems, the MSEZ will be less attractive for heavy industries.

- 3) What the development initiatives have already been undertaken, supporting the MSEZ as well as the EWEC?
 - Four 4-lane land roads are currently under construction;
 - Public transportation services have been expanded between Mukdahan and nearby cities;
 - The establishment of an airport in Mukdahan is in process of planning;
 - Twin rail roads from Ban Phai to Nakhon Panom, passing through Mukdahan are currently in process of planning;
 - 1,085- rai investment zone has already been selected and under developing.

If the planned transportation expansions in Mukdahan are well accomplished, the number of tourists is expected to increase as well as the expansion of border trade.

When the MSEZ plan was initiated, the small international checkpoint custom in Mukdahan was closed and only one custom was kept open at the 2nd Thai-Laos friendship bridge to prevent influxes of drug and terrorism. Through this security measure it is easier for Chinese tourists to cross the Lao border to enter Thailand.

4) What concerns raise Mukdahan's citizens towards the establishment of the MSEZ?

Many impoverished villagers are afraid to lose their land for the establishment of the MSEZ. Mr. Kusol believes that they do not fully realize the profits they could gain through the new industry and stand pad towards the MSEZ.

5) What impact will the Sawan-Seno SEZ in neighboring Laos have on MSEZ?

The Sawan-Seno SEZ is expected to be competing with the MSEZ on the consumption of raw material, skilled labor and machines. These resources are limited and Sawan-Seno SEZ is currently importing these resources from Thailand.

Positive for Thailand, however, could be a developed interest of the Sawan-Seno SEZ to distribute their products, such as gold, sulfuric acid and machines, to the international market via the Thai deep-water seaport, Leam Chabung and Bangkok port, in order to ship it directly to countries such as China.

6) Which urgent improvements need to be undertaken to improve the MSEZ?

- Infrastructure (transportation system);
- People (in skills and number);
- Databases on skill requirements and job availabilities;

7) In which way is the aspect of climate change and climate change resilience integrated into the MSEZ plan?

Mukdahan has never experienced serious droughts and floods since the establishment of the Chinese dams. Drought is also not a major problem for Mukdahan as the province is located close to the lower Mekong River where the Huay Muk River empties into the Mekong River. The municipality and its citizens of Mukdahan are also not concerned about climate change impacts. However, the people in Mukdahan could feel in the past ten years that the temperature increased by 2° C and fluctuated in winter, and that the air became noticeable drier. Deforestation in China and Vietnam could be responsible for these climate changes implications in Mukdahan although deforestation in Mukdahan is not relevant.

In order to correspond with the national strategies on climate change and adaptation, MSEZ plans to develop the concept of an "Eco Industrial Town".

To reduce the environmental implications from the MSEZ, the municipality is planning to build a waste-to-energy plant for solid waste and industrial waste, and a new water treatment plant using raw water from the Mekong River. The Electricity Generation Authority of Thailand (EGAT) has guaranteed sufficient energy supply for the expected consumption of the MSEZ.

8) What implications in relation to urbanization are expected through the MSEZ?

Present city	Next 10+ years
GDP ~10+% per year	Transport expansion: Airport and high-speed train
1 ring road	Trading center
	Medical hub
	Educational institution
	Aging society
	Digital city
	Increase in tourism
	3 ring roads within 5 years

9) What implications in relation to land use planning are expected through the MSEZ?

- More new buildings with modern architecture;
- Land use changes for agricultural lands and establish resorts;
- Increase of green space areas due to enforcement of land use policy;

10) How will the MSEZ create further vulnerabilities to systems, agents and institutions?

Agents SMEs, including OTOP, could be vulnerable to MSEZ due to higher competition;

Systems People may not be fully adapted to market expansion;

Institution No problem as the provincial industrial development plan can be well adapted to the MSEZ;

- 11) What other activities/ programs did the city conduct so far or is planning in order to address climate change adaptation and/or mitigation?

