
The Project Feasibility study of Solid waste Management in Kalasin Local Governance Organization to Produce Refuse Derived Fuel (RDF)

**Prayoon Wongchantra^{1*}, Kuantean Wongchantra², Kannika Sookngam¹,
Likhit Junkaew¹, Suparat Ongon¹, Surasak Kaeongam¹, Chonlatit
Phansiri¹ and Akkharadech Oncharoen¹**

¹Center of Environmental Education Research and Training, Faculty of Environment and Resource Studies, Mahasarakham University, Mahasarakham, Thailand 44150 ; ² Srimahasarakham Nursing College, Mahasarakham, Thailand 44000.

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The purposes of this research were to study the situation and waste management of the Kalasin local governance organizations and to project feasibility study of the construction waste management in order to produce a fuel. The sample is used Kalasin province local government district of 150 purposively selected. Tool in research was an interview of solid waste management in local government organization of Kalasin province. The data were analyzed by statistics ; percentage and mean. The results showed that the Kalasin province was divided into two municipalities, the rule of 79 and break a rule of area of tambon administrative organization of 71 of total 150. They had garbage collection of 99 and no garbage collection of 51. The floor was made of Kalasin waste quantities 402.97 tons / day, there were 47 waste disposal pond. Most of the place of waste disposal to the bulk had illegally burned by the pond of waste disposal system in the removal of hygiene, powerful, and also affect the people who live nearby. The budget in solid waste management was 182,178,902 baht per year which department was the possibility of creating waste management to produce refuse derived fuel(RDF). The waste caused a 402.97 tons / day used in production is the refuse derived fuel(RDF). and can reduce the problems in solid waste management using the style being appropriate in the management of solid waste management in the form set disposal system by producing refuse derived fuel(RDF).

Keywords: The project feasibility study, Solid waste management, Kalasin Local Governance Organization, produce refuse derived fuel(RDF)

*Coressponding Author: Prayoon Wongchantra; E-mail address: prayoon_nam@yahoo.co.th

Introduction

The problem of solid waste is a major problem in Thai society for a long time. This is due to an increase in the amount of solid waste each year in proportion to the increase in population, economic expansion and changes in consumer behavior of the people. At the same time, the amount of solid waste received to manage to increase properly at low rates. Although local authorities, which are responsible for waste management Both storage, moving, destroying. The budget for the construction of the waste disposal system will be increased but it is not enough with the amount of solid waste (Pollution Control Department, 2013).

Thailand has a total waste of 26.85 million tons per year, an average of 73,560 tons per day, but only 31.06% or 8.34 million tons per year is disposed of properly, bringing the total consumption of 4.94 million tons per year to 7.15 million tons per year, and there is 6.22 million tonnes of waste left in the area and transported to landfills and burned in a hygienic kiln, reduction and separation of waste from the source. According to the draft master plan for the management of solid waste and hazardous waste of the country 2016-2021 in progress for the Cabinet approval, the 3R ; Reduce, Reuse, and Recycle to recycle disposal of solid waste and hazardous waste by properly processing energy or limiting hazardous waste. The rate of community solid waste is expected to increase from 2008 to 2015 at an average of 1.13 kg per person per day, the amount of waste is 600,000 tons per year, but there are only 433 correct disposal sites because Thailand has 7,800 localities nationwide (Yangtean P. 2017).

Kalasin province get the importance of solid waste management of local governance organizations in Kalasin province, which is the problem of solid waste in Kalasin province. This is due to rapid economic and social expansion impacted on environmental quality in areas such as water pollution, soil pollution, air pollution. And it is a public health problem, dangerous for people's health, such as foul odor as a breeding ground for pathogens. The solid waste management of local governance organizations in Kalasin province. It was not as effective due to lack of personnels having knowledge and understanding of appropriate solid waste management in the operation as well as the use of inappropriate technology. Since most of today's waste is collected from the municipality, it collects on the ground to allow for natural decay and may be burnt. In this way, environmental disposal results in environmental problems and the health of the people, in addition, the problem of the provision of waste disposal facilities to dispose of properly disposed waste. For this reason, the researcher wishes to study the situation and guidelines of solid waste management of local governance organizations in Kalasin province.

