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Environmental Impact of Solid Wastes Generated from Land use Change in Highland Tourism : A case study of Pai District, Mae Hong Son province

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Abstract

Increasing amount of solid wastes due to land use change has been resulted by the intensive tourism services in Pai District, Mae Hong Son Province. It has consequently affected the ecosystem, especially in the highland area, where are natural tourist attractions. The aims of this study are: (1) to assess the environmental impact of the solid wastes generated from the generated point as well as from the disposal point, and (2) to assess the environmental impact of land use change for tourism sites in mountain areas or tourist attraction highlands, using the Geographic Information System (GIS). GIS is an assessment tool for land use planning in accordance with sustainable urban development. The study results presented that 6.07 tons/day being the amount of wastes generated by tourists of urban areas. An average of 52.25 kg/sampling spot/day generated from various hotel sizes, while an average of 66.63 kg/sampling spot/day generated from the tourist sites. There were 32 wastes disposal points, using the Trench Method, Open dump and Open burning where are spatially distributed at different areas and at different heights. Many areas are classified as sensitive areas, contamination risk areas, spreading to other nearby areas. Conclusively, if wastes management is in conformance with land use planning, legally wastes disposal to the right spots with academic performing, it would be possible to minimize the environmental impact possibly occurred in the short and long term. This could also lead to urban planning that promotes tourism while maintaining a balanced environmental and ecological status.

Keywords : Highland tourism attractions; Solid wastes; Environmental impact; Land use

Introduction

Tourism is considered as service industry, consisting of hotels, resorts, travel agencies, restaurants, shops and currency exchange businesses that are continuously growing, constituting an important source of income for many countries [1]. When tourism occurs in any area, especially if it attracts heavy tourist traffic, the amount of solid wastes will increase rapidly [2]. Such wastes have a negative impact on humans and on the environment [3]. When tourism occurs at the mountains, such as the highland adventures, there are difficulties in managing the environmental impact. Spatial management is therefore an important factor in solving environmental problems [4]. The problem has begun to intensify.Consequently, there have been studies of wastes management models, predicable systems and future trend estimation of wastes, and network collaboration, which can lead to creating strategies related to wastes management in each area [5]. Mountain tourism areas or highland tourism have been experiencing problems in management of wastes from tourism or various related activities. In particular, such establishments often dispose of wastes by the Open dump method, resulting in direct and indirect water pollution in the environment [6]. Popular activities for tourists in mountain areas or during highland tourism are trekking, mountain climbing and camping. Most of these activities cause pollution in various ways, such as water pollution and soil pollution. The most obvious thing about tourism is the occurrence of wastes. At present, several studies investigate the impact of wastes generated from various sources. There have also been modern and accurate technological developments for measuring pollution. For example, Geographic Information System (GIS) is one tool that can be used for assessing the environmental impact along with mapping and mathematical models; for example, a study by Davide (2009) using GIS to study wastes disposal and its location in the Ladakh region in India found that dumping directly affects surface water and groundwater [7]. Using Spatial Autoregression (SAR), Geographically Weighted Regression (GWR), or Ordinary Least Squares Regression (OLSR) with spatial data from local to national levels assists in the analysis and assessment of the problem of wastes, for the purpose of policy formulation [8]. In addition, the application of indicators is one of the tools that has received attention, because it is a tool for analysing spatial data and works well on mountains, in cities, local areas, and beaches; it is called the ISOST index. There are interesting environmental indicators such as energy consumption, utilisation, wastes generation, utilisation area and distribution of tourist spots, which may affect the environment [9]. There are other tools also which help to assess the environmental impact caused by the increasing number of tourists in an area, such as assessment of the environmental impact that may occur from tourism, in order to protect the Natural Protected Areas (NPA) or areas with specific characteristics landscape (Protected Landscape)using the method of impact tourism, the Tourism Impact Assessment (TIA) from the activities of tourists.Evaluated results prove that the number of tourists who have stayed overnight in urban areas that have the infrastructure, accommodation and services with high growth rates directly affect the environment [10, 11]. In addition to other activity forms according to tourists' preferences, it is important to identify increase in certain types of wastes that come from purchasing goods and services as well as staying in hotels [12]. Apart from the satisfaction from tourism activities, it is also found that tourists, especially foreign tourists, have a positive attitude towards the environment, as do the people who own the area and resources [13]. Due to the increasing popularity of ecotourism, in the years 2011-2012

