SOLID WASTE MANAGEMENT OF TOURIST RESORTS CASE STUDY: ROM FA THAI VILLAGE, TUBTAO SUBDISTRICT, THOENG DISTRICT, CHIANGRAI PROVINCE

PARICHAT THONGBUARUANG

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Parichat Thongbuaruang

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ABSTRACT

Phu Chi Fa National Park is famous tourist attraction of Chiangrai province to which, during 1999, 2,000-3,000 person/day traveled during high season and stayed in the resorts in Rom Fa Thai and Rom Fa Thong Villages. Rom Fa Thai Village has capacity to receive the tourist about 1,043 person/year, but it has solid waste management problems. The propose of this research was to study the generation rate and the characteristics and composition of solid waste from seven resorts and one restaurant in order to use these data for solid waste management of tourist resorts in Rom Fa Thai Village. The study was conducted during two periods: high season from 31 December, 2001 to 6 January, 2002 and low season from 12 to18 April, 2002. This study indicated that the solid waste generation rate of tourist resorts and restaurants was 0.06 kg/person/day and 0.04 kg/person/day, respectively during high season and 0.04 kg/person/day and 0.05 kg/person/day, respectively during low season . The amout of solid waste was 7,537.21 kg, throughout the year. From the study, the solid waste from these area were divided into 4 types, the recyclable waste comprised 44.74% of total weight estimated at 3371.96 kg/year, the food waste was 39.53% of total weight estimated 2,979.22 kg/year, the yard waste was 2.22% of total weight and 167.40 kg/year and non-biodegradable, except for recycled waste, was 13.51% of total weight and 1,018.62 kg/year. Solid waste management of the study area can be done by source separation into three bins system and by waste reduction by: 1) recycling solid waste and selling to buy-back centers or recycling buyers. The income from the selling the recycling waste was determined to be 8,180.87 baht/year, 2) composting by food waste and yard waste that the resort owners to sell bioextract at around 20,000 baht/year and 3) animal feeding. It was also found that 4) the remain waste was carried back by tourists for disposal in the city at a rate of 1,018.62 kg/year. The coporation of The local government and Phu Chi Fa National Park train the resort owners and room services in order to do source separation and collection, composting and feeding at the resorts. Campiagn and information on waste separation for the tourists by outdoor billboards, handbills and stickers for a sustainable environment of Phu Chi Fa.

KEY WORDS : SOLID WASTE/TOURIST RESORT/RECYCLING/REDUCTION

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การจัดการขยะของที่พักแรมในแหล่งท่องเที่ยว กรณีศึกษา: หมู่บ้านร่มฟ้าไทย ตำบลตับเต่า อำเภอเทิง จังหวัดเชียงราย (SOLID WASTE MANAGEMENT OF TOURIST RESORTS CASE STUDY: ROM FA THAI VILLAGE, TUBTAO SUBDISTRICT, THOENG DISTRICT, CHIANGRAI PROVINCE)

ปริชาติ ทองบัวร่วง 4337249 ENRD/M

วท.ม. (การวางแผนสิ่งแวดล้อมเพื่อพัฒนาชุมชนและชนบท)

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บทคัดย่อ

วนอุทยานภูชี้ฟ้า ถือเป็นแหล่งท่องเที่ยวที่สำคัญแห่งหนึ่งของจังหวัดเชียงราย โดยในปี 2544 ช่วงฤดูท่องเที่ยว มีนักท่องเที่ยว จำนวน 2,000 -3,000 คน/วัน โดยมีการพักแรมในที่พักแรมของพื้นที่หมู่บ้านร่มฟ้าไทย และหมู่บ้านร่มฟ้าทอง สำหรับที่พักแรมในหมู่บ้านร่มฟ้าไทย สามารถรองรับนักท่องเที่ยวที่ค้างคืนหรือพักแรมได้ประมาณ 1,043 คน/ปี แต่มีปัญหาในด้านการจัดการขยะ ดังนั้นงานวิจัยนี้จึงต้องการศึกษาอัตราการเกิดขยะ องค์ประกอบของขยะ และลักษณะทางด้านกายภาพและเคมีของขยะและการจัดการขยะของที่พักแรม จำนวน 7 แห่งในหมู่บ้านร่มฟ้าไทย ทั้งนี้ได้ทำการศึกษา 2 ช่วง คือ ช่วงฤดูกาลท่องเที่ยวระหว่างวันที่ 31 ธันวาคม 2544- 6 มกราคม 2545 และช่วงนอกฤดูกาลท่องเที่ยว ระหว่างวันที่ 12-18 เมษายน 2545 จากการศึกษา พบว่าในช่วงฤดูกาลท่องเที่ยว ที่พักแรมและร้านอาหาร มีอัตราการเกิดขยะเฉลี่ย 0.06, 0.04 กก./คน/วัน ตามลำดับ และช่วงนอกฤดูกาลท่องเที่ยว 0.04, 0.05 กก./คน/วัน ตามลำดับ และตลอดทั้งปี จะมีปริมาณขยะถึง 7,537.21 กก. โดยแบ่งขยะออกเป็น 4 ประเภท ได้แก่ 1) ขยะที่สามารถนำกลับมาใช้ใหม่ได้ร้อยละ 44.7 คิดเป็น 3,371.96 กก./ปี 2) เศษอาหาร ร้อยละ 39.53 คิดเป็น 2,979.22 กก./ปี 3) เศษไม้ ใบไม้ต่างๆ ร้อยละ 2.22 คิดเป็น 167.40 กก./ปี และ 4) ขยะอื่นๆ ที่ไม่สามารถย่อยสลายได้ร้อยละ 13.51 คิดเป็น 1,018.62 กก./ปี ในการจัดการขยะในพื้นที่ดังกล่าว สามารถทำได้โดยการคัดแยกขยะโดยใช้ระบบถังขยะ 3 ถัง เพื่อแยกขยะแต่ละประเภท ดังนี้ 1) ขยะที่สามารถนำกลับไปใช้ใหม่ได้นั้น จะนำไปขายให้กับคนรับซื้อของเก่าหรือร้านขายของเก่า โดยจะมีรายได้ 8,180.87 กก./ปี 2) ขยะประเภทเศษอาหารและเศษไม้ ใบไม้ สามารถนำไปทำปุ๋ยหมักน้ำ หรือฮอร์โมนน้ำ โดยหากนำฮอร์โมนน้ำไปขาย จะทำรายได้ 20,000 บาท/ปี 3) ขยะประเภทเศษอาหาร สามารถนำไปต้มกับหยวกกล้วย เพื่อนำไปให้หมูกิน และ 4) ขยะอื่นๆ จำนวน 1,018.62 กก./ปี นั้น นักท่องเที่ยวจะต้องนำขยะดังกล่าวใส่ถุงดำกลับไปทิ้งที่ตัวเมือง นอกจากนี้องค์กรท้องถิ่นควรจะร่วมมือกับวนอุทยานภูชี้ฟ้าฝึกอบรมการคัดแยกขยะ การเก็บขยะ การทำปุ๋ยหมักน้ำ และการต้มอาหารเลี้ยงสัตว์ แก่เจ้าของที่พักแรมและพนักงาน อีกทั้งรณรงค์และให้คำแนะนำการคัดแยกขยะแก่นักท่องเที่ยว โดยผ่านสื่อ เช่น ป้ายประชาสัมพันธ์ แผ่นปลิว สติกเกอร์ เป็นต้น เพื่อสิ่งแวดล้อมที่ยั่งยืนบนภูชี้ฟ้า

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CHAPTER I
INTRODUCTION

1.1 Background and Rationale

The current environmental problems both intensify and threaten to human and creatures well being with conflict and fight the process on development such as agriculture, industry cause an effect to environmental condition including tourism, tourism progress with properly management may cause of many environmental impact.

From the "Earth Summit" conference in June 14, 1992, Rio de Janeiro, Brazil has been indicated the practically essential guideline formed the sustainable tourism (1) In part of Agenda21 associated with Travel and Tourism Industry has been realized that the world natural resource was declining and reducing. Travel and Tourism activities are depending on natural resources and cultures. Therefere, it should be considered to protect the resources and cultures for sustainable existence in the future including tourism encouragement will have to be adjusted to lead an environmental awareness focus on Eco- Tourism or sustainable tourism.

From the Globe' 90 conference in March 19-23, 1990, Vancouver B.C., the definition of Sustainable Tourism is "the current interactive development from the tourist's requirement and the owner of local area with protection and also conservation in any occasion of the next generation. This kind of tourism is mean resource management to correspond the socio-economic necessity and also aesthetic beauty while conserving cultural unique and ecology system" (2). The sustainable tourism in principle will be 1) Using Resource Sustainably both natural resources, society, culture and long-term business guideline 2) Reducing Over-consumption and waste helps the demolished environment long-term maintenance expenditure and anyway increase more tourism quality.

The tourism industry in Thailand brings about economic expansion, and development of transportation including infrastructure development simultaneously to get income into the country. In prevention Then Tourism Authority of Thailand has concerned about the environment and done the policy item no. 3 in 1987, the year of Thailand tourism that " Preserve and Rehabilitate the best Thai's unique cultural treasure, natural and environmental resource." (3). The tourism activities are still proceeded to exploit resource and unawareness to the environmental adverse effect. Finally, some of tourism activity have been affected on various environmental problems such as solid waste, waste water and public utility problems, for example, Pattaya.

For the tourism industry management in Thailand according the National Social and Economic Development Plan No.8, 1997-2001 which determined tourism industry as instrument of response to the objective 1 of 5 in the tourism management. Which focus on the Thailand economic growth with sustainability and equilibrium enhance the human potential opportunity in participation of development process and achieve an equitable development results." And the tourism encouragement policy (2), determination the target on foreign tourist expansion not less than 7 percent per year, for extend an income of foreign currencies not less than 15 percent per year including supporting domestic tourism with more Thai visitors not less than 3 percent per year

Chiangrai, the northernmost province of Thailand bordering with Myanmar and Lao People Democratic Republic. Chiangrai's geographical features are mountainous surroundings with cool weather and many natural resources compounded significantly especially tourism development of the country. There are historical, Lanna traditional culture attractions which is Chiangrai unique attract more visitors causes the tourism growth and continuously expand in other fields of economy also trends in the future will have an expansion (3) As a result, Chiangrai is resource such as beautifully natural attraction for rest, art and culture and historical sites contained. Chiangrai's tourist attractions are Doi Tung, Doi Mae Salong, Golden Triangle, Mae Sai, Mae Fah Luang Garden, and Golden Triangle Hall of Opium (4).

Phu Chi Fa National Park has the peak area in Pha Mon Mountain connect with Thai-Lao PDR border in the National Forest Conservation area, Mae Ing forest on the right and Mae Ngao forest, the region of Rom Fa Thai Village, Moo 9, Tab Tao,

Thoeng and Rom Fa Thong Village, Moo 10, Poh, Wiang Kaen, Chiangrai is in conservation forest with an area covering of 2500 rais, high 1,200 – 1,628 mean sea level. The highest spot is view spot area featuring the penetrate cliff on in the sky which tourist designated its name of enormous rock with the peak penetrating through sky that "The Roof of Siam"

Phu Chi Fa National Park is considered Chiangrai's one famous tourist attraction. Here is especially in winter begins in November – February the visitors comes to see foggy cloud and sun rises all over the panoramic view of the mountaintop. In addition, Ton Chongko and ton Sieo are available in February – March. Ton Chongko and ton Sieo blossom all over Phu Chi Fa attract to Thai and foreign visitors by average of 500-1,000 person/day and mostly in December – January many visitors are about 2,000-3,000 person/day. For visitors in other months of external season of this tourism are about 100-200 people/day (Appendix A). From the study of Thai development Institute (5) in 1997 titled "The study of tourism development initiated plan" with the physical features assessment of tourist attraction found that Phu Chi Fa has been nearly critical. Then the official must follow up the eventual problem after season of tourism and find the suitable solution for Phu Chi Fa problems. Some of the problem are about the insufficient solid waste serving and disposal. Mention a few there are no any agency cope with specially in part of Phu Chi Fa National Park including Rom Fa Thong Village and Rom Fa Thai Villages its problems must be disposed on environmental management, prevention and reduce the environmental effects from solid waste disposal for sustainable tourism. Therefore, this research interested in the method of solid waste management of tourist resorts in Rom Fa Thai Village, Tabtao Subdistrict, Thoeng District, Chiangrai Province to find the suitability of solid waste management for this tourist resort. In this study will be emphasized on the waste minimization and clean technology for providing the solid waste management guidance in the future.

