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# **Demonstration of BAT and BEP in the Fossil Fuel-fired Utilities and Industrial Boilers in response to the Stockholm Convention on POPs**

## **Draft Survey Report**

### **Waste Vegetable Oil and Waste Lubricant Oil**

#### **Lao PDR**

**Case Study in Vientiane Capital and Bolikhamxay Provinces**



April 2012

## Abbreviation

- WVO Waste vegetable oil
- WLO Waste lubricant oil
- L Litter
- WD Working day
- Cap Capital

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## Abstract

Due to increase of local interest in biodiesel production and heating energy from waste oil, the study was conducted to estimate potential source of the necessary feedstock cooking oil or waste vegetable oil and waste lubricant oil, the survey was conducted in two provinces in Vientiane capital and Bolikhamxay province for two weeks, gathering information about rates of oil throughput, collection practice and local interview. After compilation and analysis, this information revealed a projected waste vegetable oil and waste lubricant oil throughput 34,850 L per month in Bolikhamxay (WLO potential to supply) and 111,600 L per month (WLO demand), however estimate the quantity of WLO demand is about 45,000 L per month in Vientiane capital.

## I. Introduction

With the demand of heating power in heating industry, flue oil, bio product and renewable resources increasing, there is a great demand for raw materials.

### 1.1 Location of Survey

The survey area was select in two provinces in Lao PDR, because according the time of study is short, beside that Vientiane capital and Bolikhamxay are the way to import the lubricant oil and vegetable oil and beside that two provinces have much demand to use waste oil (WVO & WLO).

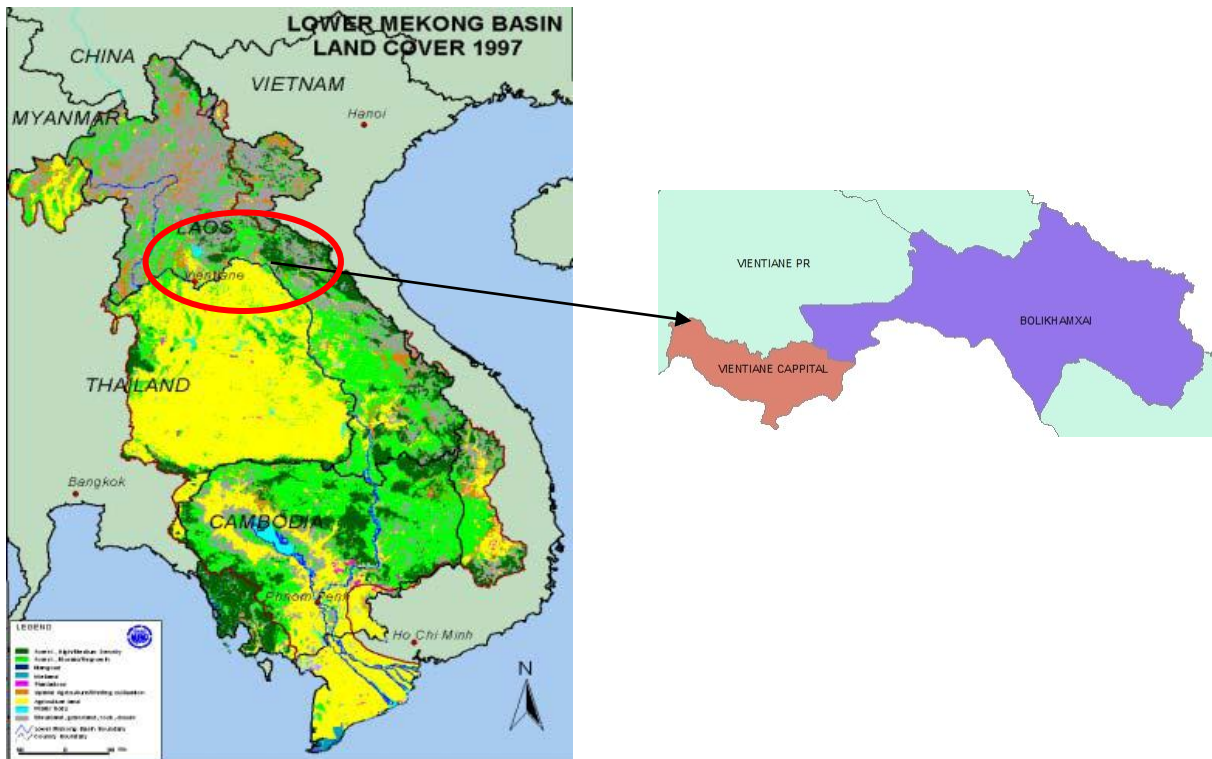


Figure 1 Location of study area

## II. Methodology and Time Line

The concept of quantifying WVO and WLO output by surveying was conceived in March of 2012. At that time, a WVO and WLO survey visited the private factory that is fabricated steel and the restaurant and hotel to interview a person who is participant in both provinces and interview of the owner factory how to correct and stock raw material of heating power as the waste oil and how can they improve the burner and how much for each month they used.

