

Bhutan Water Partnership



Assessment Report

Effluent Discharge and Management by Automobile Workshops in Paro Municipal Area; Bhutan

November, 2017

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1. Background to the study

Automobile workshop primarily deals with petroleum products. Its wastes are potentially harmful to humans and the natural environment. These automobile workshop use and generate waste from engine lubricating oils, paints, fossil fuels, detergents, metal cleaners, gear oil, brake fluids, and contaminated wastewater from car wash. Automobile waste also contains heavy metal that is toxic. Thus, it is important that these automobile waste are properly handled at source and appropriately disposed of.

Deteriorating of water quality is a global concern. Water bodies have always been challenged with quality deterioration leading to rising drinking and agriculture water shortages, affecting aquatic life and human health. Besides natural sources, human activities contribute the major source of pollution. Industries, agriculture, domestic wastes are some of the key sources of pollution. Effluent discharge from automobile workshops contributes substantial amount of waste deteriorating quality of water.

Bhutan is blessed with bountiful water resources. However, with the growing population and its activities, the water quality, specially in the urban centers have deteriorated. Monitoring of the country's water bodies has been undertaken by several agencies. The National Environment Commission (NEC) undertaken several water quality monitoring activities since 1997 to collect baseline water quality data. The Public Health Engineering Section (PHES) under the Department of Health has monitored 83 samples of water from water supply sources throughout the country. Currently, the Watershed Management Division (WMD) is conducting study on water sources drying and water quality.

All available data confirm that Bhutan's water resources are very healthy on a macro-scale. Bhutan's rivers are highly oxygenated, slightly alkaline with low conductivity and no recorded salinity. Whilst the overall water quality of rivers is good in Bhutan, on a localized scale, water pollution problems do exist especially along the banks of streams and rivers in both urban and rural locations. This problem is exacerbated at urban locations where surface drainage, oil and grease spills from automobile workshops, grey water discharge from domestic households and uncontrolled waste disposal.

1.1 Objective

The Bhutan Water Partnership identified Paro to be the assessment site with an understanding that no such assessments were carried out in Paro while the number of vehicles and automobile workshops were in rise. The objective of the assessment is to:

- Investigate and describe the effluent discharge and management systems of the automobile workshops.
- Draw comparison of the water quality upstream and downstream of the automobile workshops.
- Sensitized workshop owners and workers on the need for proper management of effluent discharge.

1.2 Scope and Limitations of the Study

In order to collect data and understand the status of the effluent discharge and management system of the automobile workshops under Paro Municipal area, the Bhutan Water Partnership (BhWP) initiated an assessment of the workshop areas.

In this assessment, we tried to collect as much information from the automobile workshop owners pertaining to the existing structures and practices and the challenges they face in functioning the workshops. Besides, questionnaires to add more information, field observation to understand the ground reality and water quality test looking at physical and biological parameters to determine water quality.

However, due to limited budget, the assessment is only a preliminary study on the status of automobile workshops in the municipal area in Paro and its implication of the environment. Nevertheless, the report generated from the study will assist the Municipal Office, Paro to plan and intervene if necessary in order to improve the management system of the automobile workshop to prevent pollution from the effluent discharge.

2. ASSESSMENT METHODOLOGY

The assessment will adopt more of a descriptive research design to analyze results and draw conclusions. The rationale for using descriptive research design is that the research is expected to investigate and describe the effluent discharge and management systems in automobile workshops as they exist. The assessment would also generally take raw data and summarize it. The following approach has been administered for this assessment.

2.1 Stakeholder Consultation and Focus Group Discussion

Based on the identified lists of the stakeholders from the Automobile Workshop, and following a predefined framework, the stakeholders were informed and made aware of the following:

- Water Act 2011, Water Rules and Regulation,
- Waste Act 2014
- The environmental impact of effluent discharge on the water bodies
- The management steps they can take to avoid free flow of effluent into the water bodies
- The legal implications of non-compliance.



One to one interview with owners, managers and supervisors of the automobile workshop was held to draw out information to supplement and support all the above process.

2.2 Primary data collection and Coverage

Primary data for this assessment was collected by visiting the automobile workshop in the municipal area of Paro and administering a standard questionnaire at the site with the following parameters:

- Describe the effluent discharge and management system by the automobile workshops.
- Identification of issues related to management of the effluent discharge.
- Upstream and downstream water quality testing.
- Automobile workshop monitoring systems for effluent discharge
- How various Wastes are Managed by these automobile workshops.