Objectives: to study the situation and guidelines of waste management of the Kalasin local governance organizations and study project feasibility of the construction waste management in order to produce a Refuse Derived Fuel (RDF).

Materials and methods

Study area

Study Kalasin province area total of 18 districts (150 sub-districts).

Population and sample

local governance organizations of Kalasin Province consists of 18 districts (150 sub-districts); Mueang Kalasin district, Yang Talat district, Kamalasai district, Sahatsakhan district, Kuchinarai district, Tha Khantho district, Somdet district, Khao Wong District, Huai Mek district, Kham Muang district, Rong Kham district, Nong Kung Si district, Na Mon district, Huai Phueng district, Sam Chai district, Na Khu district, Don Chan district, and Khong Chai district.

Instruments used to collect data

Used record and survey of solid waste management of local governance organizations of Kalasin province.

Field data collection

- 1) General information of Kalasin province.
- 2) Survey of solid waste management of local governance organizations of Kalasin province
- 3) Study and analyze the feasibility of the RDF project consisting of 4 aspects:
 - 3.1) Feasibility study for the area of waste management project in the production of RDF.
 - 3.2) Feasibility study for technical waste management as RDF.
 - 3.3) Feasibility study for the economics of waste management for Fuel Production as RDF.
 - 3.4) Feasibility study on waste management for Fuel Production as RDF.

Results

Situation and guidelines of solid waste management of local governance organizations of Kalasin province

There are 150 local governance organizations of Kalasin province. There are 99 solid waste collection facilities and 51 waste disposal sites which have 190 garbage trucks. In the collection of solid waste, there were 50 wastes sorters and 49 wastes were not sorted out. The highest was Yangtabat district about 93.74 tons / day and the highest was sub-district of Yang Talat 37.27 tons / day (Table 2.) The income budget derived from the collection of waste from household waste is on average 10 baht per household and the budget for waste collection and solid waste management. In the management of the local governance organizations of Kalasin province, the fee is 26,929,021 Baht per year and the budget is divided into. The budget for garbage collection is 49,617,972 Baht per year and the solid waste management is 105,631,909 Baht per year. In solid waste management in Kalasin province, the waste management budget is 182,178,902 Baht per year. (Table 2)

In Kalasin Province, there are 47 solid waste disposal sites in the area. There are various types of waste disposal, including Open Dumping, Open Burning, and the cost of solid waste disposal is about 400-450 Baht per tons. The waste disposal site has a size of 1-10 rai of 30 locations, size of 11-20 rai of 11 locations, size of 21-30 rai of 3 locations, and the area of 31 rai or more 3 locations.



Figure 1. The current location of solid waste collection

Table 1 Area of local governance organizations of Kalasin province and Areas for solid waste storage.

District	Area of Administration		number of local authorities	Collection of solid waste from local governance organizations		Number of garbage trucks (cars)
	Municipality	Sub-district		storage	No storage	
1. Mueang Kalasin	16	1	17	14	3	32
2. Yang Talat	8	9	17	7	3	14
3. Kamalasai	5	5	10	15	2	22
4. Sahatsakhan	6	2	8	5	3	6
5. Kuchinarai	5	9	14	9	5	15
6. Tha Khantho	5	1	6	5	1	7
7. Somdet	5	4	9	2	7	6
8. Khao Wong	4	2	6	5	1	7
9. Huai Mek	4	7	11	7	4	9
10. Kham Muang	3	5	8	5	3	6
11. Rong Kham	1	2	3	1	2	3
12. Nong KungSi	7	3	10	7	3	10
13. Na Mon	2	4	6	5	1	9
14. Huai Phueng	3	2	5	3	2	5
15. Sam Chai	0	4	4	-	4	-
16. Na Khu	2	4	6	4	2	6
17. Don Chan	2	3	5	3	2	3
18. Khong Chai	1	4	5	2	3	2
Total	79	71	150	99	51	190

Table 2 The amount and budget of waste management of local governance organizations of Kalasin province classified as 18 districts as follows.