1.2 Conceptual Framework

The research framework in this study was existent solid waste and solid waste management of tourist resort as follows:

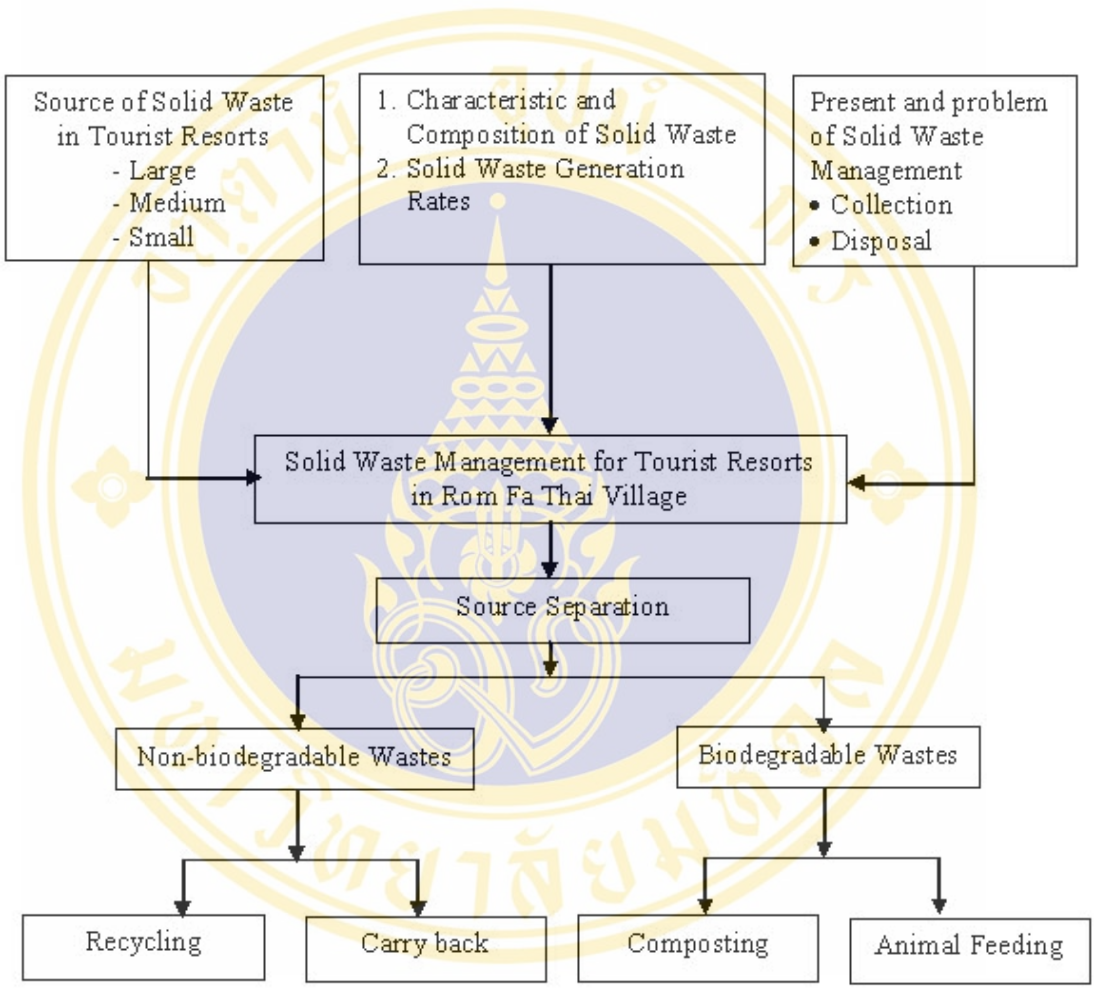


Figure 1.1 Conceptual Framework

1.3 Objective of The Study

1.3.1 To study solid waste generation rate of tourist resorts in Rom Fa Thai Village.

1.3.2 To study solid waste characteristic and composition of tourist resort in Rom Fa Thai Village.

1.3.3 To determine the solid waste management for Rom Fa Thai Village.

1.4 Scope of The Study

The study solid waste management cover 16 resorts areas in Rom Fa Thai Village, Tubtao Subdistrict, Thoeng District, Chiang Rai Province which occupied Phu Chi Fa Forest Park.

The study duration have been determined since December, 2001 – May, 2002 with the range of two during data collection as range of High Season on 31st December, 2001 to 6th January, 2002 and Low Season on 12th – 18th April, 2002.

The research cover solid waste management in present and determine the solid waste management of tourist resorts in Rom Fa Thai Village as follow: To study of solid waste characteristic, composition and generation rate of tourist resorts in Rom Fa Thai village, and to study present and problem of solid waste management for determine the solid waste management of tourist resort in Rom Fa Thai Village.

1.5 Definition of Terms

Solid waste is normally solid and are discarded as useless or unwanted. That is solid or semisolid source by Tourist in resort or restaurant.

High season refers to the part of the year when the weather condition that is cold and includes following periods from December to January at Rom Fa Thai Village.

Low season refer to the part of the year when the weather condition that is cool and includes following periods from Febuary to April and October to November at Rom Fa Thai Village.

1.6 Expected Outcomes

1.6.1 The results of solid waste characteristic and composition and solid waste generation rate of tourist resorts in Rom Fa Thai Village.

1.6.2 The solid waste management for tourist resort in Rom Fa Thai Village.

CHAPTER II
LITERATURE REVIEW

The research entitled “Solid waste Management of Tourist Resorts: Case Study Rom Fa Thai Village, Tubtao Subdistrict, Thoeng District, Chaingrai Province” Following is a discussion of:

1) The concepts of tourism
2) Phu Chi Fa Forest Park
3) The concepts of solid waste management
4) Related research and studies

2.1. The Concepts of Tourism

2.1.1 The Tourism definition

In 1963, the United Nations (UN) on international travel and tourism conference was held in Rome, Italy, and “Tourism” was defined as travelling for pleasures, entertainments, family visiting, as well as conference participation was not for job employment and permanent accommodations (5). In addition to the definition of tourism, the main principles provided were divided into 3 factors as follows:

1) Holiday travel
2) Voluntary travel
3) Common purposes of travel (except job employment and revenues)

Tourism, in short, means that travelling from own accommodations to temporary places is not for job employment and revenues.

According to the UN conference, foreigners can be called “visitor” that refers to any person visiting a country other than that in which he/she has his/her usual place of residence, for any reason other than following; and occupation remunerated from within the country-visited (6). The term “visitor” is divided into the two classes of travelers as follows:

1) Tourists are the temporary visitors staying at least 24 hours visited in the country and the purposes of whose journey can be classified as leisure, i.e. recreation, health, study tour, religious rituals, business contacts, sports competitions, conference participation, etc.

2) Excursionists are the passengers travelling for pleasures in a short period of time or less than 24 hours.

As for the consideration of tourism on the management system, the current conditions and the changes of tourism, which had outstanding different tourist attractions, could be approached in terms of subsidiary systems with its component, its componential function and componential interrelationship, as well as the environment of tourism system regarding ecology system and management or government system. The tourism system could be distinguished into 3 sub-systems (1) as follows:

1) As for the tourism resources, tourist attractions in local areas have attracted travelers' and visitors' interests, These included: natural resources, man-made resources, and community's annual traditional festivals, particularly in wonderful tourist attractions with its natural resources (i.e. hills, waterfalls, caves, hot springs, hot spas, wild animals conservation zones, zoos, national parks, forest parks, botanical garden parks, seas, coral reefs and marine animals, beaches, lakes, islands, dams, reservoirs, fresh water resources (streams, ponds, canals, and swamps)), as well as tourist attractions with different styles of tourism. As for the natural-based tourism, the tourism industry's specialists designed the various types of natural-based tourism in order to maintain its sustainable environment and to perfect management effectiveness and standards. Most importantly, "Ecotourism", one of the well-known natural-based tourism in Thailand, which focused on locally- styled natural resources and ecology-based cultural sites, marine ecotourism, litho travel, as well as agrotourism that were conducted with the conservationists' cooperative learning process on the environmental management and the community-based participatory tourism in order to motivate the conservative awareness of sustainable ecology.

2) As for the tourism services, services for various styles of tourism taken place in the community's areas affecting tourism areas' management.

3) As for the tourism market, the demands of tourism involving with tourism were considered to regulate the tourists' requirements, the styles of tourism management happened in areas.

The growth and the development of tourism industry, at present, have been benefited on economic expansion, job employment, the development of transportation system, as well as the development of infrastructures. Furthermore, the development of tourism industry on environmental management also affected the unavoidable impacts that led to the visitors' physical and mental impacts and the visitors' impression, i.e. tourist attractions' dilapidation and filthiness with plenty of garbages and trahes, the imbalances of tourist attractions, the rapid plantation reduction and animal extinction, the reduction of the tourist attractions' idyllic landscapes, public properties invasion, construction obstacles with its materials, the development of infrastructure and facilities.

The following impacts affecting tourism industry management are as follows (7):

1) Planning and implementation

2) Management system effectiveness, permanent staffs' employment, staff's responsibilities according to the provided organizational regulations, as well as the understandings of tourism industry management in some areas.

3) Visitors', tourism entrepreneurs', local people's, and government officers' awareness of the importances of the natural and social environment toward the effective systems of tourism industry management

4) Public collaboration, i.e. kiln construction for a vast amount of the visitors' wastes and garbages, land property invasion, illegal shop reservation with sales by carts and street stands.

5) Requirements of interorganizational collaboration

6) As for the laws, the drawbacks of some laws regarding the out-of-date, the complication, and the conflicts of its law obligation and laws users impacted mal-practices and non-cooperation on law uses.

7) As for the private - government sector collaboration, some businessmen in private sectors did not require participating in government sectors because of

avoiding laws obligations and offering the government officers' rewards on illegal business contacts and environmental invasion, i.e. in a case study of the businessman's national forest park invasion for resorts and accommodations construction.

8) As for the technology development, technology as double-edged factors that have been brought to assist produce tools, electric machines, and advanced equipments. On the other hands, these were used as a medium to destroy forests in the nature. Eventually, the impacts that the environment has been dilapidated for a rapid period of time were found that the development of high technology was not necessary for some areas, but should be more concerned with the environmental sound technology.

2.1.2. Policy and Management of Tourism

According to the environmental and social impacts of tourism industry, the organizations' and the divisions' awarenesses of the tourism importance that was eventually called "Sustainable Tourism", were initially required to adjust the strategies for tourism promotion leading the environmental protection and sustainable tourism industry. Subsequently, the Globe'90 conference held in Canada was mentioned the definition of "Sustainable Tourism" that referred to the progression of tourism could be reflected the tourists' and the shop owners' requirements in order to protect and conserve a great deal of sustainable tourism for young generations. And the other definition of "Sustainable Tourism", which referred to the resource management for the economical and social requirements, as well as natural appreciation, but the cultural identities and ecology system were even maintained.

As for the management of tourism, the main principles of tourism concerns were: 1) the conservation for natural, social, and cultural sustainable resource uses, as well as the strategies for a long-term business management and 2) The reduction of over-consumption and waste for a long - term expense saving of environmental protection, as well as the quality guarantees of tourism management on environmental impacts.

In addition to the managements for sustainable tourism, the entrepreneurs' and the visitors' requirements aimed at managing tourist attractions and tour planning for tourist guides, the development of the green products' quality, as well as the development of market promotion. The purposes of the managements for sustainable tourism were required to:

1) Protect the original conditions of tourist attractions with local identities amongst wonderful and natural atmospheres.

2) Provide the tourists' facilitators with non-chemical natural circumstances and community's traditional cultures, i.e. food and beverages service centers, as well as the management system of garbage and wastewater recycling.

3) Provide basic public utilities based on the physical carrying capacity and the environmental carrying capacity, i.e. water supplies, electricity, and garbage protection; as well as the management plans for usage effectiveness according to the capacity and the limitation of the tourists' reservation.

4) Provide the effective systems on garbage and wastewater management, waste water treatment, the management of reused/recycled garbages, as well as biogass system management.

2.2 Phu Chi Fa Forest Park

2.2.1 General data

Phu Chi Fa Forest Park, one of the natural tourist attractions, whose forms of the cliff atop Pha Mon mountain range with 1,200 meters to 1,628 meters of the height at sea level have been metamorphosed according to the geological conditions. It borders between the Kingdom of Thailand and the Republic Population of Laos with 40 % of the average sloping lands and a peak-point scenic view (8).

According to the zoning map, this park is located in the national forest reserve zone as a forest C zone that is surrounded between the right shore side's Mae- Ing forest and Mae-Ngao forest at Rom Thai Village Moo.9, Tamtao subdistrict, Theong district and at Rom Fa Thong village Moo. 10, Po sub-district, Wiang Kaen district, Chaingrai province.