Beside that the government sector has provided the list of the garage and the place in the province that has ability to sell waste vegetable oil and waste lubricant oil.



## 2.1 Vientiane capital

It is the capital and largest city of Laos, situated in the Mekong river, Vientiane is located in the prefecture Vientiane was the administrative capital and due to economic growth in recent times, it has become the economic center of Laos and It's located in the north-west of the country. The economy in Vientiane is essentially a free market system with active central planning by the government. The estimated population of the city is 754,000 (2009), and total Area is 3,920 square kilometers.

Vientiane city comprises the following districts: Chanthabuly, Hadxaifong, Sikhottabong Sisattanak, Xaysettha, Saythany, Nasaythong, Sangthong, Pakngum,

The information provided by Department of Energy and Mines, because the government sector is important part to receive information of quantity that import lubricant oil and vegetable oil to the country, however the volume of vegetable oil that imported directly by the private restaurant and hotel is not recorded.

The private sector is the part of consumption and produce waste oil; therefore, this study visited the private company to gain understanding the process of produce product that need heating from the waste oil, such as:

Table 1 Source of visited to interview in Capital

Industry	Restaurant and hotel
<ul style="list-style-type: none"> <li>- Vientiane steel industry</li> <li>- Star petroleum</li> <li>- Xomvang Iron factory VSL</li> <li>- Khamhung Xaychalern steel factory</li> </ul>	<ul style="list-style-type: none"> <li>- Chanthapanya hotel</li> <li>- Patumphone hotel</li> <li>- Sengthavane hotel</li> <li>- Wansana hotel</li> <li>- Sengthavane hotel</li> <li>- Moundernight restaurant</li> <li>- Marktvo restaurant and bar</li> <li>- Daovieng Restaurant</li> <li>- Mithaparp restaurant</li> </ul>

Table 2 the quantity of import lubricant oil and Vegetable oil in a year 2005-2011

No.	Year	Vientiane Cap.		Bolikhamsay Province		Remarks
		Lubricant oil (L)	Vegetable oil (L)	Lubricant oil (L)	Vegetable oil (L)	
1.	2007-2008	N/A		50,636	48,970	
2.	2008-2009	N/A		1,620	No	
3.	2009-2010	N/A		17,718	No	

4.	2010-2011	See detail next table	See detail next table	No	No	
5.	2011-2012	See detail next table	See detail next table	374	No	

Table 3 Statistic import of lubricant oil, Year 2011

Lubricant oil			
No.	Quantity (Kg)	Amount (USD)	Source
1	45,550	41,250	China
2	11,685	62,092	South Korea
3	3,600	47,730	Singapore
4	3,248,350	7,475,065	Thailand
5	32,400	79,863	America
6	20,808	77,091	Vietnam
	3,362,393	7,783,092	

Source: Ministry of Industry and Commerce, Import – Export Department

Table 4 Statistic import of vegetable oil, Year 2011

Vegetable oil			
No.	Quantity (Kg)	Amount (USD)	Source
1	24	14	Australia
2	45,661	28,366	China
3	72	43	Singapore
4	3,682,238	3,262,432	Thailand
5	42,165	40,705	Vietnam
	3,770,160	3,331,561	

Source: Ministry of Industry and Commerce, Import – Export Department

## 2.2 Bolikhamxay province

Bolikhamxay Province is also the location of the Nam Kading National Protected Area, which although not yet developed for tourism, has high potential for wildlife viewing with virtually no people living within its borders. The Wildlife Conservation Society has plans to assist the province in determining the feasibility of developing ecotourism in the Nam Kading. One of the country's most extensive wetland systems, located near Pakxan town, hosts a unique and abundant population of migratory birds. The area can be accessed by a number of trails southwest of Pakxan town.

In this province, the study visited the private factory who consumes waste lubricant oil and the garage who correct the waste lubricant to sell to the factory, beside that the interview question is a tool to make understanding the cycle of waste oil, after that the large restaurant and hotel were visited.

The table below shows that all trend garages that have ability to correct the lubricant oil for supply to factory.

Table 5 Main sector has visited

Industry	Restaurant and hotel	Government sector
<ul style="list-style-type: none"> <li>- KX Kounxay steel fabricator limited</li> <li>- M.X steel factory limited</li> <li>- Saylong steel factory</li> <li>- Watthana steel fabricator limit</li> </ul>	<ul style="list-style-type: none"> <li>- Sainamsan</li> <li>- Kongview</li> <li>- Khamkong</li> <li>- Tavan seendard</li> </ul>	<ul style="list-style-type: none"> <li>- Industry and mining department</li> <li>- Public work and transportation department</li> </ul>