District	Amount of waste (tons/day)	Sorting Solid waste		Solid Waste Management Budget		
		have	none	Revenue budget	Expenditures Transportation (Baht / year)	management (Baht / year)
1. Mueang Kalasin	89.25	12	2	5,129,520	9,439,520	27,933,574
2. Yang Talat	25.58	6	1	2,533,560	*	10,617,160
3. Kamalasai	93.74	8	7	3,870,100	12,628,148	13,056,330
4. Sahatsakhan	15	3	2	1,267,800	3,267,756	4,814,516
5. Kuchinarai	46	2	7	2,787,960	5,377,056	9,096,606
6. Tha Khantho	13.63	2	3	686,200	2,902,144	4,313,400
7. Somdet	8.8	1	1	1,548,960	*	6,480,000
8. Khao Wong	17	1	4	1,173,120	1,921,992	3,732,840
9. Huai Mek	19.47	4	3	1,267,290	2,024,400	4,963,705
10. Kham Muang	10.5	1	4	997,380	*	3,406,296
11. Rong Kham	3.5	0	1	218,761	2,280,000	2,285,032
12. Nong Kung Si	16.66	5	2	1,319,000	5,927,636	2,965,330
13. Na Mon	10.09	1	4	859,500	473,720	5,197,280
14. Huai Phueng	8.5	1	2	1,306,100	480,000	1,540,000
15. Sam Chai				No storage of solid waste		
16. Na Khu	10.6	2	2	741,040	2,895,600	2,664,000
17. Don Chan	11.15	1	2	852,890	*	1,735,200
18. Khong Chai	3.5	0	2	369,840	*	830,640
Total	402.97	50	49	26,929,021	49,617,972	105,631,909

Annotation: * The waste budget is shared with the waste management budget

The study found that the area of the Kamalasai District Municipality was suitable for the establishment of RDF, which was studied and analyze the feasibility into 4 areas.

1) The waste management project to produce as RDF, the projects study considered for the selection in project implementation, the alternative site of the RDF project is the RDF, which is located in Kamalasai District, Kalasin Province. The location of the project are reasonable, and the project is located in a suitable location and environment and enough space for establishment and expansion Including a space for construction Install or carry out environmental treatment or treatment and disposal. The project location is not in the watershed

area and away from the community, schools and places of worship of not less than 1 kilometer. The distance between the location of the project according to the terms of the relevant legislation.



Figure 2. Area of solid waste Management Project for Fuel (RDF)

2) Technical management of waste as RDF according to the study in Kalasin province, there are 402.97 tons of waste each day selected areas are suitable for the selection of RDF technologies, which have been selected from RDF technologies since the start of non-combustible waste sorting, such as metal, glass, rubble, hazardous waste and recyclable waste steel and aluminum components separated from the solid waste. Then add garbage to the mincer to reduce the size and feed into the oven to reduce the moisture content of the waste by using heat from steam or hot air to dry the waste, the weight can be reduced by almost 50% (moisture content not exceeding 15%) and finally sent to the pellet machine to make it Granular waste Fuel rods with appropriate size and density the waste can be manufacture of 300-400 tons per day. When the waste is collected the portion that can be produced as a fuel rod is 85% and it can produce up to 150 tons of RDF-5 fuel per day.