A questionnaire based data collection was applied, supported by the following framework:

- Physical Observation (possible discharge into the water – engine oil, detergent from car wash, grease, solid waste, sewerage)
- Water Quality Testing (pH, Temperature, conductivity, turbidity, dissolved oxygen, total dissolved solids, resistivity and salinity)

2.3 The Study Area

Paro is located in the north-western part at an altitude of 2200 meter and it has a total area of 1285.5 Sq.Km. It has fertile valley with about 65.2% of forest coverage and the rest arable land suitable for agriculture and horticulture. The Pachhu joined by Dochhu flows through the Paro valley and along the way irrigates the wetland. Paro like any other major towns of Bhutan is growing rapidly with many government offices, schools, institution, hotels and residential houses being established. Due to this rapid economic growth, the number of cars in Bhutan has increased drastically. The figure below shows the growth of vehicle population in Bhutan (source Annual Report for Financial Year 2015-2016, RSTA, MOIC).

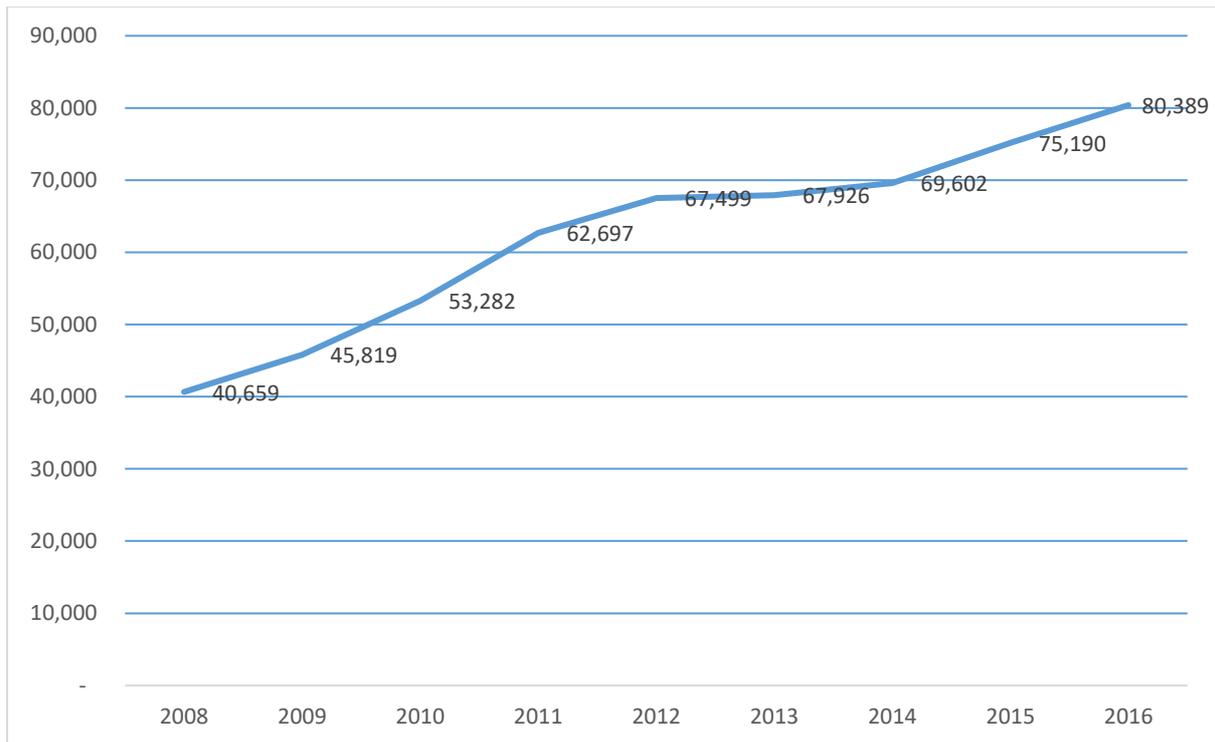


Figure 1: Growth in Vehicle Population for 9 years

2.4 Data Analysis

The field data entailed both quantitative and qualitative analysis. A database was built in the Spread Sheet (Excel) but prior to analysis, the data has been pre-processed to check for errors, accuracy and reliability. The process has continued with coding of all variables with numeric and other relevant codes. After the completion of due diligence with the information, the data will be entered in to spread sheet. The Results of this assessment has been presented in a descriptive statistical format.