There, its weather amongst mountainous areas with the tropical monsoon zone that was influenced by the Southern-west monsoons during the raining season and the Northern-east monsoons during the winter would rather be frosty. There are 3 seasons; in summer - from March to May; in raining - from June to October; and in winter - from November to February (9).

The Forest Park, one of the well-known tourist attractions in Chaingrai province, was officially established in February 6th, 1999 with the purposes of forest protection, recreation, as well as an ecology research center. (8)

Many visitors in and out of Chaingrai province, thus, took place for sightseeing and rest-taking every year, especially in winter - from November to February in consequence with the dissemination of the broadcasting media, including televisions, radios, newspapers, magazines, and journals. (9)

2.2.2 Transportation

2.2.2.1 Route from Chaingrai Province to Phu Chi Fa Forest Park

Along the superhighway number 1020 (Chaing Rai – Theong route) with 2.30 hours, it is about 107 kilometers far from Chaingrai province to Phu Chi Fa Forest Park until go past Theong district with 64 kilometers throughout the tarred road. The 2 routes for transportation are as follows:

1) Along the Theong – Pang Mae Ka route between the route no. 1021 and the route no. 1155, it is about 22 kilometers far from Pang Ka Village with tarred road. Then, take a right - turn to the rout number 1093 with rough route; and was surrounded in mountainous areas with 21 kilometers from Pang Ka village, Rom Po Thai (Lao-U) to Rom Fa Thai village.

2) It is about 49 kilometers along the Theong – Sob Bong village at Chiang kam district, Phayao province – Huak village route between the highway route no. 1021 and the route no. 11022 of the Department of Rural State Roads; and along the highway route no.1093, it is 36 kilometers far from Huak village to Rom Fah Thai village (Phu Chi Fa) with rough and off-shored route.

For a journey to Pha Tang Cliff at Wiang Kaen district, Chaingrai province, one of the well-known tourist attractions, it is about 25 kilometers far from the provincial highway route no. 1093 (8)

2.2.2.2. Route to the Peak Point of Phu Chi Fa

As for the journey to the peak point of Phu Chi Fa, it is a scenic view point with the 2 routes that can be used for journey as follows (8):

1) Along the Rom Fah Thai route with steep mountainous areas, it is about 1.8 kilometers to Phu Chi Fa by foot. As for the transport conveniences, this route with stair- like mountainous areas has nowadays been altered instead of the route with steep mountainous areas. There are 2 scenic viewpoints being surrounded with wide fields and huge trees in some areas.

2) Along the Rom Fah Thai – Rom Fah Thong route no. 1093, it is about with 4 kilometers to Phu Chi Fa; and 2 kilometers far from Rom Fah Thong village with steep mountainous areas throughout the only summer. Cars can be driven up to the car park with 500 meters by foot to the peak point of Phu Chi Fa

3) With 800 meters, it is far from the Office of Phu Chi Fa Forest Park to scenic viewpoints.

2.2.3 Utilization of Phu Chi Fa Forest Park Areas at a glance

According to the military army's project for stability development between Doi Yao – Doi Pha Mon and Doi Pha Ji areas, the areas around Phu Chi Fa mountain have been brought to utilize for the common purposes. Furthermore, the 3 villages selected as a pilot protection village were Rom Fah Thai village, Rom Fah Thong village, and Rom Fah Ngeon village. The main populations of these villages are Lanna people from reserve corps, and the majority of Hmong ethnical groups (former Thailand's national revolutionists). The professions of the groups are farmers, employees, handicraft artists, as well as merchants.

2.2.4 Camping Management at Phu Chi Fa Forest Park

No houses and accommodations for tourists' services can be found in the Phu Chi Fa Forest Park (9), but camping tents for rental can be allowed to rest at

camping service zones with tidy toilets. Asking for the service permission should be contacted the officials or the head of Phu Chi Fa Forest Park directly.

Along the offside roads, 20 private accommodations with inner toilets that are likely to be resorts were found around Phu Chi Fa Forest Park. 16 resorts at Rom Fah Thai village and 4 Resorts at Rom Fah Thong village, where some of them are made of wood and bricks in some areas; and the other accommodations with its camping area are offered the average charges of 100 - 500 Baht for camping tent rental a day and the charges of 50 baht of a visitor's tent a day.

Nonetheless, Nipon Cheomuangpan (2000) (8) studied the guideline for tourist attractions management based on ecotourism. The findings of this study revealed that the requirements of tourist's accommodations with tidy toilets and its natural circumstances were not supported during the winter. The troublesome factor the tourist's accommodations faced with was that the vast bunches of garbages, leading to the pollution and garbage problems for tourism industry.

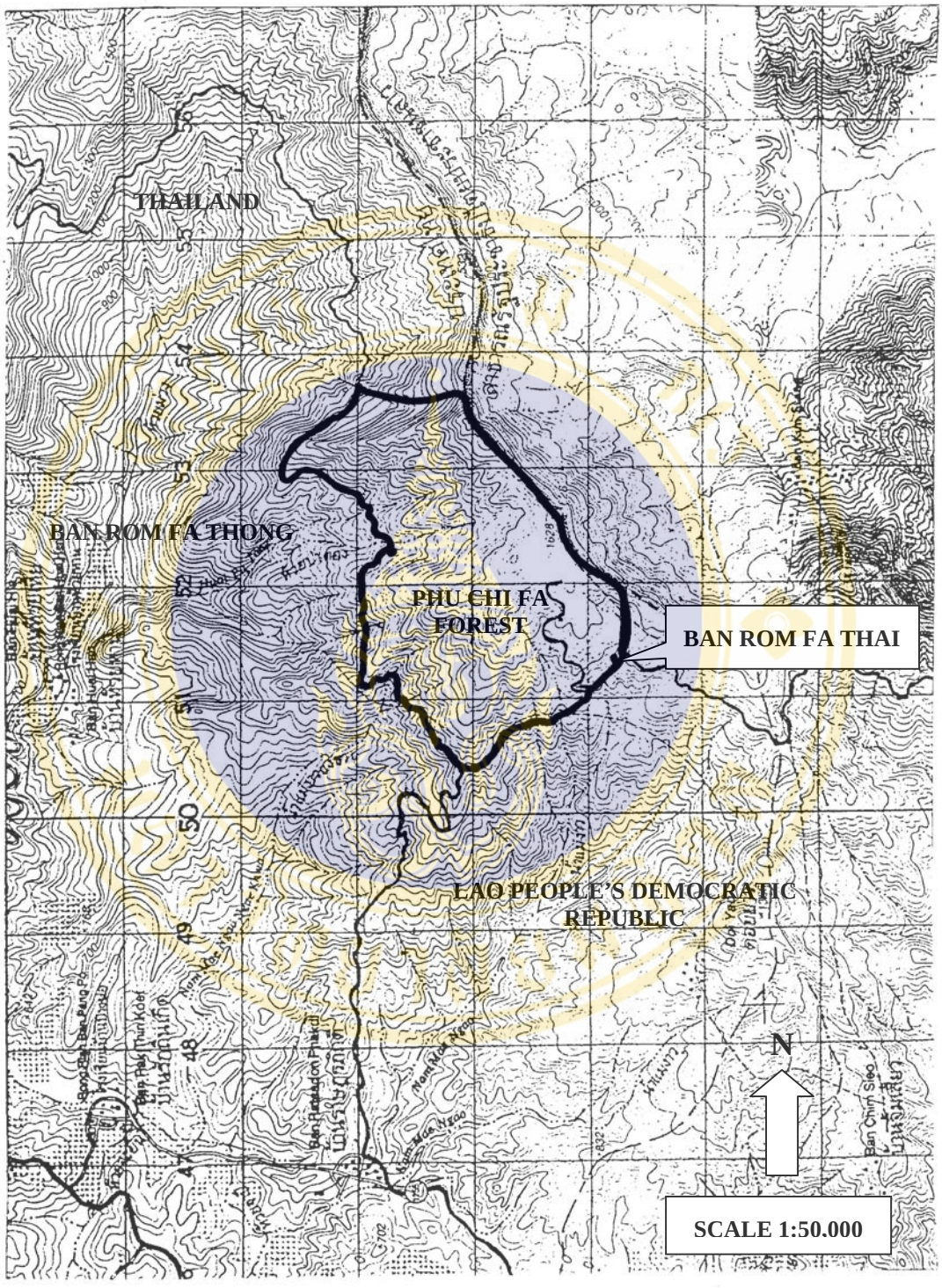


Figure 2-1 Map of Phu Chi Fa Forest Park and Rom Fa Thai Village

(Academic group, Regional Forest Office, Chiangrai Province)

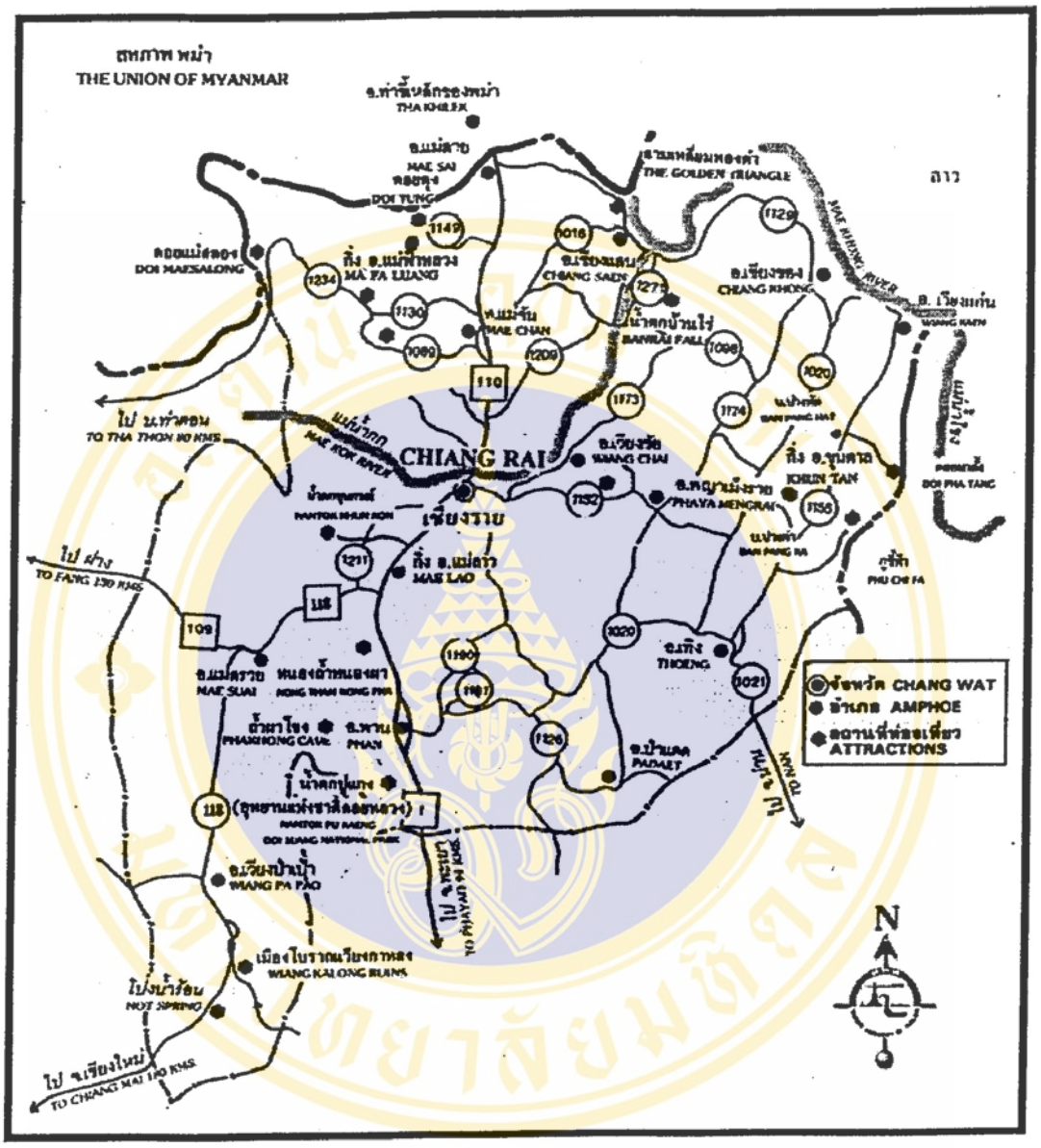


Figure 2-2 Map of Transportation to Phu Chi Fa Forest Park

2.3 The Concepts of Solid Waste

2.3.1 Solid waste definition

Office of Environmental Committee (1981) (10) Solid waste mean the material who don't want and to reject and mean total textile, food waste, dung, ashes, dirt and the surplus of material to sweep from building, road,market, farm, factory, and etc.