### III. Result

The main focus of the survey is to obtain an estimate of WVO and WLO resources in the Bolikhamxay province (7 districts) and Vientiane capital (8 districts), however in Vientiane capital is lack of access to the each district, then It was decided to break these data up by type of factory and restaurant for a more thorough understanding of the waste vegetable oil and lubricant oil profile. This information can be most clearly seen in Table 4 to 7 and the price of WVO and WLO are shown on table 8

Table 6 Waste Vegetable Oil Survey Results Categorized by Type of Establishment in Bolikhamxay Province

Business type	Total population	Average waste oil generated by respondents L/month
1. Restaurant		
<ul style="list-style-type: none"> <li>- Sainamsan</li> <li>- Kongview</li> <li>- Khemkhong</li> <li>- Tavan seendard</li> <li>- Namsongsi</li> </ul>	<ul style="list-style-type: none"> <li>50~100</li> <li>50~80</li> <li>50~80</li> <li>50~80</li> <li>20~40</li> </ul>	<ul style="list-style-type: none"> <li>60 – 80</li> <li>40 – 50</li> <li>30 – 40</li> <li>20 – 40</li> <li>30 – 40</li> </ul>

Source: Site Visit Interview

Table 7 Waste Vegetable Oil Survey Results Categorized by Type of Establishment in Vientiane Capital

Business type	Total population	Average waste oil generated by respondents L/month	After use
1. Restaurant			
- Chanthapanya hotel	100~200	80 - 100	Sell
- Patumphone hotel	50~100	80 - 100	Sell
- Sengthavane hotel	300~400	100 - 120	Sell
- Wansana hotel	300~400	400 - 500	Sell
- Moundernight restaurant	300~400	400 - 500	Sell
- Orkid hotel	100~200	100 - 200	Sell
- Daovieng Restaurant	300~400	600 - 800	Sell
- Mithaparp restaurant	100~150	700 - 800	Sell

Source: Site Visit Interview

Table 8 There are 7 districts in Bolikhamxay province as detailed table below:

No.	Name of district	Qty. of garage	Average per month (L)	Amount (L)	Remarks
1	Paksan district	49	150	7350	
2	Viengthong	10	60	600	
3	Saychamphone	9	60	600	
4	Pakading	47	120	5640	
5	Thapabath	51	112	3360	
6	Bolikan	10	20	600	
7	Khamkert	35	169	5070	
	<b>Total</b>			<b>23850</b>	

Source: Division of Public Works and Transportation of Bolikhamxay Province

Table 9 Other Main source waste lubricant oil

No.	Name of Project	Ave. Qty. in month [L]	Remarks
1	THEURN 2 HYDROPOWER DAM	4,000.00	
2	THEURN HIN BOON EXPANSION HYDROPOWER DAM	3,000.00	
3	THEURN HIN BOON HYDROPOWER DAM	4,000.00	
	<b>Total</b>	<b>11,000.00</b>	

Source: Site visit (K.X Kounxay steel fabricator limited)

See more detail in Appendix 1.

Table 10 The Cost of WVO and WLO in Bolikhamsay and Vientiane capital

No.	Waste oil	In Vientiane Cap.		Bolikhamsay province		Remarks
		Sell (Kip/L)	Buy (Kip/L)	Sell (Kip/L)	Buy (Kip/L)	
1	Waste vegetable oil	4000-5000	N/A	No	No	
2	Waste lubricant oil	5000-6000	4000-5000	5000-6000	3750-5500	

Source: Site visited

This information received from the interviewing with the owner of the business and this survey found that it's different from the seller and buyer's cost, because the factory who demand the WLO try to hide the actual cost in the market.

However, almost the WVO in two provinces is not collected for selling as the interview of the restaurant and hotel owner, and they always drain the waste vegetable to the septic tank. There are many industrial factories in Bolikhamsay province; however, the large factory that uses waste lubricant oil has only 4 factories as detailed table below:

Table 11 Waste Lubricant Oil Survey Results Categorized by Type of Establishment in Bolikhamsay

Business type	Ave. Demand in day working (L)	Workday (day)	Average waste oil generated by respondents L/month	Average waste oil generated stock for next month L/month
1. Fabricate steel factory				

- K.X Kounxay steel fabricator limited	2000	20	40000	24000
- M.X steel factory limited	1600	20	32000	16000
- Saylong steel factory	1800	20	36000	24000
- Watthana steel fabricator limit	1800	20	3600	18000

Source: Site visit

More detail in Appendix 2.