the Ministry of Tourism has begun to implement policies to attract tourists and promote tourism that is environmental friendly [14]. Later, many tourists travelled to the area and caused a noticeable negative physical change, especially due to the construction of accommodation and services, as well as various establishments that relate to the tourism business [15]. The environment is considered as one of three main points in assessing the carrying capacity of the pollution in an area [16]. The environmental analysis system based on sustainable development consists of 3 groups, which are Initial Environmental Examination : IEE, Environmental Impact Assessment : EIA, and Environmental Health Impact Assessment : EHIA. This analysis show that there are ecological issues that have been considered in the EHIA by taking ecological information together with general plan and land use plan which is one of the ways that economic, social, and environmental issues can be linked [17]. The aims of this research are: 1) assessing the environmental impact of solid wastes at generating point and disposal point, which is the destination; and 2) assessing the environmental impact due to land use of tourism sites at the mountain areas or highlands, by using the Geographic Information System (GIS) as an impact assessment tool.

Material and Methods

1. Study Area

Pai District is 1 of 7 districts in Mae Hong Son Province, covering an area of 2,244.7 square kilometres. It corresponds to the boundary between Thai and Myanmar border, and its territory is adjacent to the neighbor districts as follows: North is bordered by Spin City, Tongki Province, Shan State, Republic of the Union of Myanmar; South, next to Samoeng District Mae Chaem and Kalayaniwattana Districts; East of Chiang Mai, adjacent to Wiang Haeng District Chiang Dao District and Mae Taeng District Chiang Mai Province; West, next to Muang Mae Hong Son District and Pang Mapha District. Mae Hong Son province with a population of 38,786 people (2562 B.E.). Pai District covers 7 sub-districts with 66 villages, including Wiang Tai Sub-district, Wiang Nuea Sub-district, Mae Na Toeng Sub-district, Mae Na Toeng Sub-district, Mae Hi Sub-district, Thung Yao Sub-district Chapin and for Pong.Pai Province lies in the contact zone between the mountainous regions of Laos to the north and the Thongchai Road mountains to the east and south. The average height above sea level ranges from 470 metres to 2,005 metres. There are narrow plains of the Pai River, which have a height above mean sea level of between 470 to 650 metres. The Pai River flows through Mae Hong son province and down into the Sal River. The Win river flowing from Kayah State, Myanmar, has a length of 135 kilometres in Thailand, with water flowing all year round; there are also many branch streams (Figure 1) Pai District has the highest proportion of land use for forestry in 2010, at 2,176.26 sq. Km., representing 95.27 percent of the total area, followed by rice fields 2.6 percent, Shifting cultivation 1.09 percent, 0.54 percent farmland, 0.49 percent urban area, and 0.047 percent fruit trees. When separating land use by sub-district, it is found that Mueang Paeng Sub-district has the highest proportion of land use, which is 509.50 square kilometres or 22.29 percent. The sub-district with the highest proportion of forest area is Mueang Paeng Sub-district, at 494.19 square kilometres, representing 19.03 percent of the total forest area. The sub-district with the highest proportion of urban areas is Mae Hi Sub-district, which is 2.39 square kilometres or 21.2 percent of the total urban area.