Solid wastes (11) include all solid or semisolid materials that the possessor no longer considers of sufficient value to retain. And "Sources of solid wastes in a community are, in general, related to land use and zoning. Although any number of source classifications can be developed, the following categories are useful: 1) residential, 2) commercial, 3) institutional, 4) construction and demolition, 5) municipal services, 6) treatment plant sites, 7) industrial, and 8) agricultural.

Robert A. Corbitt.1998. (12) Solid wastes are those materials, other than liquids or gases, that are deemed by their owner to no longer possess value and are discarded. They are generated by almost every activity, and the amount varies by source, season, geography, and time

Public Health Law, 1992 (13) solid waste mean paper, textile, foodwaste the surplus of product, plastic, food ware, ashes, dung, and the surplus of material to sweep from, road, market, farm or other.

And solid waste management and disposal of Thailand research project (14) solid waste mean follow Environmental Law, 1992 mean the surplus of material to activity from community to include solid waste from residential, commercial, office buiding, factory, industrial, service group, and agricultural.

To summarize the solid waste mean the surplus of material to used or don't want may be solid and semisolid, source from commercial and torism

2.3.2 Type of solid waste

solid waste have 3 types (13) are Garbage, Rubbish, and Hazard waste

1) Garbage such as food waste and have high moisture and easy decomposed

2) Rubbish such as paper, plastic bag, glass metel can textile, rubber etc. the rubbish are decompost or non-decompost and recycling by separate to decrease the rubbish and make income.

3) Hazardous waste were chemical substance or Toxin material and Hospital waste. Such as battery dry, tanker cleaning station, fluorescent bulb, chemical from industries, cotton wood and a piece of organism from hospital. And that special disposal for disseminate of disease loss and toxic to environment

2.3.3 Characteristics and composition of solid waste (15)

2.3.3.1 Physical Characteristics

1) Typical (22) were combustible refuse; textile, food wastes, paper, plastic, rabbish, yard wastes and non-combustible refuse ; glass, metel, rock,roof etc.

2) Moisture Content

3) Density

2.3.3.2 Chemical Characterristics

1) Water content

2) Combustible and ash Contents

3) Chemical element composition

4) toxic substances

For solid waste characteristic of tourism place, when different type of tourist as to different tourist activity and to be specific different characteristic and quantity of solid waste. Probably, tourism place have many tourists as have many quantity of solid waste per day and the most solid waste from resort and restaurant in place. The solid waste characteristic of tourist resort is like multiciple solid waste (25) as show in table 2-1

From result, the rule of solid waste management of tourism resource far from community by Environmental Research Institute, Chulalongkorn University (1991) Probably, natural resources (such as waterfall, mountain, forest, river, sea and beach) have food waste, wood or yard waste, and paper or plastic, respectively.

2.3.4 Source of solid waste in Tourism resource

In general, tourism station have 5 Source of solid waste as follow : (16)

1) Tourist
2) Local people in tourism resource
3) Hotel or Resort
4) Resturant
5) Nature

Table 2-1 Comparison Type of Solid waste in section Tourist resource with Community

Type of Solid waste	Site of Samping			
	Phattaya beach	**Lahn Island**	**Naker Submunicipal**	**Chonburi Municipal**
1. Component				
(% by weight)	40.1	59.4	38.8	33.1
1. Food waste	12.7	8.0	25.2	19.1
2. Paper and Textiles	5.8	3.7	13.0	10.7
3. chip of wood	5.8	6.7	7.3	9.6
4. Rubber and Plastics	5.2	2.8	1.8	7.7
5. Glass and Mrtal	30.4	19.4	13.9	19.8
6. Other				
Total	100.0	100.0	100.0	100.0
2. Moiture (% by weight)	51.0	65.1	52.5	54.67
3. Density (Tons/m^3)	0.30	-	0.28	0.30

Source: Environmental Research Institute, Chulalongkorn University, 1991

But study the tourism resource far from community mean sources of Solid Wastes the most from tourist, resort, shop, resturant, and nature

2.3.5 Generation rate of solid Wastes

Generation rate in touristm place to depend on number of tourist and type of

tourim place which volumn per person per day or solid waste weight per person per day. The tourist much or little to depend on to like beautiful, to be appealing, communication distance accommodation in tourism place and Economic factor of tourist (25) Environmental Research Institute (1991) study to adjust the rule of solid waste management of tourism resource far from community (17). (Table 2-2)

JICA (2521) (18) to predict Pattaya and Kao Lan generation rate between 1980-1986 : generation rate of Pattaya have 0.76-1.00 kg/person/day and Kao Lan have 0.68-0.85 kg/person/day

The Nature tourism resource as mountain, Satid Pasert, 1995 (19) study the physical and social carrying capacity assessment of Phukradung National Park that tourist average generation rate have 764.76 gram/person/day, average bulk density 0.25 gram/litre, everage solid waste quantity 3.06 litre/person/day which to realize that characteristic of solid waste to change with tourism source.

In addition, the most factor is time and place for a religious festival, , custom and vacation impact to solid waste rate and tourist to increase.

Environmental Research Institute, Chulalongkorn University,1989-1990 suvey and collect the data in tourism resource to inquire for generation rate. Result, group of generation rate by domestic of tourist (17)

1) Domestic Excusionists have generation rate between 0.50-1.60 litre/person/day or 0.02-0.06 kilogram/person/day to include temple, historical place, history park and station of culture art.

2) Domestic tourist have generation rate between 1.40-10.00 litre/person/day or 0.06-0.45 kilogram/person/day to include cave, waterfall, national park,beach, island, or natural place. That can domicile and eat food.

2.3.6 Problem of Solid waste Management of tourism resource (16)

1) Have many solid waste and tobe left over in tourism place, because collection doesn’t all and don’t have enough collector.

Table 2-2 Quantity and Generation Rate of Solid Waste, Average Number of Tourist, and Frequency of Collection Solid Waste

Tourism Place	Generation rate of solid waste		Average number of tourist	Quantity of solid waste	Frequency of collection		Bulk density	Moisture content
	L/person/day	Kg/person/day	Person/day	m^3/day	Weight(kg/day)	(Time/day)	(kg/m3)	%
1. Wat Phra That Doi Suthep	1.04	0.06	2500	2.60	156	1	60	-
2. Wat Yai Chai Mongkhon	1.25	0.09	1,200	1.50	-	1	70	-
3. Wihan Phramonghon Bophit	1.25	0.12	1,600	2.00	-	1	90	-
4. Bang Pa-in Summer Palace	1.20	0.06	1,300	1.56	-	1	50	-
5. Bang Sai Royal Folk Arts and Craft Centre	1.60	0.06	4,000	6.40	-	1	40	-
6. Pha Nakhon Si Ayutthaya Historical Park	0.96	0.03	4,060	1.03	28.8	1	28	12.3
7. Phanom Rung Historical Park	0.52	0.02	2,000	1.04	43.5	1.5	41.07	40
8. Chiangdow Caves	1.44	0.17	1,000	1.44	-	1	46	-
9. Khao Luang Caves	0.25	0.01	1,000	0.25	25	1	100	16.5
10. Mae Kong Waterfall	2.20	0.59	450	0.99	266	1	269	-
11. Erawan Waterfall	1.40	0.06	2,000	2.80	-	1	150	40
12. Nam Nao National Park	3.90	0.25	700	2.70	340	1	126	65
13. Khao Yai National Park	5.00	0.17	2,000	10.00	820	1	82	34
14. Koh Samet national Park	6.00	0.42	500	3.00	390	1	130	70
15. Mae Rumphueng Beach	4.4	0.17	400	1.76	200	1	114	38
16. Puek Tian Beach	4.80	0.12	1,000	4.80	338	2	70.5	25
17. Koh Lan	10.00	0.45	2000	20.00	5,040	1	252	45

Remark : Change unit of volumn to weight and to compare with bulk density of tourism place

Source : Environmental Research Institute Chulalongkorn University, 1991

2) Containers were to be lacking, decay or form don't to be in line with sight seeing.

3) Don't have cooperate from resortowners or tourist to be able solid waste source.

4) Don't have unsuitable of solid waste disposal.

5) The legislation of sanitation doesn't compact

2.4 The Concepts of Solid Waste Management

2.4.1 Definition of Solid Waste Management

Solid waste management (21) mean the principle to perform with to leave solid waste control, collection, transportation, processed, and disposal by the most benefit in health sanitation, sight-seeing, economic, environmental conversation and to acknowledge social.

The activities associated with the management of solid wastes from the point of generation to final disposal have been grouped in to the six function elements as follow:

1) Generation of Solid Wastes

2) Onsite handling, Storage

3) Collection of Solid Wastes

4) Tranfer & Transport

5) Processing & Recovery

6) Disposal

the method of solid waste management have many level (15) are

1) Storage and Collection

2) Transportation

3) Processing

4) Disposal

In addition, the principle of solid waste management is separating useful product. Separation is accommodate to solid waste management, recycling efficiency and to decrease quantity of solid waste from sources. In addition separation of solid waste help easy select disposal technology. And have efficiency, and low cost, have economic to worth the expense(14).

Summary, solid waste management were collection from source, transfer to disposal site. Partially, processing solid waste to easy collection or anouth use. And leave solid waste suitable disposal later.

2.4.2 Separation for Material recovery

Separation for material recovery to mean separarate many type of solid waste such as paper, plastic, glass, etc. and have objective to recycling.The separation for material recovery have two methods were 1) handsorting 2) mechanical.

Generally, handsorting can use another place such as residential transportation or disposal site. While mechanical use in the most quantity solid waste place. Material recovery have many type to depend on component of solid waste and buy-back centres. Material recovery from residential such as newspaper, aluminum, and glass, material recovery from commercial and industrial such as cardboard, quality paper, metal, plastic, and material recovery from transportation and disposal site such as metal, aluminum glass for instance.

2.4.3 Waste reduction (20)

Waste reduction includes all actions taken to reduce the amount and/or toxicity of waste. It includes waste prevention, recycling, cornposting and the purchase of products that have recycled content or produce less waste.

Waste prevention is one of the easiest methods of reducing waste and can be controlled at the time of purchasing products and services. There is a direct correlation between what a hotel purchases and what it throws away. In addition, all of the resources and economic costs of materials, manufacturing, labor, transportation, packaging, storage and disposal are wasted when a product is discarded.

Cornposting food waste and yard trimmings can save a hotel money on hauling and landfilling fees. However, cornposting is limited by land space at the hotel and/or availability of commercial cornposting sites.

Purchasing products made with recycled content creates outlets or markets for the materials collected in the hotel's recycling program. As such, procurement sustains the recycling process and in turn, reduces the amount of waste going to the landfill.

Benefits of waste reduction: 1) savings through reduced purchasing costs, 2) reduced waste disposal costs, 3) reduced energy consumption and pollution, 4) conservation of natural resources.

2.4.4 Disposal Solid waste Technology

2.4.4.1 Sanitary Landfill (21)

Landfills are the physical facilities used for the disposal of residual solid wastes in the surface soils of the earth. In the past, the term sanitary landfill was used to denote a landfill in which the waste placed in the landfill was coverd at the end of each day's operation. Today, sanitary landfill refers to an engineered facility for the disposal of multiple solid waste designed and operated to minimize public health and environmental impacts.

The term cell is used to describe the volume of material placed in a landfill during one operating period, usually one day. A cell includes the solid waste deposited and the daily cover material surrounding it. Daily cover usually consists of 6 to 12 in of native soil or alternative materials such as compost that are applied to the working facs of the landfill at the end of each operating period. The purpose of daily cover are to control the blowing of waste materials; to prevent rats, flies, and other disease vectors from entering or exiting the landfill; and to control the entry of water into the landfill during operation.

A lift is a complete layer of cells over the active area of the landfill. Typically, landfills are comprised of a series of lifts.A bench (or terrace) is commonly

used where the height of the landfill will exceed 50 to 75 ft. Benches are used to maintain the slope stability of the landfill, for the placement of surface water drainage channels, and for the location of landfill gas recovery piping. The final lift includes the cover layer. The final cover layer is applied to the entire landfill surface after all landfilling operations are complete. The final cover usually consists of multiple layers of soil and/or geomembrane materials designed to enhance surface drainage, intercept percolating water, and support surface vegetation.

2.4.4.2 Composting

Composting is the biodegradation of the organic constituents in wastes (solid wastes and wastewater sludges). Through the microbial activity taking place during composting, organic matter is decomposed into a stable, humus-like substance. At the same time the heat produced can result in pathogen destruction. Composting is an ancient practice whereby farmers have converted organic wastes into soil amendments. These amendments were used to stabilize soils form erosion, provide nutrients, and replenish depleted organic matter that was lost through intensive farming.