Table 12 Waste Lubricant Oil Survey Results Categorized by Type of Establishment in Vientiane Capital

Business type	Ave. Demand in day working (L)	Workday (day)	Average waste oil generated by respondents L/month	Average waste oil generated stock for next month L/month
1. Fabricate steel factory		22		
- Vientiane steel industry		N/A	25,000	20,000
- Star petroleum		22	20,000	N/A
- Xomvang Iron factory VSL			No fuel oil	N/A
- Khamhung Xaychalern steel factory		22	No use fuel oil	N/A

Source: Site visit

Star petroleum is the company who recycling of waste lubricant oil to biodiesel in Vientiane Capital and imported raw material from Malaysia via Thailand by the imported data from Industry and Mines Ministry as show in the table below:

Table 13: Waste lubricant oil import from abroad

No.	Type of waste	2010 – 2011 (T)	2011 – 2012 (T)
	Waste lubricant oil	12,300.00	80,000.00

Source: Ministry of Energy and Mines

#### **IV. Discussion**

Data that gathered for WLO and WVO should be collected from difference sources throughout such as garage, petro station, restaurant, buffet restaurant, and hotel. Consumption of spent oil in industrial factories is quite high. In this study data received from garages, steel factory and recycling waste lubricant oil, and some information from government sectors.

Over the consumption and waste oil collection is different result because the real collection is come from many provinces in Laos. However, in this survey just correct data only two provinces that have high demand in waste oil.

On behalf of the policy of the government sector in Bolikhamxay- Ministry of Energy and mines that they would like to recycle the waste oil to the new product in order to reduce quantity of product imported up to 10 percent.

The idea of government to protect the environment from the WLO and WVO is appear in the current time by developing policy to support the concepts of reuse or recycle the WLO and WVO to another product or to reverse them to heating energy in the steel industry and recycle to the new product. However, the quantity of WVO is low and lack of knowledge to recycle this product, so they do not collected the WVO.

#### **V. Conclusion**

As the result of the study in two provinces found that the restaurant owner does not know how to recycle the WVO and WVO is the money that make benefit to the business and to save the environment in the same time, beside that the product of WVO is not much after cooking process, in other way there is no food industry in the study area to use the vegetable oil, so the output of WVO is not important as the WLO.

When focus on the imported data of lubricant oil from the government sector and WLO in survey in the year in the study area found that it is very different data when compare together. However, lubricant oil does not lose much after use because some garages do not know where to sell the WLO so they do not collected and drain it to the environment.

## Reference

### Bolikhamsay province

1. Mr. Saikham Thonglud Head of Energy and mining division of Bolikhamsay province
2. Mr. Sahouan Savang Head of industry and trade division of Bolikhamsay province
3. Mr. Ngang Savengha Director of K.X Kounxay steel fabricator limited 020 99818172
4. Mr. Sern Buyer agency 020 97444999
5. Mr. Dinkham Wattana Director of Watthana steel fabricator limit 020 55550151
6. Mr. Fouk Wattana Director of M.X steel factory limited 020 55552120
7. Mr. Dao General Manager of Saylong steel factory 020 22224252
8. Mr. Ky owner Maintenance vehicle garage
9. Mr. Smith Owner Maintenance vehicle and motorbike maintenance
10. Mr. Tah Owner Maintenance motorbike garage 020 99292132
11. Mr. Choum Owner of Khamkong restaurant 020 55937979
12. Mr. Nanthakhone Owner of Thavan Seendard (Grill ) 020 55634495
13. Mr. Lod Owner of Namsongsi restaurant 020 22070805

### Vientiane capital

1. Mr. Vayakone Ministry of Industry and trade 020 xxxxxxx
2. Ms. Khamline Administrator of Star Petroleum 020 29945892
3. Mr. Viengsavath General manager of Vientiane steel industry 021 832163
4. Mr. Pakasith Manager of Chanthapanya hotel 021 244284
5. Mr. Jokki Manager of Sengphachane hotel 021 251761/ 020 22226568
6. Ms. Vannophone Manager of Wansana hotel 021 413895
7. Mr. Phonepaserth Manager of Moondernight restaurant 021 217073
8. Ms. Thongvane Manager of Daovieng restaurant 021 212373/ 020 55620497
9. Mr. Tunmalee Manger of Labienglom restaurant 021 550235/020 55002007
10. Mr. Lienkham Manager of Kounghphao Donchane 021 312582



## Waste Vegetable Oil and Lubricant oil Survey Questionnaire

1. Name and address of business
2. How much waste oil is accumulated in a day or in month of operation?
  - a. How many deep fryers do you have in your business?
3. Is your business seasonal? If yes, what are your months of operation?
4. What type of cooking oil do you currently use?
5. Who collects the waste oil you generate now?
  - a. How often is the waste oil collected?
6. What is the current cost to have this oil removed?
7. Do you have a contractual agreement for this service?
8. Would you be interested in supporting a regional initiative that collects waste vegetable Oils to be used in the production of biodiesel? (Biodiesel would then be used by the municipality to reduce environmental emissions)
9. Would you be willing to allow someone to come to your business to draw a sample of your oil?