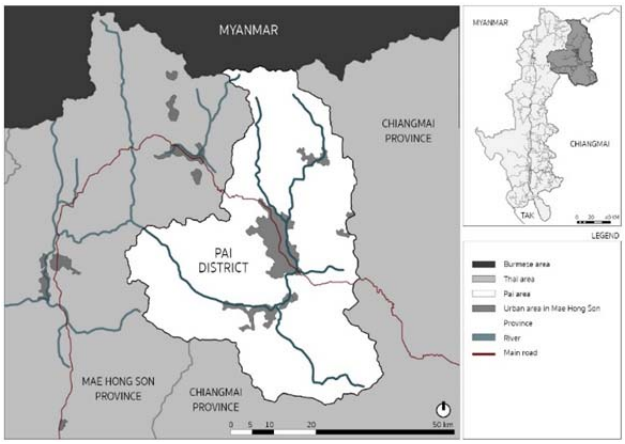

Figure 1 Study area

Determining future utilization area: the country's economic and social systems according to the National Economic and Social Development Plan No. 11 have a transportation network policy to support the expansion of Pai District in the future and promote this district as an ecotourism centre of Mae Hong Son Province. This involves promoting service and tourism activities in the cultural and culture conservation areas as well as supporting the expansion of the commercial area in the centre of the city. Department of Public Works and Town and Country Planning shown the projected improvements in the land use from 7 categories to 13 categories, which are: (1) Reserves for living, (2) Less dense residential areas, (3) Moderately dense residential areas, (4) Commercial areas and very densely residential, (5) Rural and agricultural areas, (6) Rural and agricultural conservation areas, (7) Agricultural land reform areas, (8) Open space for recreation and protecting the environment, (9) Forest conservation areas, (10) Educational institution areas, (11) Conservation areas for the promotion of Thai art and culture, (12) Religious institution areas, and (13) Government institutions, public utilities and utilities with use areas. Later, there were announcements of changes to the content of the ministerial regulations. According to the Government Gazette 2015, the Pai Town Community Plan was enforced in Mae Hong Son province for 5 years in the area of Mae Na Toeng sub-district, Wiang Nuea sub-district, Wiang Tai sub-district, Mae Hi sub-district and Thung Yao sub-district, to guide the development and maintenance of cities and related areas or the rural areas. Land use would be in accordance with the development and maintenance of cities and related areas or rural areas, the use of property, transportation utilities, public service and the environment. One passage states the use areas for hotel construction, because there is a tourism industry in the area.

The beginnings of Pai tourism lay in its use as a trading route in the past and a military route from Chiang Mai to Burma during the Lanna Kingdom. Later, during World War 2 (1939-1945), Japan created a way to transport soldiers from Mae Taeng (Chiang Mai Province) to the Union of Myanmar. This route was developed and improved by the Office of Rural Development in Thailand in 1962 to allow motor vehicles to traveling. In 1977, tourists began to go hiking in Pai. Therefore, the road was developed from Mae Taeng to Mae Hong Son between 1978-1987. Transportation became easier, resulting in tourists arrual for rest and recuperation, and after that the tourism business grew accordingly. From the summary of the situation of tourist stays during the year 2018, Mae

Hong Son had 1,004,967 visitors, with an increase of 0.027 percent, and a tourism revenue of 4,980.71 million baht, an increase of 2.40 percent (Statistical data for tourism, Mae Hong Son Province).

2. Study of waste data and final disposal methods

1) Wastes quantity analysis by weighing wastes from the garbage collection trucks to find the total amount of wastes is divided between 2 areas: (1) urban area, including Pai Sub-district municipality, and (2) outskirts of the city, i.e., the Thung Yao Sub-district Administration Organization. The urban area is a big tourist attraction. Therefore, we managed to save wastes data divided into 2 types, which were hotels and accommodations and tourist attractions which were 4 types: natural tourist attractions, cultural attractions, historical attractions and ecotourism. The wastes weighing was divided into 2 periods, one during the tourist season (Nov-Feb) and the other during the non-tourist season (Mar-Oct), in order to check the different amounts of wastes generated by tourists.

2) Study of the final wastes disposal model was carried out in 8 administrative districts, including 1 Pai Sub-district Municipality and 7 Sub-District Administrative Organizations, by surveying the disposal sites in the area as well as recording geographic coordinates for the study as displayed on the map using GIS.

3. Land use of tourist attractions in mountainous regions or highland tourism

Pai District maps from Satellite imagery interpretations from 2015, Google Earth, together with the Land Development Department's land use map were employed as base maps to show the final wastes disposal sites. The height of the garbage collection point, surface water and groundwater resources are scoped throughout the conservation forest areas and village locations.