Rapid biodegradation of the sludge and stabilization of organic fraction as compost depends mainly on the optimal interaction of temperature, oxygen, moisture, and the carbon/nitrogen ratio. The carbon/nitrogen (C/N) ratio is one of the most impotant parameters affecting the role of decomposition of organic materials. Carbon is an energy source for the microorganisms, whereas nitrogen is necessary for protein synthesis. The ideal C/N ratio is between 25 and 30. Sewage sludge has a low C/N ratio(10 to 15), whereas solid waste has a high ratio (35-80). The use of bulking materials with sewage sludge enhances the C/N ratio and the use of sewage sludge in combination with solid waste improves the latter’s ratio.

In addition, The selection criteria of disposal site, transportation and incinerator. (1998) (22) to remain the criterias, this area don’t living in Water Shed 1 and 2. Follow as resolution of the council of ministers to assign Water Shed May 28th, 1985.

2.5 Related Researches

2.5.1 Solid waste and Tourism

The Institute of Science and Technology of Thailand (1992) (23) had studied the ability for touring development of Phi Phi islands. The research had surveyed source and amount of rubbish around islands and found that the area of Tonsai Bay community was a major source of rubbish. The accumulation of rubbish was from tourist shops, restaurants and villagers' households with the amount of about 2.2 tons or 15 cubic meters per day; rubbish from 10 bungalows contained 2,104 kilograms or 4,890 litres per day or 1.02 kg/person/day or 2.29 litres/person/day. Rubbish collection service was in responsibility of Phi Phi islands management council. Rubbish was collected every day, removed and transported by boat to dispose of at disposal site designated by Muang Krabi Municipality. Other rubbish from bungalows located out of Tonsai Bay community were collected by bungalow' owners and disposed of by depositing, burying underground, outdoor incinerating and burning in incinerator. The research found the scattering rubbish was left unfinished which indicated that the management and methods of rubbish disposal of Tonsai Bay community did not reach the requirements and not correct in accordance with methodology.

Faculty of Social Sciences, Chiangmai University (1998) (24) had studied a research titled " Review Study of Tourism Development Plan in Upper-Northern Part" and presented to Tourism Authority of Thailand. The contents of a research found or few researches related to rubbish quantity in touring attractions as follows:

1. Solid waste quantity in outstanding tourist attractions

The result of study for adopting in the Natural Environment Conservation Management Plan at Namlod Cave, Maehongsorn reported by Chiangmai University (1994-1995) showed the amount of rubbish from tourists during June 25th-28th, 1994 was about 0.04-0.33 kgs/person. The sample rubbish were composed of waste

materials measured by percent of dry weight including glass 30.9%, leaf and branch 23.8%, paper 11.4%, plastic 9.6%, metal 5.9%, wood 3.6%, food waste 0.6%, rubber 0.3% and others 13.9%. Rubbish were disposed of occasionally by separation, incineration and burying underground.

2. Solid waste quantity in communities where tourist attractions located

The result of project studied by Chiangmai University (1993-1994) about waste water and rubbish collection and management system of Maesai Public Health Unit, Chiangrai showed that the average quantity of rubbish from a guest house and a hotel during October 27th-29th was about 2.45-2.88 kg/room/day which was occasionally collected and disposed of by burying underground

3. Solid waste quantity in tourist cities

The research was studied in Maehongsorn city by Chiangmai University (1993-1994), the result found average rubbish quantity from 2 hotels and 2 guesthouses was about 2.34-2.78 kgs/room/day. This rubbish was removed by Maehongsorn Municipality's dump trucks and disposed of by burying underground or incineration.

In addition, there were several research studied about rubbish disposal system in 144 tourist attractions in 8 provinces of upper north part. The results found that most of tourist attractions provided enough rubbish bins and regularly rubbish collecting service. But there was some problem of rubbish disposal method.

The result of study of Sathit Prasert (1995) (19) titled "the Study of Physical and Social Ability Assessment towards Tourism Service of Phukradung National Pacrk" found the average weight of rubbish from tourists was about 764.76 gm/person/day, average density was 0.25gm/litre or average quantity was 3.06/litres/person/day. Rubbish were collected from rubbish bins placed around city by rubbish trucks, removed and disposed of by dumping in a big disposal pit, size of 10x15 sq.m which have a capacity for rubbish from 98,039 tourists. There was no rubbish separation process before burying underground or incineration. In addition, the disposal site was scattered by wild animals as well. This place required further

protection and resolution approach.

The study result of a research titled “Eco-Tourism Management by Local People” ; a case study of Keereewong village, Kamlone sub-district, Lansaka district, Nakornsrithammarat by Uthai Thaksintham (1999) (26) found that there was accumulation of rubbish left in many points around a village and park area particularly fruit markets. A study suggested 2 guideline activities for rubbish collection and disposal as follows:

Activity I: Rubbish Separation and Collection

Rubbish from households and fruit markets must be separated into putrescible and nonputrescible waste before collection and disposal.

Activity II: Disposal of putrescible rubbish

Most kind of rubbish was putrescible waste contained organic substances which could be composted to be compost or buried underground for returning minerals to the ground according to ecological cycle.

Nipon Chueamuangphan (1999) (8), an author of research titled “Guideline for Tourist Attractions Management based on Eco-Tourism”, a case study of Phuchifah Forest Park, Chiangrai, reported that the information from interview responded by related people and area surveying indicated that there was increasing of rubbish and rubbish dumping was in disorder. This was regarded as an important problem. The providing of rubbish was including 2 bins at tourist view point, 3 bins placed along the paths around Romfahthai village, 5 bins places along the paths around Romfahthong village. All rubbish bins were not large comprised 2 types including bamboo basket and iron net basket. There were also small rubbish bins placed at every hotel rooms and restaurants. There was no separation method before collection, 2 disposal sites were provided at a roadside in front of Romfahthai village and a roadside 5 kms from Romfahthong village.

Rubbish from tourists was including putrescible waste such as food, vegetable and fruit waste, grasses, leaves etc. and monputrescible waste such as glass

and plastic etc. in different ratio and quantity.

2.5.2 Solid waste Management and Management Guideline

Environmental Research Institute, Chulalongkorn University (1991)(17) had studied and set the rubbish management and management in 17 sample remote tourist attractions. The findings of study were as follows:

1) Storage: Rubbish was dumped into rubbish bins before collected and disposed. The result found inappropriate bins due to a lack of tight lids, short length of service and poor design.

2) Collection: Rubbish can be collected by removing only sacks and rubbish in bins and transported by push-carts or small rubbish trucks. The result found uncertain transportation route due to responsible unit did not understand a necessary of route schedule.

3) Transportation and Transfer: The result found some tourist attractions did not realize an importance of location of rubbish disposal site. Some site was designated not far from tourist attraction then could damage local environment.

4) Recycling: The result found rubbish were separated only some material which could be sold to be recycled such as plastic water bottles.

5) Disposal: The result found most of rubbish was disposed by out door incinerating and some were dumped into the valley, which was source of river.

Chakkrit Siwadejathep (1989) (26) reported a study titled “Rubbish Management in Tourist Attractions”. The result found that problem of rubbish in tourist attractions was arranged into 2 types including regular problem which occurred similarly in all kinds of tourist attractions and needed the same management and resolution and particular problem which occurred differently in each tourist attraction and needed particular management, protection and resolution. Regular management schedules were including cleansing, collection and disposal which have to be done regularly and continuous public relations campaign. Particular management plan was the suitable selection of rubbish disposal method for each tourist attraction such as harmful rubbish was prohibited around waterfall area etc.

The implementation could

be carried out by simple method or technology but management and administration needed quite complex technique.

Jagdish C. Kuniyal and Arun P. Jain (2000) (27) reported a study investigates the annual visits of 116,000 tourists to Hemkund Sahib and Valley of Flowers, India, within a four-month season. Most tourist inflow was Sikh pilgrims. In a detailed study of visitors perception, 23 percent realized that they themselves were responsible for creating a SW problem. Many of waste remained lying in and around trek stalls, apart from rare containers placed either by stall keepers or concerned authorities. Regrading SWM options at local level, some religious tourists agreed to carry back garbage to roadheads if the Sikh priest (Granthji) would issue a religious decree to Sikh pilgrims during prayer. Cold drink bottles and plastics comprised 92 percent of the non-biodegradable wastes (NBW) available for reuse and recycling. The remaining readily biodegradable wastes (RBW) and biodegradable wastes (BW) are suitable for micro-level biocomposting. The common discarding practice by visitors considering things straightway valueless that immediately turns the things into wastes needs to be given up. The visitors ingrained habits of discarding onsed items as valueless need to be changed. This study investigates some of the cultural and practical challenges this entails.

CHAPTER III
METHODOLOGY

The solid waste management of tourist resorts case study: Rom Fa Thai Village, Tubtao Subdistrict, Thoeng District, Chiangrai Province is a Survey Research. Specify to study avalible alternative of solid waste management (collection and disposal solid waste). This research collecting the data on High season and Low season period for study the suitable solid waste management. The method of studies are presented as follow:

3.1 Population and Sample

The population of tourist resorts in Rom Fa Thai Village have sixteenth resorts. There were three stratified groups in this research as follow:

1) Large size of resort, having the capacity for receiving the tourist morethan 74 persons. Number of resort totally 2 resorts.

2) Medium size of resorts, having the capacity for receiving the tourist between 30-74 persons. Number of resort totally 5 resorts.

3) Small size of resorts, having the capacity for receiving the tourist leastthan 30 persons. Number of resort totally 9 resorts.

After that, random sampling tourist resort on three groups by draw lots method as show result in Table 3-1

Table 3-1 List of Tourist resorts Sample

Group of Tourist Resorts	Name of Tourist Resort
1) Large (The resort receiving morethan 74 persons.)	1) Phu Chi Fa Resort
2) Medium (The resort receiving between 30-74 persons.)	1) Luk,s House 2) Ruam San Sang House
3) Low (The resort receiving equal and lessthan 30 persons.)	1) Dang's House 2) Yod's House 3) Phu Chi Fa Pochana 4) Santipap House

3.2 Study Procedure of Solid Waste Management

The study have four procedures as follows:

Procedure One: Study of the present and problem of solid waste management of tourist resorts and restaurant.

Procedure Two: Study in generation rate of solid waste.

Procedure Three: Study in composition and characteristic of solid waste.

Procedure Four: Study of solid waste management in tourist resorts and restaurant.

3.2.1 Solid Waste Generation Rate

1) Weigh solid waste from seven tourist resorts and one restaurant.

2) Solid waste generation rate, The total of solid waste generated were determined in unit of kilogram per person per day

3.2.2 Solid Waste Composition and Characteristic

Collection solid wastes from seven tourist resorts and one restaurant in Rom Fa Thai Village, unload and agreed upon quantity of waste in a cleared area at the

village. Mix the various collections of waste thoroughly with a front end loader. Rake the sample into quarters and mix again thoroughly. Continue quartering the sample and mixing until a representative sample weighing greater than 100 L is generated. The sample should then be weighed and separated into its components. Each recyclable category should be weighed and compared with the total. see Fig. 3-1