## Appendix 1.1

### SAYCHAMPHONE GARAGE SHOP

No.	List of Garage shop	Location (village)	Type of business	Ave. Qty. collection /day	Remarks
1	N/A	Phonesy	Maintenance Motorbike	2	
2	N/A	Phonesy	Maintenance Motorbike	2	
3	N/A	Phonesy	Maintenance Motorbike	No	
4	N/A	Nacheng	Maintenance Motorbike	No	
5	N/A	Phonengarm	Maintenance Motorbike	No	
6	N/A	Nam On	Maintenance Motorbike	No	
7	N/A	Nam On	Maintenance Motorbike	2	
8	N/A	Nam On	Maintenance Motorbike	2	
9	N/A	Nam On	Maintenance Motorbike	2	
				10	300 (monthly)

## Appendix 1.2

### THAPHABARD GARAGE SHOP

No.	List of Garage shop	Location (village)	Type of business	Ave. Qty. collection /day	Remarks
1	Aphinan	Palay	Motorbike service	2	
2	Odd	Palay	Motorbike service	2	
3	Khedkeo	Palay	Motorbike service	2	
4	Lichernyan	Palay	Motorbike service	2	
5	Laung	Palay	Motorbike service	2	
6	Tod	Palay	Motorbike service	2	
7	Prasith	Palay	Motorbike service	2	
8	Phanthavong	Palay	Motorbike service	2	
9	Sengsouvan	Saysavane	Vehicle	5	
10	Tan Vongvisay	Saysavane	Motorbike service	3	
11	Chomphet	Oudomsay	Motorbike service	2	
12	Xay	Palay	Motorbike service	2	
13	Keum	Thabok	Motorbike service	3	
14	Sonsay	Thabok	Motorbike service	3	
15	Khamsing	Thabok	Motorbike service	3	
16	Prasong	Houay beng	Motorbike service	2	
17	Nang Nidsa	Houay beng	Motorbike service	2	
18	Kai	Somsaard	Motorbike service	2	
19	Lod	Somsaard	Motorbike service	2	
20	phao	Phabard	Motorbike service	2	
21	Oley	Touy Yai	Motorbike service	2	
22	Sanya	Touy Yai	Motorbike service	2	
23	Somphid	Touy Yai	Motorbike service	2	
24	Lair	Na Khand	Motorbike service	2	
25	Vidthaya	Na Khand	Motorbike service	2	
26	mailoh	Saysavang	Motorbike service	2	
27	Khooun	Nasay	Motorbike service	2	
28	Sithanom	Houay sapai	Motorbike service	2	
29	Toum Souvanavong	Houay sapai	Motorbike service	2	
30	Yao	Palay	Motorbike service	2	
31	Bounty	Thabok	Motorbike service	3	
32	Phova	Houay Lerk	Motorbike service	2	
33	Thongsouk	Houay Lerk	Motorbike service	2	
34	Kongkeo	Phonesavane	Motorbike service	2	

35	Arvy	Phonesavane	Motorbike service	2	
36	Ouboun	oudomsay	Motorbike service	2	
37	Khamsouk	Nam Lo	Motorbike service	2	
38	Lamphan	Yoy hai	Motorbike service	2	
39	Oudom	Nongkern	Motorbike service	2	
40	Phouvong	pak Touy Tai	Motorbike service	2	
41	Taah	pak Touy Tai	Motorbike service	2	
42	Vansawad	Nongkern	Motorbike service	2	
43	Phonevilay	Vernthad	Motorbike service	2	
44	Dao	Vernthad	Motorbike service	2	
45	Ki Kodpanya	pak Touy Tai	Motorbike service	2	
46	Visanou	Thabok	Motorbike service	3	
47	Ay Saivongsa	Thabok	Motorbike service	3	
48	Phouvieng	Hatxay	Motorbike service	2	
49	Thongkhan	Hongthong	Motorbike service	2	
50	Nang Touy	Hongthong	Motorbike service	2	
51	Piek	Hongthong	Motorbike service	2	
				112	3360 (L) Monthly

### Appendix 1.3

#### BOLIKHAN GARAGE SHOP

No.	List of Garage shop	Location (village)	Type of business	Ave. Qty. collection/day	Remarks
1	N/A			No	
2	N/A			No	
3	N/A			No	
4	N/A			No	
5	N/A			2	
6	N/A			2	
7	N/A			2	
8	N/A			2	
9	N/A			2	
10	N/A			2	
				12	360 (L) monthly