4. Environmental Impact Assessment from the interaction of wastes data and land use

All garbage and spatial data were displayed with ArcGis to show the likelyhood of the areas that may be especially affected, in order to lead to the EIA and propose management guidelines.

5. Research tools

This study employed weighing methods to quantify wastes survey data. Data and geographic information systems (GIS) were employed to store geographical coordinates by GPS (Global Positioning System) and the data display program ArcGis.

Results and Discussion

1. Wastes study results

1) Total wastes from the study using the weighing method was equal to 6.07 tons/day (Low Season) and 6.68 tons/day (High Season) in Wiang Tai Sub-district. The total amount of wastes outside the city was 1.90 tons/day in Thung Yao Sub-district.

2) Amount of wastes from urban areas This includes wastes from various sized hotels and the wastes from all 4 types of tourist attractions during the high season and low season. It was found that there was an increase solid wastes from hotels of various sizes in high season during Nov-Feb, although without any statistically significant differences in T-test (T-Value = 1.15 P-Value = 0.34). From the observation, it was seen that 15-30 room hotels' rooms generate the highest quantity of wastes. This showed that hotels of this size were popular with tourists. Therefore, the local authorities in the area should focus on the supervision of medium-sized hotels, in the area of wastes management. (Table 1)

Table 1 Hotel wastes

Hotel size classified by number of rooms	Solid waste (Kg)	
	High Season	Low Season
Less than 15 rooms	47.03	11.30
15-30 rooms	72.34	50.70
More than 30 rooms	37.38	40.60
Average	52.25	34.2

As for wastes from all 4 types of tourist attractions, the amount of increase in the High Season was not statistically significant from the test : T-test (T-Value = 1.04 P-Value = 0.35). However, data show that natural attractions have the highest amount of wastes, and therefore the authorities should first pay attention and promote the wastes management policy in such types of tourist destinations. (Table 2)

2. Final wastes management model

As for the final form of wastes management in all 8 areas, almost all are open dump and open burning. Only Pai Sub-district Municipality uses the Trench Method. However, it still lacks a complete waterproofing system Therefore, the wastes may leak out into natural resources. The most common problem is that open dumping lacks writing systematically because of the conditions in hilly area. Therefore, there may be a problem of washing the garbage in the rainy season, resulting in soil and water pollution and also the probability of wastes entering the agricultural areas. (Table 3) Open burning will cause a lot of problems during January-February, because the fumes from the burning will not rise and instead will fall into the basin, causing the problem of burning haze, which has adverse effects on health. (Figure 2)

In addition, for other departments in the study area such as Pai Hospital located in the municipal area of Wiang Tai Sub-district, there was a form of wastes management which can be divided into general wastes and hazardous wastes, i.e., infectious wastes. There was general wastes being sent to the community for disposal in the municipal area. Infectious wastes was disposed by the legal private company. Although the hospital has a wastes incinerator to eliminate infectious wastes, as it is located in the centre of the community it is not possible to use the incinerator and it is currently inactive. Huai Nam Dang National Park is a popular tourist destination with wastes management systems where valuable wastes was separated first and wastes disposal is done by incinerator.

3. Some types of land use in Pai District

Although the garbage disposal model is similar in each area, but the distribution characteristics of wastes collection points in each sub-district might have differences in area height and community proximity. One problem occurred regularly in the area is that junk cars cannot reach the disposal point in the rainy season due to road surface problems. From the geographic coordinates of the total 32 collection points in the area, it was found that the highest wastes collection point is Huai Nam Dang National Park With a height of 1,649 metres above sea level, where as the lowest is Ban Huai Bon, which is in the administrative district of Muang Pang Sub-district, at a height of 436 metres above sea level. In order to see the relationship of some important land use in the area of Pai District.