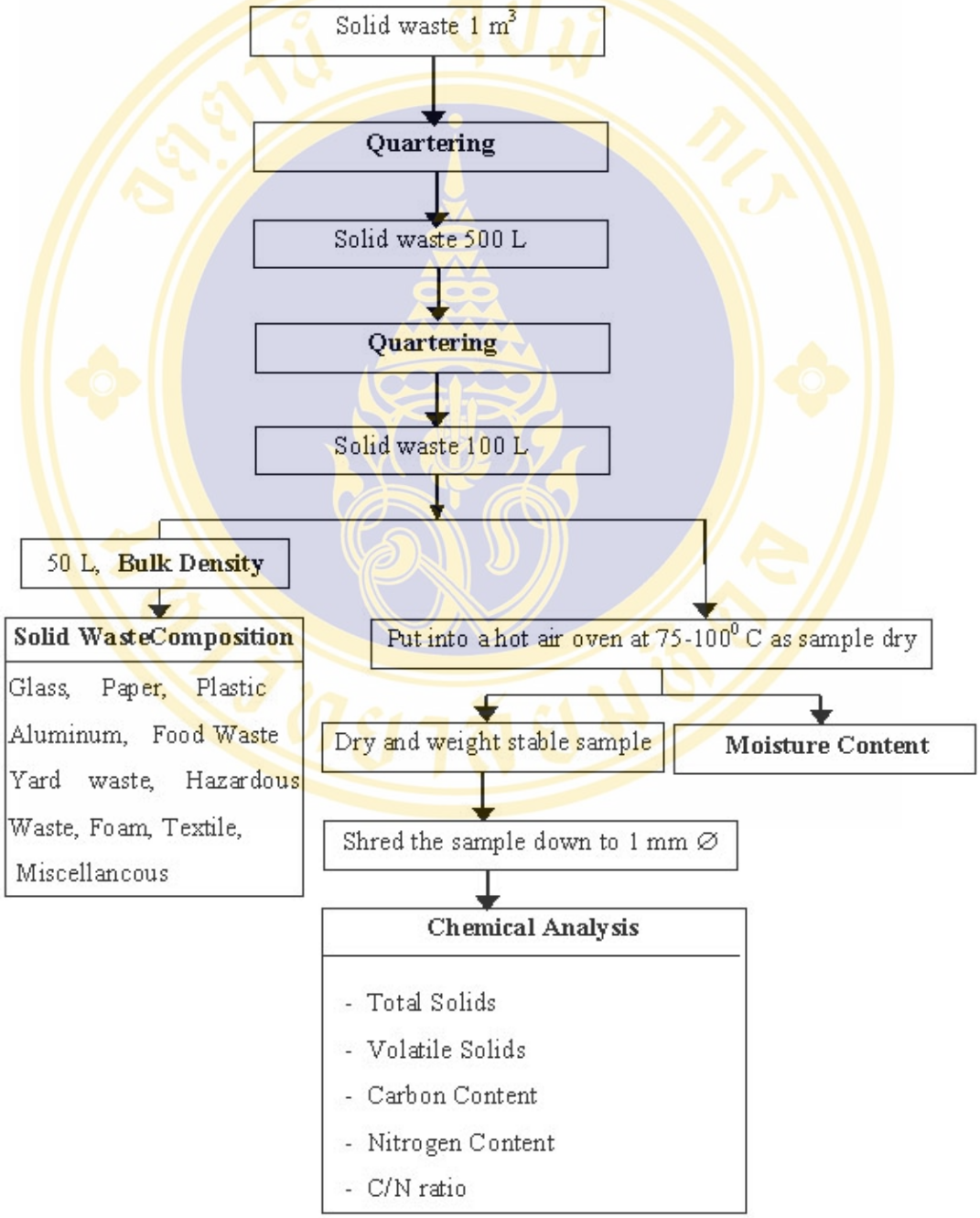


Figure 3-1 Characteristic and Composition measurement

1) Composition of Solid Waste

The samples in seven tourist resorts and one restaurant are mixed thoroughly and applied conning and quartering techniques. Final the sample size of about 50 litres is sorted in ten components (% w/w) is shown in Fig. 3-1

2) Physical Characteristic

2.1) Bulk Density

Using container of 50 litres (V) record this weight as W_1. Pour the sample into the container unit it is overflowing. Compacting emply container the content in the container by dropping it three times from a height of 30 cm. Top up the container volumn with the remainder of sampled solid waste. Weight the container including solid waste and record this weight as W_2. Then, calculated the sample as follow :

Calculate :

$$D\ (kg/m^3) = \frac{W_1 - W_2}{V}$$

2.2) Moisture content

Place 50 litres of solid waste sample on a weighed aluminium tray and record the weight of the sample as W_1. Put solid waste sample into a hot air oven at 75-100^0 C for 3-4 days when solid waste sample dry and had stable weight . Reweigh the dry sample as W_2.Then, calculated the sample as follow :

Calculate :

$$(\%)MS = \frac{(W_1 - W_2) \times 100}{W_1}$$

3) Chemical Characteristic

3.1) Total Solids

Calculate from Moisture content :

$$(\%)TS = 100-(\%)MS$$

3.2) Volatile Solid

Shred the sample down to diameter 1 mm. by a willey type crusher and dry at 75^{o} C for 2 hours. Put inside a dessicator. Put 3-6 grams of sample to a 100 ml crucible and measure the correct as W_1. Heat the sample in side the electric furnance with a temp of 600-650^{o} C to 2 hours. Cool again inside the dessicator for 1-2 hours and measure the weight as W_2. Then, calculated the sample as follow :

Calculate :

$$(\%)VS = \frac{(W_1 - W_2) \times 100}{W_1}$$

3.4) Chemical Composition

- Carbon Content : Calculate from Volatile Solid

$$(\%)\ \text{Carbon} = \frac{(\%)\ \text{Volatile Solid}}{1.8}$$

- Total Nitrogen Content use Kjeldahl Method
- C/N Ratio : Calculate from Carbon content and Total Nitrogen

$$\text{C/N Ratio} : \frac{C}{N}$$

The data were decided and selected avaitable solid waste management.

3.2.3 The Present Solid Waste Management of Tourist Resorts and Restaurant.

To study present of solid waste management and the solid waste management problem of tourist resorts in Ban Rom Fa Thai. To interview the source of the data were chair of Tub Tao Subdistrict Administration Organization, Ban Rom Fa Thai headman, Tourist resortowners by observed in tourist resort and village to include 1) separation at source 2) collection and 3) disposal.

3.2.4 Study of solid waste management of tourist resorts and restaurant.

1) Source separation at tourist resorts and restaurant.
2) Recycling solid waste.
3) Solid waste carry back by tourist.
4) Composting and Animal feeding.

and determine the solid waste management for Rom Fa Thai Village.

CHAPTER IV
RESULTS AND DISCUSSION

The study of existing solid waste management of tourist resorts in Rom Fa Thai village took place during high season on 31st December, 2001 to 6th January, 2002 (7 days) and low season on 12th to 18th April, 2002 (7 days). Then, the solid waste management of tourist resorts were collected from the resort owners and solid waste characteristic were collected from totally seven resorts and one restaurant and were analysed to use as the guidance for solid waste management in these area.

The study consisted of the present and problem of solid waste management of tourist resorts and restaurant, generation rate, composition and characteristic of solid waste. And the solid waste management in tourist resorts and restaurant under waste minimization and clean technology as following details:

4.1 The Present Solid Waste Management

4.1.1 Collection of Solid Waste

The tourist resort put garbage in or in front of rooms to include rattan garbage(Keng), small plastic garbage, small metal garbage, plastic bucket, black plastic bag, gunny bag. Everday, resort owners beginning collect solid waste at 10.00 a.m. In addition, some resort owners separated recyclable solid waste such as glass botter, plastic botter, aluminum can and sold to buy-back center at Thoeng district, Chiangrai province or Chaingkhum district, Phayao province. Some of tourist resorts and restaurants collected food wastes to plastic bucket to feed for pig and chicken later. And moreover solid waste, resort owners or hill tribe employees (employ by rate 100-200 baht per person per day) to keep and pulled in black plastic bag or gunny bag to disposal in landfill's village or shoulder of a hill beside village.

The solid waste around village's area, Rom Fa Thai Village headman employed five hill tribes (as adult and children by rate 100 baht per person per day)

collected solid waste by pick-up vehicle (volumn 1 ton) to disposal in landfill's village or shoulder of a hill beside village. Collected solid waste 3-5 times per day at 10.00 am to 14.00 pm

Collection in tourist resorts and restaurants had many problem to include 1) Tourist resorts didn't have enough garbage and collector. 2) Some tourist resort and restaurant didn't separate solid waste for recycling such as plastic or glass botter, aluminum can etc. 3) In festival such as New year's day and Valentine's day, the most tourist went to Phu Chi Fa and Rom Fa Thai Village to make many solid waste. The collector not able to collect solid waste to be finished in the day.

4.1.2 Disposal of Solid Waste

There are no solid waste landfill in Rom Fa Thai Village. Then, the disposal of solid waste using three methods as follow :

1) Open burning

The tourist resort owners collect solid waste to pile up and burn (such as paper and plastic) in the resort's area.

2) Open-dumping

Open-drumping in resort' s area and shoulder of hill far from Rom Fa Thai Village five hundred metres.And from the Febuary, 2003 solid waste was drumped of the newsite that was constructed by Tubtao Subdistrict Administration Organization which far from Rom Fa Thai Village of around one kilometer. But, this area is in the conversation forest and water shed class 1A which is not suitable for dumpling.

3) Animal Feeding

The food waste from tourist resorts and restaurants was mixed with softy stem of banana (*Samydaceae*) and boiled before using as feed for pig and chicken.

4.2 Solid Waste Generation Rate

The result of study and survey about the quantity and generation rates of solid waste in seven tourist resorts and one restaurant were presented as follow:

4.2.1 The Average Generation rate of Solid Waste (High and Low Season)

The total number of tourist in seven days was 1,163 persons. And the quantity of solid waste in seven days was 68.70 kilograms. Therefore solid waste generation rate 0.06 kg/person/day, on high season as show in table 4-1.

And the total number of tourist in seven days was 180 persons. And the quantity of slid waste in seven days was 3.90 kilograms. Therefore solid waste generation rate 0.02 kg/person/day, on low season as show in table 4-1.

The data have to be close to Environmental Research Institute, Chulalongkorn University, 1989-1990 survey and collected the data in tourism resource. Domestic tourist have generation rate between 1.40-10.00 litre/person/day or 0.06-0.45 kg/person/day to include cave, waterfall, national park,beach, island, or natural place, and the tourist could campling and eating food in these place.

And Rom Fa Thai Village have three restaurants. This research sampling Phu Chee Fa Pochana to case study. The restaurant have maximum service 70 seats. and open on 07.00-09.00 am, 11.00 am -13.00 pm, and 18.00-20.00 pm totally open to six hours and assure 0.5 hour/person/meal add three meals. The restaurant could totally capacity of tourist 840 person per day.

On high season within seven days, the totally number of tourist was around 588 persons (70% of total seat) and had quantity of solid waste collect (7 days) 23.54 kg/day. Therefore solid waste generation rate 0.04 kg/person/day as show in table 4-2.

On low season within seven days, the totally number of tourist was around 168 persons (20% of total seat) and had quantity of solid waste collect (7 days) 8.10 kg/day. Therefore solid waste generation rate 0.05 kg/person/day as show in table 4-2.

4.2.2 Quantity Solid waste of the years

In Rom Fa Thai Village have 16 tourist resorts and totally area of resort and tent were 3737.94 m^2 or 2.4 rai , and domestic tourist capacity were 1,043 person/day or 435 person/rai (1 person/3.6 m^2). And then quantity of solid waste in one year is 7,537.2 kilograms as show in table 4-3.

Table 4-1 Solid waste quantity and average generation rate of tourist resort (High and Low Season)

Season	Size of Resort	Number of Tourist (person/ 7 days)	Quantity (kilogram/day)		Average Generation rate (kg/person/d)
			Maximum (kg/person/d)	Minimum (kg/person/d)	
High	Large	324	1.59	0.07	0.07
	Medium	459	0.58	0.03	0.06
	Small	328	1.57	0.02	0.06
	Total				0.06[a]
Low	Large	86	0.20	0.12	0.02
	Medium	62	0.20	0.01	0.02
	Small	32	0.03	0.02	0.002
	Total				0.02[b]

Note : [a] 0.06= [(152.57 kg/324 person)+(181.21 kg/459 person)+ (36.08 kg/356 person)] /7 days

[b] 0.02= [(12.13 kg/86 person)+(10.79 kg/62 person)+(18.70 kg/56 person)]/7 days

Table 4-2 Solid waste quantity and average generation rate of restaurant (High and Low Season)

Season	Number of Tourist (Person/ 7 day)		Quantity (kg/person/d)	Average Generation rate (kg/person/d)
Low	70% of totally service capacity	588	23.54	0.04[c]
High	20% of totally service capacity	168	8.10	0.05[d]

Note : [c] 0.04 = 23.54 kg/d ÷588 person

[d] 0.05 = 8.10 kg/d ÷ 168 person

Table 4-3 Quantity of solid waste of the year

Source	Quantity of Solid waste		
	High season (62 days)	Low season (150 days)	Total (212 days)
1. Resort and Tent	3,879.97	939	4,818.97
2. Restaurant	1,458.24	1,260	2,718.24
Total (kg)	5,338.21	2,199	7,537.21

4.3 Composition and Characteristic of Solid Waste

4.3.1 Composition of Solid Waste

These were ten types of solid waste composition, of tourist resorts and restaurant, in this study which were generated during the seven days of surveying period on high season and seven days of surveying period on low season were shown in table 4-4.

Table 4-4 Material of solid waste in tourist resort and restaurant

Composition of Solid Waste	Materials
Glass	Beer bottle, spy bottle
Paper	Newspaper, cardboard, newsprint,
Plastic	Bottle
Aluminum	Aluminun can,
Food waste	Vegetables, fuits, meats,
Yard waste	Branch, leaf
Hazardous waste	Battery, insecticide can, oil
Foam	Ware foam
Textile	Cloth, glove, socks
Miscellancous	Tyre,condom, niron

All waste generated in the tourist resorts and restaurant were segregated into biodegradable or non-biodegradable. The non-biodegradable waste was further sorted into glass, paper, plastic, aluminum, hazardous waste, foam, textile and miscellancous – such as condom, niron etc. The biodegradable waste was further sorted into food waste and yard waste.