## Appendix 1.4

### KHAMKRD GARAGE SHOP

No.	List of Garage shop	Location (village)	Type of business	Ave. Qty. collection/day	Remarks
1	A Jounh		Motorbike service	2	
2	Phouthone		Motorbike service	2	
3	Bouakhai		Motorbike service	2	
4	A Ji		Motorbike service	2	
5	A Chy		Motorbike service	2	
6	A Yih		Motorbike service	2	
7	Youy		Motorbike service	2	
8	A Ly		Motorbike service	2	
9	Tonh		Motorbike service	2	
10	Xiengsod		Motorbike service	2	
11	Bounhieng		Motorbike service	2	
12	Xienghuk		Motorbike service	2	
13	Done		Motorbike service	2	
14	Ouan		Motorbike service	2	
15	Baby		Motorbike service	2	
16	Xiengsane		Motorbike service	2	
17	Phetsakhone		Motorbike service	2	
18	Sengphet		Motorbike service	2	
19	Khamthavy		Motorbike service	2	
20	Souliyothai		Motorbike service	2	
21	Phadthana		Motorbike service	2	
22	Phadthana		Motorbike service	2	
23	Bee		Motorbike service	2	
24	Phengsy		Motorbike service	2	
25	Wan		Maintenance vehicle	11	
26	Done		Maintenance vehicle	11	
27	Odd		Maintenance vehicle	11	
28	Xiengthong		Maintenance vehicle	11	
29	Odd		Maintenance vehicle	11	
30	Khamon		Maintenance vehicle	11	
31	Nouan		Maintenance vehicle	11	
32	Kham		Maintenance vehicle	11	
33	Loy		Maintenance vehicle	11	
34	Touayang		Maintenance vehicle	11	
35	Hongkham		Maintenance vehicle	11	
	Total			169	5070

## Appendix 1.5

### VIENGTHONG GARAGE SHOP

No.	List of Garage shop	Location (village)	Type of business	Ave. Qty. collection/day	Remarks
1	Umphone	Nam Yang	Maintenance Motorbike	1.5	
2	Xiengvandee	Nam Yang	Maintenance Motorbike	1.5	
3	Xiengthongkham	Nam Yang	Maintenance Motorbike	1.5	
4	Ahoua	Nam Yang	Maintenance Motorbike	1.5	
5	Xieng	Nam Yang	Maintenance Motorbike	1.5	
6	Khenmon	Nam Kang	Maintenance Motorbike	1.5	
7	Maipeng	Chomthong	Maintenance Motorbike	1.5	
8	Nangmai	Chomthong	Maintenance Motorbike	1.5	
9	Sompai	Chomthong	Maintenance Motorbike	1.5	
10	Xiengkhenyeun	Chomthong	Maintenance Motorbike	1.5	
				15	450 (L) monthly

## Appendix 1.6

### PAKSAN GARAGE SHOP

No.	List of Garage shop	Location (village)	Type of business	Ave. Qty. collection/day	Remarks
1	Somsanith	Meexay	Maintenance vehicle	10	
2	Nang Thongsabai	Meexay	Maintenance vehicle	10	
3	Sisavay	Phonexay	Maintenance Motorbike and vehicle	13	
4	Somsack	Phonexay	Maintenance vehicle	10	
5	nang Keoudone	Anousonexay	Maintenance vehicle	10	
6	Akkasin	Houay Sied	Maintenance vehicle	10	
7	Oudaon	Phonexay	Maintenance vehicle	10	
8	Khone	Anousonexay	Maintenance vehicle	10	
9	Khong	Phonesy	Maintenance vehicle	10	
10	Yangko	Phonesy	Maintenance Motorbike	2	
11	Somphet	Meexay	Maintenance vehicle	10	
12	Sivern	Meexay	Maintenance vehicle	10	
13	Max	Nachick	Maintenance vehicle	10	
14	Nang khamphai	Sysaard	Maintenance Motorbike	2	
15	Khamleum	Syvilay	Maintenance vehicle	10	
16	Keoudone	Syvilay	Maintenance vehicle	10	
17	Khonesavan	Syvilay	Maintenance vehicle	10	
18	Samit	Phonexay	Maintenance vehicle	13.5	
19	Nangsoulivant	Phonexay	Maintenance Motorbike	2	
20	Hong	Phonexay	Maintenance Motorbike	4	
21	Chanthapone	Phonexay	Maintenance vehicle	10	
22	Bouchane	Phonexay	Maintenance vehicle	10	
23	Oudone	Phonexay	Maintenance vehicle	10	
24	Vilakone	Phonexay	Maintenance Motorbike	2	
25	Nang Somchai	Phonexay	Maintenance vehicle	20	
26	Vhine	Symoungkoun	Maintenance Motorbike	2	
27	Chinda	Meexay	Maintenance Motorbike	2	
28	Davane	Meexay	Maintenance Motorbike	2	
29	Phao	Phonesy	Maintenance Motorbike	2	
30	Air	Houay Sied	Maintenance vehicle	10	
31	Umphone	Thasikhay	Maintenance Motorbike	2	
32	Sonephasert	Sysaard	Maintenance Motorbike	2	
33	Nang Kidthavane	Phonesy	Maintenance vehicle	10	