Table 2 Amount of wastes from all 4 types of tourist attractions

Type of tourist attraction	Solid waste (Kg)	
	High Season	Low Season
Natural attractions	110.20	84.23
Cultural attractions	86.73	22.13
Historical sites	37.83	40.60
Ecotourism	31.77	19.17
average	66.63	37.18

Table 3 Final wastes management model

Area	The final form of disposal waste	Issues
Pai Sub-district Municipality	Trench Method	No waterproofing system
Wiang Tai Sub-district	Open Dump, Open Burning	There is only one disposal site
Wiang Nuea Sub-district	Open Dump, Open Burning	There is only one disposal site
Mae Hi Sub-district	Open Dump	There is only one disposal site
Mae Na Toeng Sub-district	Open Dump, Open Burning	Many places scattered in the village area
Thung Yao Sub-district	Open Dump, Open Burning	There is only one disposal site
Mueang Pang Sub-District	Open Dump, Open Burning	There is only one disposal site
Pongsa Sub-district	Open Dump, Open Burning	There is only one disposal site

Figure 2 Various methods of wastes disposal

1) Characteristics of community housing distribution

Figure 3 shows the distribution of housing in various communities in Pai District. Community distribution follows the same pattern as the layout of water resources. There will be only some areas that are far away from water sources because water is a natural resource that is vital to life and is important for agricultural activities.

2) Characteristics of surface water sources and groundwater sources

The nature of the upstream area affects the surface water flow and the location of the groundwater. Figure 4 shows the direction of water flow from the upstream area to the Pai River and shows the location of groundwater sources. As mentioned previously, human settlement is closely tied to water

sources, and so the map positioning with the ArcGis can show the likelihood of a particular area being affected by the wastes.

3) Scope of natural forest area

The green colour in Figure 5 shows the natural forest areas and the forest areas. From the statistics of the Royal Forest Department for 2015, Mae Hong Son Province has a total forest area of 11,103.93 square kilometres or 6,939,953.28 rai, which is 86.99 percent of the total area. The province consists of national forest reserves and a permanent forest zone. According to the resolution of the Cabinet in 1966, the national park, wildlife sanctuary, forest park and arboretum were established in the Pai Basin wildlife sanctuary in the area of Mae Na Toeng sub-district, Thung Yao sub-district, Wiang Tai sub-district, Mueang Paeng sub-district, Pai District, Som Pong sub-district, Tham Lod sub-district, Pang Mapha sub-district, Na Pu Pom sub-district, Pang Mapha District, Pang Mu sub-district, Huai Pha sub-district, Mok Champae sub-district, Mueang District and Mae Hong Son Province cover an area of 738,195 rai or 1,181 square kilometers.

4. Environmental impact assessment

Information related to land use characteristics is mentioned in section 3.3 once overlapped with the disposal point, the possibility of contamination or impact on surface water and groundwater resources might be considered, causing the spread of pollution to other areas which are unavoidably close, both directly and indirectly. The scope of the final stage of wastes management points has been spatially distributed in various parts of the study area. There are different elevations from the sea level and there is an EIA from various points of origin at a radius of 10 kilometres from the source. Some points have a radius overlay, indicating that the area being affected by neighbor sources, (Figure 6) depending on other factors related to the promotion of fragmentation or the increased severity of effects. Therefore, if wastes management is ineffective, it will have a widespread impact. The area within the radius is an area where a public awareness campaign should be carried out. In particular, communities that are isolated on the high ground should be cultivated and made aware, not only about managing household wastes but also for preserving the natural resources of upstream forests.