The composition of solid waste on high season consisted of glass (29.80% of total weight), paper (4.59% of total weight), plastic (3.72% of total weight), aluminium (1.76% of total weight), food waste (43.34% of total weight), Yard waste (3.14% of total weight), hazardous waste (0.10% of total weight), foam (0.34% of total weight), textile (0.30% of totalweight), and miscellancous (12.910% of total weight) as show in table 4-5.

The composition of solid waste on low season consisted of glass (42.76% of total weight), paper (3.56% of total weight), plastic (8.69% of total weight), aluminium (1.56% of total weight), food waste (30.29% of total weight), Yard waste (non% of total weight), hazardous waste (0.22% of total weight), foam (0.67% of total weight), textile (non% of total weight), and miscellancous (12.25% of total weight) as show in table 4-5.

4.3.2 Characteristic of Solid Waste

The characteristic of solid waste were presented in table 4-7. The Bulk density was 130 kilogram/cubic meter; moister content was 67.14 % by weight; Total solids 32.87 % of weight; volatile solids (VS) 74.71 % of total solids, nitrogen 2.99%, and carbon 41.5% respectively. In addition, the C/N ratio of solid waste were less than the recommended values. The C/N ratio of the solid waste was 14.22, unsuitable to compost. Because, the C/N ratio has been widely used to determine the quality of compost product. If the tourist resort owners want to compost biodegradable waste, then wood chip or yard waste have to add for C/N ratio.

Table 4-5 Composition of Solid waste in tourist resorts and restaurants.

Component	High season		Low season	
	Kg/day	(%w/w)	Kg/day	(%w/w)
Glass	25.66	29.80	6.27	42.76
Paper	3.95	4.59	0.52	3.56
Plastic	3.20	3.72	1.27	8.69
Aluminum	1.52	1.76	0.23	1.56
Food waste	37.31	43.34	4.44	30.29
Yard waste	2.70	3.14	-	-
Hazardous waste	0.09	0.10	0.03	0.22
Foam	0.29	0.34	0.10	0.67
Textile	0.26	0.30	-	-
Miscellancous	11.12	12.91	1.80	12.25
Total	86.10	100.00	14.66	100.00

Table 4-6 Composition of solid waste in tourist resorts and restaurants of the year

Component	High season (62 days)	Low season (150 days)	Total/Year	
	(kg)	(kg)	(kg)	(%w/w)
Glass	1,590.92	940.50	2,531.42	33.59
Paper	244.90	78.00	322.90	4.28
Plastic	198.40	190.50	388.90	5.16
Aluminum	94.24	34.50	128.74	1.71
Food waste	2,313.22	666.00	2,979.22	39.53
Yard waste	167.40	-	167.40	2.22
Hazardous waste	5.58	4.50	10.08	0.13
Foam	17.98	15.00	32.98	0.44
Textile	16.12	-	16.12	0.21
Miscellancous	689.44	270.00	959.44	12.73
Total	5,338.20	2,199	7,537.20	100.00

Table 4-7 Physical and chemical characteristic of solid waste

Characteristic	Unit	High season	Low season	Yearly Average
Physical				
1) Bulk density	Kg/m^3	130	-	130
2) Moister content	% by weight	66.16	68.11	67.14
Chemical				
1) Total Solids	% of weight	33.84	31.89	32.87
2) Volatile Solids	% of TS	81.64	67.77	74.71
3) Nitrogen	%	3.52	2.46	2.99
4) Carbon	%	45.35	37.65	41.5
5) C/n Ratio	-	13.23	15.21	14.22

The bulk density of tourist resort in Rom Fa Thai Village have to be close to Koh Samet national Park was 130 kilogram/cubic meter, researched by Environmental Research Institute, Chulalongkorn University, 1989-1990.

4.4 Solid Waste Management of Tourist Resort and Restaurant.

From data of generation rate, components and characteristic solid waste of tourist resort and restaurant in Rom Fa Thai Village, could be determine the solid waste management for non-biodegradable and biodegradable, as follow:

4.4.1 Source Separation and Collection

In tourist resorts, container may be put in or in front of room . The container in restaurant should be placed in convenient locations. A wide variety of recycling container styles are available. The size of container must be appropriate for the number of tourist, such as a 20-30 litres and design a three-container system per room for storaged of waste should be provided such as:

1) One container for recyclable waste. That had yellow colored container, rope. and had plastic bag put in.

2) One container for food waste by tourist. That had green colored containers, rope and had plastic bag put in.

3) One container for carry back of solid waste. This container use for non-biodegradable to except recyclable waste. That had black colored container, and had plastic black bag put in the container. When the tourist checked out, used rope to saddled a plastic bag and carried waste bag back to the city.

The three container had affixed with the stricker logo to promote the separation in tourist resort.

4.4.2. Waste Reduction and Utilization

The solid waste reduction and utilization as following details:

4.4.2.1 Recycling

The tourist resort owners could collected recyclable waste from recycling garbage of each room in tourist resorts. The following materials are currently recyclable in 1) glass-such as Beer bottle, 2) paper-such as newspaper, cardboard, newsprint ,3) plastic-such as bottle and 4) Aluminium-such as aluminum can.,

The recyclable waste was 44.74% of total weight and 3,371.96 kilogram/year. Many of these material have a very good reuse market value The recyclable waste, tourist resort owners were able to sold it to itinerant buyers or buy-back center in Chiangkum or Thoeng District and to supplement tourist resort owners income 8,180.87 baht/year as show in table 4-8.

4.4.2.2 Carry Back

The tourist resort in Rom Fa Thai Village was approximate1,600 metres above average sea level (m). This area was the conversation forest and water shed class 1A. The non-decomposting waste (in clued, hazardous waste, foam, textile and miscellancous – such as condom, niron etc.) could managed by carry back to the city (Thoeng district or Chiangkam district). The tourist could get plastic black bag from carry back waste garbage in or in front of room before check and carry back to the city. The quality solid waste for carry back was 13.51% of total weight and 1,018.62 kilogram/year.

Table 4-8 Benefit value of separation solid waste for recycling

Component of solid waste	Prices of Recyclable waste (Baht/kg)	High season		Low season	
		Quantity (kg)	Value (Baht)	Quantity (kg)	Value (Baht)
Glass	1	1,590.92	1,590.92	940.50	940.50
Paper	3.5	244.90	857.15	78.00	273.00
Plastic	5	198.40	992.00	190.50	952.50
Aluminum	20	94.24	1,884.8	34.50	690.00
Total (Baht)	-	-	5,324.87	-	2,856
Income (Baht/year)					8,180.87

4.4.2.3 Composting

All solid waste generated in the tourist resort is segregated into biodegradable, include food waste and yard waste (bio-composting waste). Currently the tourist resorts and restaurants produces food waste and yard waste more than 3,146.62 kilogram per year. This waste could made 1) bioextract 524 L could be use as fertilizer for plants and protect the plant from the insects as well, the tourist resort owners could sold bioextract to around 20,000 baht/year. 2) organic fertilizer could be use dregs waste for plants. The bioextract and organic fertilizer. was an essential method of waste reduction.

The simple method as follow: Put food and yard waste to fertilizer bag in the container to use as tourist resort or restaurant waste receiver. Mix water with molasses or brown sugar and micro-organic essence. Add more water or molasses at the above rate if the liquid is found too little. After one-two months, micro-organic liquid will be produced which will be very useful. see in appendix c.

4.4.2.4 Animal Feeding

The restuarant produce food waste between more than 30.29-43.34 % of total solid waste everyear. The food waste from restaurants can to boil with softy stem of banana (*Samydaceae*) and boiled before using as feed for pig and chicken and these use to replace prepared food for animals, tourist resort owners could be save.

4.5 Campaign of Solid Waste Management in Rom Fa Thai Village

4.5.1 Phu Chi Fa Forest Park were trained tourist resort owners, rppm service and tourist as follow detail:

1) Training the tourist owners and room service to separate and collect materials of solid waste, to made bioextract organic fertilization from food and yard waste, and could be used in resort and sold and to boil the food waste with soft stem of banana by sterile technique.

2) Training the tourist could to separate solid waste in three-containers system and solid waste carry back with black plastic bag in order to disposal in the city.

4.5.2 The local government such as Phu Chi Fa Forest Park, TAT northen office: Region 2 and Tub Tao Subdistrict Administration Organization to cooperate to information and campaign source separate to the tourist by "Carry Back for Phu Chi Fa" Project which is campaigning on the importance for the environment and wildlife.

CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

These have density 130 kg per m^3, moister content 67.14% by weight, total solid 32.87 % of weight, volatile solid 74.71% of total solids, total Nitrogen 2.99%, carbon 41.5%, and C/N ratio 14.22. If want to compost biodegradable waste, then wood chip or yard waste have to add for C/N ratio.

Sources of solid waste in Rom Fa Thai Village to consist of tourist resorts, and restaurant. Each source have generation rate in this:

1) On high season
   - Generation rate of Tourist Resorts 0.06 kg/person/day
   - Generationrate of Restaurants 0.02 kg/person/day
2) On low season
   - Generation rate of Tourist Resorts 0.04 kg/person/day
   - Generationrate of Restaurants 0.05 kg/person/day

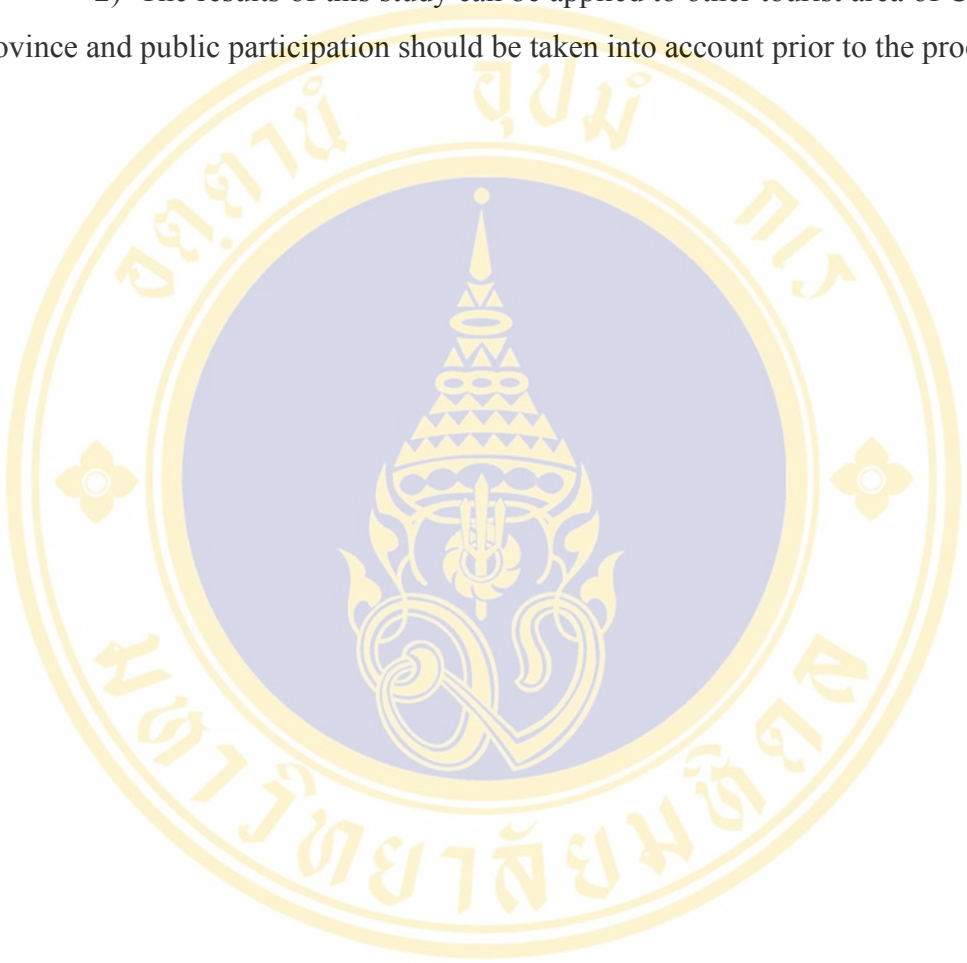
Total of solid waste 7,537.21 kilogram/year in present. On high season 5,338.21 kilogram/year and on low season 2,199 kilogram/year. And the composition of solid waste on the year consisted of 1) biodegradable- food waste, yard waste were 39.53% and 2.22% of total weight, respectively. 2) non-biodegradable- hazardous waste, foam, textile and miscellancous were 0.13%, 0.44%, 0.21%, and 12.73% of total weight, respectively. And 3) recycle waste-glass, paper, plastic, aluminium were 31.59%, 4.28%, 5.16%, and 1.71% of total weight, respectively.