34	Rod	Phonexay	Maintenance vehicle	10	
35	Vansay	Anousonexay	Maintenance Motorbike	2	
36	Thavysouk	Anousonexay	Maintenance Motorbike	2	
37	Moukham	Hongsay	Maintenance Motorbike	2	
38	Samlong	Anousonexay	Maintenance Motorbike	2	
39	Chanthapone	Sanaxay	Maintenance vehicle	10	
40	Ontha	Sivilay	Maintenance vehicle	10	
41	Ward	Sanaxay	Maintenance vehicle	10	
42	Sinheng	Syvilay	Maintenance vehicle	10	
43	Lang	Phonexay	Maintenance vehicle	10	
44	Nang Malaphone	Phonexay	Maintenance vehicle	10	
45	Nang Mee	Meexay	Maintenance vehicle	10	
46	Khamfong	Paksan neua	Maintenance Motorbike	2	
47	Vanid	Wanid	Maintenance Motorbike	2	
48	Bounkeo	Bounkeo	Maintenance Motorbike	2	
49	Nang Thick	Nang Tick	Maintenance Motorbike	2	
	<b>Total</b>			<b>356.5</b>	<b>10,695.00 (L) monthly</b>

## Appendix 1.7

### PAKADING GARAGE SHOP

No.	List of Garage shop	Location (village)	Type of business	Ave. Qty. collection/day	Remarks
1	Say Garage	Tongnamee	Maintenance Motorbike	2	
2	Haterm	Tongnamee	Maintenance Motorbike	2	
3	Sy	Tongnamee	Maintenance Motorbike	2	
4	Hongya	Tongnamee	Maintenance Motorbike	2	
5	Noy	Tongnamee	Maintenance Motorbike	2	
6	Thongsin	Tongnamee	Maintenance Motorbike	2	
7	Watthana	Tongnamee	Maintenance Motorbike	2	
8	Nang Sitha	Tongnamee	Maintenance Motorbike	2	
9	Phouvan	Viengkham	Maintenance Motorbike	2	
10	Aping	Viengkham	Maintenance Motorbike	2	
11	Acheng	Viengkham	Maintenance Motorbike	2	
12	Khammun	Viengkham	Maintenance Motorbike	2	
13	Asoun	Viengkham	Maintenance Motorbike	2	
14	Heng	Viengkham	Maintenance Motorbike	2	
15	Phonthisay	Viengkham	Maintenance Motorbike	2	
16	Thavone	Viengkham	Maintenance Motorbike	2	
17	Nang Bouaphun	Viengkham	Maintenance Motorbike	2	
18	Phonesay	Viengkham	Maintenance Motorbike	2	
19	Konchack	Nam Kou	Maintenance Motorbike	2	
20	Boun on	Konesong	Maintenance Motorbike	2	
21	Bounyok	Konesong	Maintenance Motorbike	2	
22	Soulin	Konesong	Maintenance Motorbike	2	
23	Souvieng	Boungkouang	Maintenance Motorbike	2	
24	Sivay	Boungkouang	Maintenance Motorbike	2	
25	Som art	Ban Don	Maintenance Motorbike	2	
26	Tong	Khonekouang	Maintenance Motorbike	2	
27	Le	Sod	Maintenance Motorbike	2	
28	Saty	Pakading Neua	Maintenance Motorbike	12	Include Vehicle
29	Achieng	Pakading Neua	Maintenance Motorbike	2	
30	Home	Pakading Neua	Maintenance Motorbike	2	
31	Keokiethisak	Pakading Neua	Maintenance Motorbike	2	
32	Nang Somly	Donsay	Maintenance Motorbike	2	

33	Tha Khan	Nam deua	Maintenance Motorbike	2	
34	Heng	Donesay	Maintenance Motorbike	2	
35	Vy	Phonesy	Maintenance Motorbike	2	
36	Asing	Phonesy	Maintenance Motorbike	2	
37	Khamfong	Phonesy	Maintenance Motorbike	2	
38	On Kai	Phonesy	Maintenance Motorbike	2	
39	Joy Phonekham	Phonekham	Maintenance Motorbike	2	
40	Mai	Phonekham	Maintenance Motorbike	2	
41	ongnamdeua	Namdeua	Maintenance Motorbike	2	
42	Somphone	Namdeua	Maintenance Motorbike	2	
43	Van	Namdeua	Maintenance Motorbike	2	
44	Euangkham	Phonesy	Maintenance Motorbike	2	
45	Vansay	Phonesy	Maintenance Motorbike	2	
46	Tai	Hatsaikham	Maintenance Motorbike	2	
47	Ta	Hatsaikham	Maintenance Motorbike	2	
	<b>Total</b>			<b>104</b>	<b>3,120.00</b>

## Appendix 1.8

### THEURN 2 HYDROPOWER DAM

No.	List of Garage shop	Location (village)	Type of business	Ave. Qty. collection/day	Remarks
1	N/A		Maintenance Motorbike	133.33	4000

## Appendix 1.9

### THEURN HIN BOON HYDROPOWER DAM

No.	List of Garage shop	Location (village)	Type of business	Ave. Qty. collection/day	Remarks
1	N/A		Maintenance Motorbike	133.3333333	4000