Mukdahan conducted several “green activities”, such as the river side walk or bike lane, in order to promote public health and tourism but not to tackle climate change impacts. The people in Mukdahan do not realize that climate change could have significant impacts on their livelihoods.



Figure 2: Meeting between the UCRSEA MSU working team and Khun Kusol at the Mukdahan Provincial Industrial Office



Faculty of Environment and Resource Studies

Mahasarakham University Thailand

A Premier Academy for ASEAN Environmental Professionals

Briefing Note: Thailand UCRSEA Project Year 2, Mukdahan Province

WHEN: 18th March 2016

WHERE: Office of Natural Resources and Environment, Mukdahan

WHO: Director: Mr. Paiboon Ratanajarntham คุณไพบูรณ์ รัตนเจริญธรรม

Summary

The Mukdahan provincial development strategies are focusing on tourism and cultural preservation, agriculture and natural resources. Currently all institutions spend individually their budget to accomplish the goals but lack in adequate governance. The databases on water budget are collected individually as the city has no data collection center or geo-information center. Every year, the government will spend ten to 20 million baht to dredge the Huey Muk tributary. The Office of Natural Resource and Environment also plans to build multiple small check dams along the Huey Muk tributary. To assess the effectiveness of this plan long-term monitoring is required.

Present city	Next 10+ years
Serene city with no night life.	More people from multiple cultures and countries will move into the city. Local people will be pushed into poverty and live off-town because they had to sell their land. There will be more superstores, malls and 24-hour businesses.

Currently, the Office of Natural Resources and Environment is conducting in collaborating with local universities an EIA for 15 industries and the planned infrastructure expansion.

According to Mr. Paiboon the problems associated with the MSEZ are the solid waste management. Solid waste problem is not a priority issue to gain national attention. The supporting budget for the solid waste management that is allocated from the provincial revenue is only limited and currently spent on the establishment of a waste segregation plant and a backhoe. Out of 137 tons, only 70 tons of daily waste generation could be managed properly. What is the municipality's capacity on the understanding of climate change and climate change resilience?

The government officers in Mukdahan have not realized the significant impacts of climate change and the issue is only poorly integrated into activities that could raise Mukdahan's citizens' awareness. This could be mainly due to extra workload. However, there are many Non-Governmental Organizations (NGOs) in Mukdahan that raise public awareness on environment and nature conservation.

Which current climate impacts can you identify that have major implications to urban systems?

Mukdahan has never announced drought as a disaster. Climate change in Mukdahan can be described through the amount of available budget for water supply during dry season. According to Mr. Paiboon, climate change rather affects the ecological system than the people. In some areas, Mukdahan's water quality is only poor due to contamination from the rubber plantation and livestock farming.

Which agents do you see as vulnerable to climate change impacts?

- Households are not considered as vulnerable.
- Agricultural and industrial sectors could be vulnerable due to limited water supply during dry season, however, the city is confident to be able to adapt.

Water resource in Mukdahan is actually sufficient but there is no water gate on the Huey Muk tributary to retain water in dry season. The budget for water gate construction is approximately 100+ M baht.

Is there a city vision for climate resilience and/or are there any specific targets defined?

Previously the provincial office of Natural Resource and Environment has only a budget of less than one million baht a year available. Currently, the Mukdahan governor is setting up strategies to preserve natural resources and conserve water resources. In the first quarter of 2016, the province has allocated a budget of 11.6 million baht for the construction of a check dam along the Huey Muk tributary and for reforestation around the Huey Muk water origin, aiming at an increase of 33% to 40%. The implementation of the proposed plan is, however, humbled by lack of

public awareness and lack of human resources for long-term assessment. Moreover, the water resource conservation has only second priority while the transportation system is the major focus.



Figure 1: Meeting between the UCRSEA MSU working team and Khun Paiboon at the Office of Natural Resource and Environment, Mukdahan

SLD meeting in May 24th, 2016