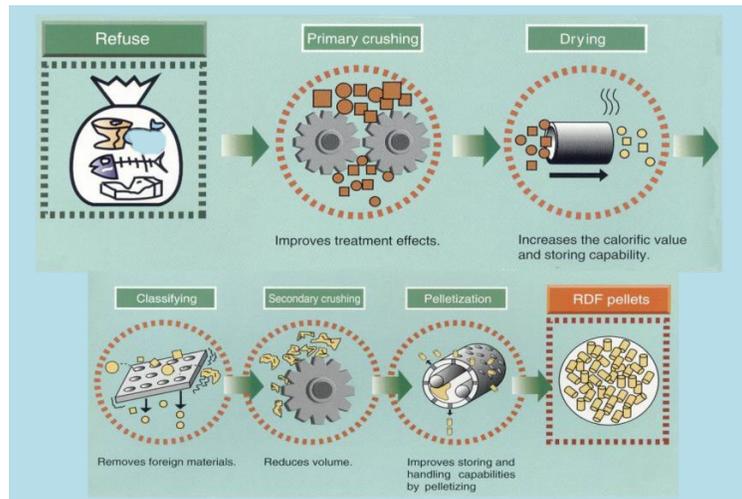


Figure 3. Processing of waste from solid waste (Densified RDF : RDF5)
 origin : <http://prachuapkhirikhan.mnre.go.th>

3) The economics of waste management to RDF, the financial return of the investment project of 177,489,006.14 Baht will have an IRR of 26.4% and a net cash flow of NPV 624,349,487.31 million. The payback period of the project is 2 years 3 months. It shows that the RDF-5 waste incineration plant is feasible to invest in. It is a fast-paced and cost-effective RDF-5 project.

4) Management within the solid waste management project (RDF), found that Kamalasai district municipality in Kamalasai district, Kalasin province is ready to manage waste to produce fuel as Refuse Derived fuel (RDF). Solid waste is used in the production of fuel rods 402.97 tons / day. It can reduce the problem of waste disposal use appropriate waste management approach. In the form of a solid waste disposal system, RDF-5 can be used to produce electricity. In addition to the management of solid waste RDF-5 is capable of handling solid waste up to 400-450 tons and can reduce the environmental, social, economic, and environmental impacts of landfill disposal in the future.

Discussion

1. Situation and guidelines of solid waste management of local governance organizations of Kalasin province, there are 99 solid waste collection facilities and 51 of them have no solid waste and have 190 cars garbage trucks of solid waste. There were 50 wastes sorters and 49 wastes were not sorted out. The amount of solid waste is 402.97 tons per day the total waste management budget is 182,178,902 Baht per year. There are 47 waste

disposal sites, most of which are waste disposal sites Dumping on the floor and then burnt (Open Burning) buried in the incubator because solid waste disposal does not have a system for disposing of ineffective waste, it also affected the communities that live nearby following the concept of Udomsirirotj, Kr. (1994) It said that solid waste management is a guiding principle in the implementation of control temporary collection of garbage in containers, collection of solid waste, transport and transportation, conversion of solid waste and disposal of waste, taking into account the maximum benefits of hygiene, scenery, economics, environmental preservation and the acceptance of society. Rubbish is a problem that affects communities a lot of germs causes of foul odors and wastewater generated by debris accumulation around the area. Knowledge and understanding of solid waste management systems can help to develop a solid waste management system that is effective and sanitary and following the concept of Samarts, M., Srisarin.R. (1997) future trends and restrictions on solid waste will be avoided or reduced this is to minimize waste and to reduce the risk of contamination from solid waste, which is the nature of the prevention and resolution of the problem that causes the site to be more appropriate and accurate than the past The management of waste must be changed to focus on reducing the amount of waste according to the modern concept which is in line with the research of Kaewhao, S. (2014) Participation of the community in the solid waste management of the nongko administration, borabue district, maha sarakham province. The results showed that most household waste was managed by the sub-district administrative organization, and that about 93 % of the community people were satisfied with the management. The people were found to moderately participate in solid waste management by solid waste separation before throwing it away what they needed were black plastic bags for solid waste, bins with the lids, punctuality for waste collection, promotion of effective waste re-use or recycling, and establishment of a solid waste bank.

2 The study found that the area of the Kamalasai District Municipality was suitable for the establishment of RDF, which was studied and analyze the feasibility into 4 areas.