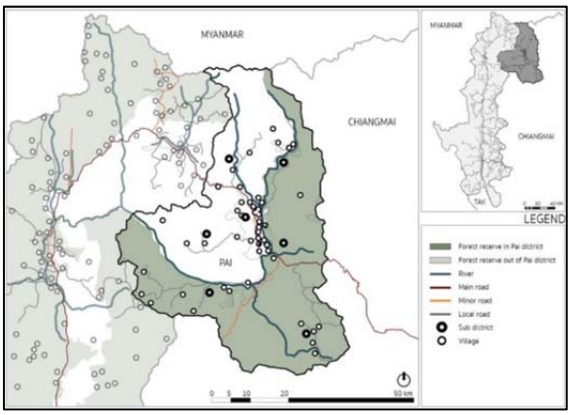

Figure 3 Characteristics of community housing distribution

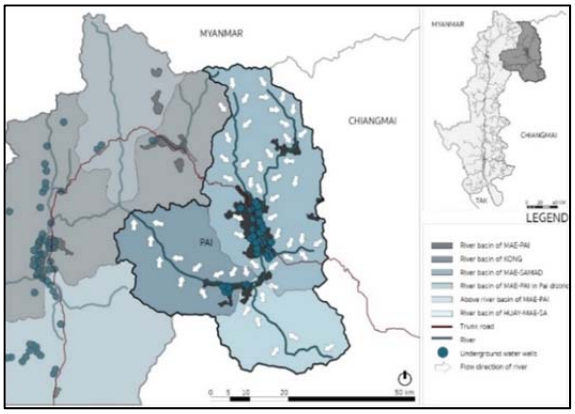

Figure 4 Characteristics of surface water sources and groundwater sources

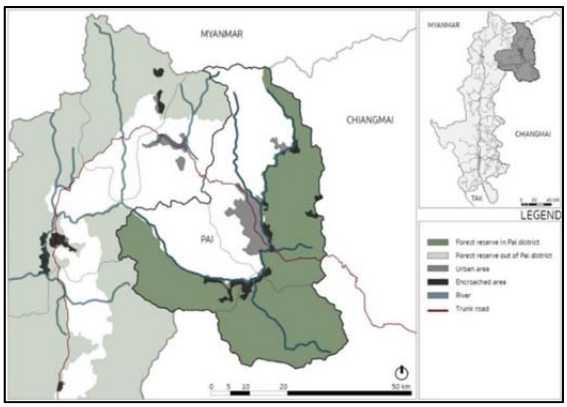

Figure 5 Characteristics of forest boundary

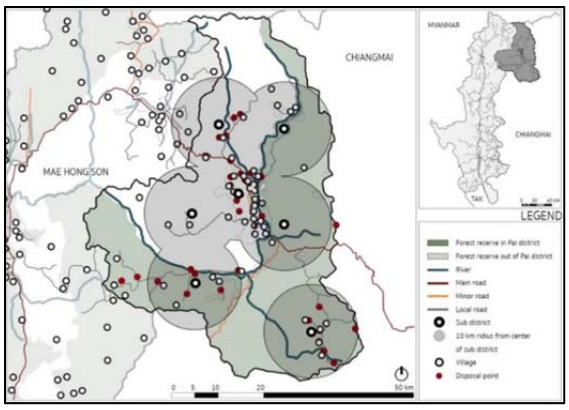

Figure 6 Characteristics of environmental impact from wastes disposal sites

Conclusions

The study results from the environmental impact assessment of the land use plan in the study area show the boundaries of various areas that are a source of pollution and also show the scope of those areas that might be affected. One of the aims of the research is to propose guidelines for sustainably managing wastes from tourism to solve the environmental issues in Pai district at the present and also in the future. These suggestions will be useful for the consideration of the agency in charge at their discretion, they are 1) To stipulate the policy to use areas differently from general area, in the form of special economic zones or specially controlled zones that are able to effectively manage wastes from tourist attractions, and to limit the number of tourists staying in the area, especially in sensitive areas such as national parks and cultural attractions. 2) To support the establishment of a centre for buying recyclable wastes or recyclable junk in the area in the form of private enterprises or with financial support from the government, to stimulate the economy in the community and encourage people to understand and participate in wastes segregation activities. To develop garbage collection areas for separation, such as temporary buildings of separated wastes at high volume disposal points or spaces to engage communities in the wastes separation activities. To acknowledge people and stimulate their responsibility as well as promote sustainable community cooperation such as through a recycling wastes fund, a bank for recycling wastes, or other activities for motivating the community to continuously participate in short and long term activities including regular follow-up and evaluation of activities 3) To encourage local governments to provide suitable wastes disposal areas and to eliminate existing wastes disposal points that may carry the risk of environmental contamination. To determinate the form of wastes management in each area to be consistent in order to preserve the environment of the upstream areas that are important areas of the country. However, the determination of land use in tourist areas needs to be actualised in order to limit the expansion of the hotel business, since it can cause spatial problems and have an environmental impact.

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