Finally, the solid waste management of every tourist resorts, Rom Fa Thai Village was soure separation, recycling, composting, animal feeding and solid waste carry back by tourist with black plastic bag in order to disposal in the city.

5.2 Recommendations

1) Research on solid waste management the other tourist resorts in Phu Chi Fa – Pha Thang area.

2) The results of this study can be applied to other tourist area of Chiangrai province and public participation should be taken into account prior to the process.



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APPENDIX

APPENDIX A

สถิติจำนวนนักท่องเที่ยวที่เข้าไปในเขตวนอุทยานภูชี้ฟ้า

ประจำเดือน	จำนวนนักท่องเที่ยว	ปี 2541*		ปี 2542		ปี 2543		ปี 2544**	
		ไป-กลับ	พักแรม	ไป-กลับ	พักแรม	ไป-กลับ	พักแรม	ไป-กลับ	พักแรม
มกราคม	ชาวไทย	-	-	36,588	47,204	26,673	27,940	111,690	22,120
	ชาวต่างประเทศ	-	-	3,894	2,212	4,145	2,310	13,982	2,608
กุมภาพันธ์	ชาวไทย	-	-	6,602	9,978	6,678	2,283	7,940	3,030
	ชาวต่างประเทศ	-	-	1,213	1,064	242	85	610	196
มีนาคม	ชาวไทย	-	-	3,639	4,774	6,488	2,340	3,762	1,950
	ชาวต่างประเทศ	-	-	728	422	246	107	470	166
เมษายน	ชาวไทย	-	-	2,910	2,248	3,060	1,378	8,240	3,880
	ชาวต่างประเทศ	-	-	248	179	451	170	650	458
พฤษภาคม	ชาวไทย	-	-	2,630	-	3,359	1,601	3,170	-
	ชาวต่างประเทศ	-	-	324	-	561	188	110	-
มิถุนายน	ชาวไทย	34	5	965	-	1,087	-	-	-
	ชาวต่างประเทศ	-	-	-	-	55	-	-	-
กรกฎาคม	ชาวไทย	179	47	2,596	-	2,046	-	-	-
	ชาวต่างประเทศ	28	-	213	-	118	-	-	-
สิงหาคม	ชาวไทย	148	23	270	-	335	-	-	-
	ชาวต่างประเทศ	11	4	20	-	30	-	-	-
กันยายน	ชาวไทย	89	11	480	-	1,458	-	-	-
	ชาวต่างประเทศ	33	-	60	-	114	-	-	-
ตุลาคม	ชาวไทย	1,637	501	4,080	94	3,085	350	-	-
	ชาวต่างประเทศ	79	18	51	-	35	-	-	-
พฤศจิกายน	ชาวไทย	4,573	3,818	49,546	21,036	57,613	23,364	-	-
	ชาวต่างประเทศ	24	-	1,044	474	1,089	470	-	-
ธันวาคม	ชาวไทย	60,105	26,796	69,920	60,014	70,404	50,038	-	-
	ชาวต่างประเทศ	10,949	2,798	10,045	9,111	8,052	8,804	-	-
รวม		111,910		356,876		318,852		185,032	

หมายเหตุ: ปี 2541 เริ่มเก็บตั้งแต่เดือน มิถุนายน ถึง ธันวาคม

ปี 2542 เริ่มเก็บตั้งแต่เดือน มกราคม ถึง พฤษภาคม

ที่มา: กลุ่มงานวิชาการ ฝ่ายอนุรักษ์ สำนักงานป่าไม้เขตจังหวัดเชียงราย

APPENDIX B

Solid Waste Generation Rate on High Season and Low Season

จำนวนผู้ที่เข้าพัก ปริมาณขยะ และอัตราการเกิดขยะของที่พักแรม ช่วง HIGH SEASON

ที่พักแรม	จำนวนผู้ที่เข้าพักรวม	จำนวนผู้ที่เข้าพัก (คน) ธันวาคม 2544	ปริมาณขยะ (กิโลกรัม) และจำนวนผู้ที่เข้าพัก (ห้อง) มกราคม 2545						รวม	อัตราการเกิดขยะ กิโลกรัม/คน/วัน
		31	1	2	3	4	5	6		
1. ขนาดใหญ่ (จำนวนผู้ที่เข้า >75)										
ภูพิงค์ราชนิเวศน์		42.6	74.81	8.4	7.3	16.3	0.9	2.26	152.57	0.47
	80	143	47	25	27	35	13	34	324	
2. ขนาดกลาง (จำนวนผู้ที่เข้าพัก 35-75)										
ร่วมสงวนสร้าง		43.58	26.11	27.42	-	-	-	18.28	115.39	0.43
	60	76	126	47	-	6	16	-	271	
ดักษณ์มิลิการ		16.6	21.1	1.5	12.8	-	9.04	4.78	65.82	0.35
	70	51	37	46	4	-	25	25	188	
3.ขนาดเล็ก (จำนวนผู้ที่เข้าพัก <35)										
แดง		38.75	3.9	1.04	0.2	0.16	-	0.54	44.59	0.25
	35	103	32	10	12	4	-	19	180	
สันติภาพ		20.25	4.7	13.6	0.2	-	-	9.46	48.21	0.52
	30	52	3	25	2	-	-	10	92	
ยอด		25.2	9.76	0.64	-	-	-	-	35.6	0.68
	25	20	27	5	-	-	-	-	52	

ที่พักแรม	จำนวนผู้	ปริมาณขยะ (กิโลกรัม) และจำนวนผู้ที่เข้าพัก (ห้อง)							รวม	อัตราการ
	ที่เข้าพักรวม	ธันวาคม 2544	มกราคม 2545							เกิดขยะ
		31	1	2	3	4	5	6		กิโลกรัม/คน/วัน
ภูชี้ฟ้าโภชนา		0.85	11.4	2.8	0.25	-	-	3.4	18.7	0.33
1. ห้องพักและเต้นท์	20	4	12	18	7	-	-	15	56	
2. ร้านอาหาร	70	71.75	40.2	-	29.69	5.5	13.2	4.48	164.82	2.35

ดังนั้น ปริมาณขยะเฉลี่ยของห้องพัก = 68.70 กิโลกรัมต่อวัน

ปริมาณขยะเฉลี่ยของร้านอาหาร = 23.54 กิโลกรัมต่อวัน

หมายเหตุ 1. ปริมาณขยะที่เกิดขึ้นในที่พักแรมนั้น รวมระหว่างห้องพักและบริเวณลานกางเต้นท์

2. จำนวนผู้ที่เข้าพักแรมในที่พักแรมนั้น รวมระหว่างที่พักในห้องพักและกางเต้นท์

3. จำนวนผู้เข้าใช้บริการร้านอาหาร คิด 70 % ของจำนวนที่นั่งทั้งหมด

จำนวนผู้ที่เข้าพัก ปริมาณขยะ และอัตราการเกิดขยะของที่พักแรม ช่วง LOW SEASON

ที่พักแรม	จำนวนผู้ที่	ปริมาณขยะ (กิโลกรัม) และจำนวนผู้ที่เข้าพัก (ห้อง)							รวม	อัตราการ
	เข้าพักรวม	เมษายน 2545								เกิดขยะ
		13	14	15	16	17	18	19		กิโลกรัม/คน/วัน
1. ขนาดใหญ่ (จำนวนผู้ที่เข้า >75)										
ภูชี้ฟ้าอินทร์		-	1.53	5.09	5.51	-	-	-	12.13	0.14
	80	-	13	26	30	-	17	-	86	
2. ขนาดกลาง (จำนวนผู้ที่เข้าพัก 35-75)										
ร่วมสรรสร้าง		-	-	-	-	-	-	-		
	60	-	-	-	-	-	-	-		
ลักษณ์บริการ		0.72	0.34	2.57	5.71	1.39	0.06	-	10.79	0.17
	70	4	-	14	29	9	6	-	62	
3.ขนาดเล็ก (จำนวนผู้ที่เข้าพัก <35)										
แดง		-	-	-	-	-	-	-		
	35	-	-	-	-	-	-	-		
สันติภาพ		-	-	-	-	-	-	-		
	30	-	-	-	-	-	-	-		
ยอด		-	-	-	-	-	-	-		
	25	-	-	-	-	-	-	-		

ที่พักแรม	จำนวนผู้ที่	ปริมาณขยะ (กิโลกรัม) และจำนวนผู้ที่เข้าพัก (ห้อง)							รวม	อัตราการ
	เข้าพักรวม	เมษายน 2545								เกิดขยะ
		13	14	15	16	17	18	19		กิโลกรัม/คน/วัน
ภูชี้ฟ้าโภชนา		-	0.03	-	0.45	-	-	-	0.48	0.02
1. ห้องพักและเต้นท์	20	-	2	13	13	4	-	-	32	
2. ร้านอาหาร	70	15.16	10.51	8.88	5.76	5.82	2.49	-	48.62	2.31

ดังนั้น ปริมาณขยะเฉลี่ยของห้องพัก = 3.9 กิโลกรัมต่อวัน

ปริมาณขยะเฉลี่ยของร้านอาหาร = 8.10 กิโลกรัมต่อวัน

หมายเหตุ 1. ปริมาณขยะที่เกิดขึ้นในที่พักแรมนั้น เฉพาะห้องพัก

2. จำนวนผู้ที่เข้าพักแรมในที่พักแรมนั้น เฉพาะที่พักในห้องพัก

3. จำนวนผู้เข้าใช้บริการร้านอาหาร คิด 30 % ของจำนวนที่นั่งทั้งหมด

APPENDIX C

น้ำหมักชีวภาพ (Bioextract) หรือฮอร์โมนน้ำ

1. วัสดุและส่วนผสมโดยประมาณ

1) เศษพืช ผัก ผลไม้	60	กก.
2) EM	200-400	ซี.ซี.
3) กากน้ำตาล	400-500	ซี.ซี.
4) น้ำ	100	ลิตร

2. วิธีทำ

1) สับเศษผัก ผลไม้ ทั้งเปลือกและเมล็ดเข้าด้วยกันจนละเอียดบรรจุลงในถังหมัก

2) ผสม EM กากน้ำตาล น้ำ คลุกให้เข้ากันดีบรรจุลงในถังพลาสติก ปิดฝา หมักไว้ 1-2 เดือน กรองน้ำหมักใส่ขวดไว้ใช้ ส่วนกากน้ำไปฝังดินเป็นปุ๋ย น้ำฮอร์โมนพืชเก็บไว้ได้นาน 3 เดือน

3. วิธีใช้

1) นำฮอร์โมนน้ำ 20 ซี.ซี. (2 ช้อนโต๊ะ) ผสมน้ำสะอาด 5 ลิตร ฉีดพ่นหรือรดน้ำต้นไม้ ช่วงติดดอกจะทำให้ติดผลดี

2) ส่วนที่เป็นไขมันเหลืองๆ ในถังหมัก นำไปทากิ่งตอน กิ่งปักชำ ฯลฯ ช่วยให้การแตกรากดีมาก

แนวทางการแก้ปัญหา โดยการนำเศษผัก ผลไม้ มาผลิตเป็นฮอร์โมนน้ำ

กลุ่มสมาชิก จากครัวเรือนบ้านขัวแคร่ รวมทั้งตลาดสดบ้านดู่ ประมาณการว่า ในระยะ 3 ปีแรก จะผลิตให้ได้ปีละ 500 ลิตร ซึ่งต้องใช้เศษผัก ผลไม้ ประมาณ 3,000 กิโลกรัมต่อปี เท่ากับได้ช่วยกำจัดเศษผัก ผลไม้ ไม่ให้เน่าเสียได้ถึง 9,000 กิโลกรัม และสมาชิกกลุ่มจะมีรายได้จากฮอร์โมนน้ำอีกประมาณ 60,000 บาท (ลิตรละ 40 บาท)

ที่มา: แนวทางการแก้ปัญหาขยะและวัสดุเหลือใช้โดยชุมชน บทเรียนจากประสบการณ์ของโครงการวิจัยกระบวนการมีส่วนร่วมของชุมชนบ้านขัวแคร่ ในการแก้ปัญหาขยะ โดยการผลิตอินทรีย์สารเพื่อการเกษตร. ศูนย์ประสานงานวิจัย สกว.ภาค เขตเชียงราย-พะเยา-ฝาง, 2546.

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