2.1) The project area of Kamalasai district; Kalasin province the location and location of the site are of an appropriate size, and the project is located in a suitable location and environment. The area is adequate for the establishment and expansion of the business, as well as areas for the construction, installation or operation of environmental treatment or for the treatment and disposal of solid wastes generated by the project site, not in the watershed area. It is more than one kilometer from the religious community and has a distance from the location of the project in accordance with the relevant

laws according to the rules Pollution Control Department. (2013) For recycling and recycling of common materials. Any person who will operate as a separate place. 1) map showing the location and location of the site using the appropriate scale. 2) displays the process flow chart Origin / type, weight of the amount of waste or recycled material. 3) number of days and hours of operation total personnel, the size of the facility, machinery and equipment used in the operation. 4) displays the area used for the separation collection of recyclable and non-recyclable materials. And The location of the site is: 1) not located in the first and second floor watershed in accordance with the Cabinet resolution related to the watershed classification on 28 May 1985. 2) the site is located away from Wat Mun community schools, educational institutes, hospitals, and the drinking water from wells, natural or manmade wetland, irrigation canal and water supply plant not less than 300 meters, or as required by government agencies or other relevant laws. 4) located in a suitable location and environment, sufficient space for establishment and expansion including a space for construction install or carry out environmental treatment or treatment and disposal which is in line with the research of Vichiansinpa, J., Wongram, N., and Wantong, Ch. Application (2015) The research entitled application of geographic information systems on Sanitary Landfill Site Selection: a case study of Lam Plai Mat District, Buriram Province' aimed to determine suitable areas for sanitary landfill and the opinions of people towards new sanitary landfill site in the area of Lam Plai Mat district, Buriram province. The research methods were used through the analysis of biophysical factors and the social-cultural environmental factors, which included 10 factors, for instance, historic site, main Street, communities, ground water, land use, soil characteristics, groundwater levels, artesian well and flood risk area. An Analytic Hierarchical Process (AHP) was employed to compare the factor weight by 4 specialists because the factors influencing suitable area were different. The suitable areas can be divided into 5 levels: most appropriate, very appropriate, medium appropriate, less appropriate and inappropriate. The results showed that appropriate areas for sanitary landfill in Lam Plai Mat District, Buriram Province, covered an area of 54.302 square kilometers and the respondents agreed with the creation of one area of landfill out of four areas at Nongbuakhok with coordinates : 271254E 1658041N, covering an area of 4.25 square kilometers, which was about 7 kilometers far away from Lam Plai Mat Sub-district Municipality.

2.2) Technical management of waste as RDF; the amount of solid waste in Kalasin province is 402.97 tons per day, which is suitable for solid waste management. The RDF technology is used to produce fuel rods of appropriate size and density. The amount of solid waste in Kalasin province is

402.97 tons per day, which is suitable for solid waste management. RDF technology is used to produce fuel rods of appropriate size and density the garbage can get 300-400 tons per day. After sorting out unused garbage, 85% of the solid waste can be produced as fuel rods. The RDF-5 is a fuel rod that can produce up to 150 tons of fuel per day following the concept of Ngadkrathok, S. (2017: Website) It said that the project and the project analysis will consist of project flow analysis, output analysis, and project indicators analysis of relationships and linkages between projects and strategies at various levels stakeholder analysis, cashflow projection, cost / benefit analysis, relationship analysis with other projects and risk analysis which is in line with the research of Foundation of Environmental Education (2015) Study and analyze the waste management and disposal project of the metropolitan municipality and local administrative organizations nearby Phra Nakhon Si Ayutthaya Province. The purpose to solve the problem of municipal solid waste and local administrative organizations nearby the waste management and disposal of the Nakhon Luang, municipality and local administrative organizations nearby according to the waste management plan of Ayutthaya Province and to increase local power security and Phra Nakhon Si Ayutthaya Province. The study indicated that the project of the Nakhon Luang municipality is in line with the implementation of the solid waste management plan of Phra Nakhon Si Ayutthaya Province by eliminating waste through conversion into fuel (RDF), which were suited up waste management must be managed efficiently and the waste management plan of Phra Nakhon Si Ayutthaya Province encourages the implementation the guidelines for the development of solid waste disposal system from collection reuse removal technology and style of management in addition, the private sector is involved in the implementation the project can accommodate the amount waste that occurs in the future as well it can reduce the amount of waste that can be disposed of and can be recycled for economic and environmental benefits.