## Appendix 1.10

### THEURN HIN BOON EXPANSION HYDROPOWER DAM

No.	List of Garage shop	Location (village)	Type of business	Ave. Qty. collection/day	Remarks
1	N/A		Maintenance Motorbike	100	3000

## Appendix 2

No.	Code	Name of Factory	Business type	Man power			Pow er of Mac hine	Energy source	Qty. in use/day	Qty. permo nth	Source	Price/tank 200l
				Wo me n	For eig ner	Tot al	Hp		Litter	Tank (200l)		
1	24101	WTN Watthana steel fabricator limited	Fabric rebar to supply in Local	26	50	76	5.25	Use oil/ Fuel oil	1200- 1400		Thailand, Savanakhet, Vientiane, and local district	700000-750000
2	24101	KX Kounxay steel fabricator limited	Fabric rebar to supply in Local	6	30	36	1.28	Use oil	1800- 2000	200- 300	Local, NT2, NTHB, VT	700000-750000
3	24101	M.X steel factory Ltd	Steel product and distribution	8	6	80	250. 00	Use oil/ Fuel oil	1800- 2000	200- 300	Thailand, Savanakhet, Vientiane, and local district	700000-750000
4	24101	SSK steel fabricator limited	Fabric rebar to supply in Local	5	12	35	2000 .00					
5	24101	Saylong steel fabricator limited	Fabric rebar to supply in Local	3	5	34	2080 .00	Use oil	1000- 1200	200- 300	Pretolium Viet Km 36 VT	700000-750000

### Appendix 3

#### Estimate collection waste lubricant oil in Bolikhamxay province

No.	District	Ave. Qty. in month [L]	Remarks
1	SAYCHAMPHONE GARAGE SHOP	540.00	
2	THAPHABARD GARAGE SHOP	3,360.00	
3	BOLIKHAN GARAGE SHOP	600.00	
4	KHAMKERD GARAGE SHOP	540.00	
5	VIENGTHONG GARAGE SHOP	450.00	
7	PAKSAN GARAGE SHOP	10,695.00	
8	PAKADING GARAGE SHOP	3,120.00	
9	THEURN 2 HYDROPOWER DAM	4,000.00	
10	THEURN HIN BOON EXPANSION HYDROPOWER DAM	3,000.00	
11	THEURN HIN BOON HYDROPOWER DAM	4,000.00	
	<b>Total</b>	<b>30,305.00</b>	

## Appendix 4

### Estimate waste lubricant oil demand in a month at Bolikhamsay province

No.	Factory name	Ave. Demand in day working (L)	WD	Amount in month (L)	Stock for a month (L)
1	KX Kounxay steel fabricator limited	2000	20	40,000.00	24,000.00
2	M.X steel factory limited	1600	20	32,000.00	16,000.00
3	Saylong steel factory	1800	20	36,000.00	24,000.00
4	Watthana steel fabricator limit	1800	20	36,000.00	18,000.00
	<b>TOTAL</b>			<b>144,000.00</b>	<b>82,000.00</b>

## Appendix 5

### Estimate waste lubricant oil demand in a month at Vientiane Capital

Business type	Ave. Demand in day working (L)	Workday (day)	Average waste oil generated by respondents L/month	Average waste oil generated stock for next month L/month
14. Fabricate steel factory				
- Vientiane steel industry		22	25,000	20,000
- Star petroleum		22	20,000	N/A
<b>TOTAL</b>			<b>45000</b>	<b>N/A</b>

Appendix 6 Photo of WLO source



Jub Garage



Xokesay Garage





Tah spare part shop



Smith Garage



Somchai spare part and Vehicle maintenance



Chinese 1 motorbike Garage



Od motorbike maintenance



Chinese 2 motorbike Garage



Garage



Chinese 1 motorbike Garage



Watthana steel fabricator limit



Watthana steel fabricator limit



Watthana steel fabricator limit



Watthana steel fabricator limit



Watthana steel fabricator limit



Watthana steel fabricator limit



Watthana steel fabricator limit



Watthana steel fabricator limit



KX Kounxay steel fabricator limited



KX Kounxay steel fabricator limited



KX Kounxay steel fabricator limited



KX Kounxay steel fabricator limited



KX Kounxay steel fabricator limited



KX Kounxay steel fabricator limited



KX Kounxay steel fabricator limited



KX Kounxay steel fabricator limited





KX Kounxay steel fabricator limited



KX Kounxay steel fabricator limited



M.X steel factory limited



M.X steel factory limited



M.X steel factory limited



M.X steel factory limited



M.X steel factory limited



M.X steel factory limited



M.X steel factory limited



M.X steel factory limited



Saylong steel factory



Saylong steel factory



Saylong steel factory



Saylong steel factory



Saylong steel factory



Saylong steel factory



Saylong steel factory



Saylong steel factory



Star petroleum



Star petroleum



Saylong steel factory



Saylong steel factory



Star petroleum



Star petroleum



Vientiane industry steel



Star petroleum



Vientiane industry steel



Star petroleum