2.3) The Economics of Waste Management for RDF when studying and analyzing the financial return of a project from an investment there will be financial returns the payback period of the project is 2 years 3 months which showed that waste plants to produce fuel RDF-5 for the possibility of investing in construction projects yield high return on their investment quickly and seamlessly integrate with projects to generate electricity from fuel RDF-5 following the concept of Yingcharoen, P. (1999) In the analysis of economic data the optimal ratio for economic analysis is the opportunity cost of capital this is the return of capital to the best alternative the appropriate discount rate used in the financial analysis is the cost of capital, which is the interest rate or the rate at which financial supporters expect from their investments which is in

line with the research of Ariyaphonpanya, R. (2008) The objective of this research was to the study which estimate cost,return and a financial and economic feasibility study of hotel building investment in Patong beach, Phuket. The study based on theory of feasibility project analysis in four aspects payback period,Net Present Value(NPV),Benefit-cost ratio (BCR),and Internal Rate of Return (IRR) and variation testing, the internal rate of return was 12.02 percent and the pay-back period was 8.5 years. The swiching value test that cost increasing was 37 percent and benefit decreasing was 27 percent. A financial and economic feasibility study of hotel building investment in Patong beach, Phuket province do be still feasible and had a low degree of risk worth for investing.

2.4) Management within the solid waste management project (RDF). It found that Kamalasai district municipality in Kamalasai district, Kalasin province is ready to manage waste to produce fuel (Refuse Derived fuel : RDF). Solid waste is used in the production of fuel rods 402.97 tons / day. It can reduce the problem of waste disposal use appropriate waste management approach. In the form of a solid waste disposal system, RDF-5 can be used to produce electricity. In addition to the management of solid waste RDF-5 is capable of handling solid waste up to 400-450 tons and can reduce the environmental, social, economic, and environmental impacts of landfill disposal in the future following the concept of Bangmo, S. (2010) Have a comment that the organization is a group of individuals co-workers to achieve the set goals group sharing must be permanent organized within groups about the authority of each person and regulations to comply with the definition of an organization consists of 1) a group of people permanently assembled 2) a joint activity 3) to achieve a common goal. And following the concept of Chandansuwan, S. (2007) Concluded that management is the process of designing and integrating the environment to achieve the goal effectively management of the organization requires organizational management by gathering the various activities of the organization, leading to the realization of the roles, objectives, concepts and functions of the organization the management of each level includes the management of resources within the organization with effective integration which is in line with the research of Wongchantra, P. *et al.* (2017) This research were to study solid waste management in Mahasarakham Province and to study the solid waste management model in Mahasarakham province. The research area was made up of 13 districts in Mahasarakham province. The amount of solid waste in Mahasarakham province was found at 379,9 tons per day. There were 28 waste disposal sites in Mahasarakham. Over the past five years, 693,542.5 tons of solid waste has been accumulated. The used budget for garbage collection totals 34,262,280 Baht per year. There were 39 solid waste management personnel and there are 111 garbage collection trucks. The frequency of solid waste

collection was about 115 times per day collected from Monday through Friday. The solid waste management of Mahasarakham was divided into centers: cluster 1: a district waste energy plant (mueng districts), cluster 2 (Chiang Yuen districts), cluster 3 (Borabuesubdistrict districts), cluster 4 (Phayakkhaphum districts) and cluster 5 (WapiPathum districts) were a landfill site for waste disposal to be transported to the waste electrical power plant.

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