3. Results

This section highlights the findings of the assessment based on data collected from the eight automobile workshop owners through focus group discussion and also questionnaire. In addition, measurement of physical parameter of water and observation and collection of benthic macro-invertebrates supported the assessment. Simple descriptive statistics, relative frequencies and percentage has been used to present the results.

In general, all the eight automobile workshops that was within the municipal zone participated in the assessment. Most of the respondents that attended the focus group discussion were owner

of the automobile workshop. However, the total number of automobile workshop within Paro Dzongkhag is 14.

3.1 Water Quality

An assessment on the water quality was carried out focused only on the physical and biological parameters as these two parameters can determine status of the water quality.

The physical parameters measured including water & air temperature, pH, electrical conductivity (EC), dissolved oxygen (DO), total dissolved solids (TDS), resistivity, turbidity and, salinity. A simple random sampling was carried out in the upstream, at the effluent discharge point and at the downstream of the automobile workshop. However, for sampling for the benthic macro-invertebrates, specimens were collected only from the up-stream and downstream. The pollution sensitive macro-invertebrates were dominant at upstream compared to downstream. The major groups identified were Ephemeroptera and Trichoptera, which indicated relatively clean water. The values of physical parameters at all the sampling sites were within the permissible limit of NEC's Environmental Standards, 2010. In addition, a preventive measure for direct discharge of wastewater and disposal of solid waste should be taken along the Paa-Chhu riverbank.

The physical measurement results from all the sampling sites are presented in table 1 to 3. The results showed that all the parameters were within the NEC's maximum recommended limit as reflected in ambient water quality criteria and industrial effluent discharge standards, 2010. The pH of the water was slightly alkaline in all the sampling sites as its pH values were higher than 7 (neutral) ranged from 8-8.29.

3.1.1 Physical Parameters

The physical monitoring of water bodies at different location was also initiated to supplement the understanding of the state of the water in Pachhu. The following are the details:

Table 1: Measurement of Physical Parameters Close to Effluent Discharge Point (Mid-Stream)

<i>Location: 1.5 meter below Karma Automobile workshop, at 12 Noon, on 21/10/17</i>				
Sl. No	Parameters	Unit(s)	Standard (Quality A, B & C)	Reading
1	Water temperature	° C	-	12.3
2	Ambient temperature	° C	-	22
3	Turbidity	NTU	-	3.12
4	Total Dissolved Solids	Mg/L	150	63.1
5	pH		6.5-8.5 (A) 6.5-9 (B&C)	8.29
6	Conductivity	µS/cm	800, 1000, 2000	133.5
7	Dissolved Oxygen	Mg/L	6, 4	7.92
8	Salinity	%	-	0
9	Resistivity	kΩ.cm	-	7.50



Table 2: Measurement of Physical Parameters (Above Effluent Discharge Point), Up-Stream

<i>Location: 100 meter up-stream - PaaChu, at 12:30 PM, on 21/10/17</i>				
Sl. No	Parameter	Unit(s)	Standard (Quality A, B & C)	Reading
1	Water temperature	° C	-	13.1
2	Ambient temperature	° C	-	24
3	Turbidity	NTU	-	2.39
4	Total Dissolved Solids	Mg/L	150	63.6
5	pH		6.5-8.5 (A) 6.5-9 (B&C)	8.00
6	Conductivity	µS/cm	800, 1000, 2000	134

7	Dissolved Oxygen	Mg/L	6, 4	7.98
8	Salinity	%	-	0
9	Resistivity	kΩ.cm	-	7.45

Table 3: Measurement of Physical Parameters (Below Effluent Discharge Point), Down-Stream

Location, Below Jaga Zam, 2:15 PM, on 21/1017				
Sl. No	Parameter	Unit(s)	Standard (Quality A, B & C)	Reading
1	Water temperature	° C	-	13.3
2	Ambient temperature	° C	-	22.5
3	Turbidity	NTU	-	2.83
4	Total Dissolved Solids	Mg/L	150	64.7
5	pH		6.5-8.5 (A) 6.5-9 (B&C)	8.27
6	Conductivity	μS/cm	800, 1000, 2000	136.7
7	Dissolved Oxygen	Mg/L	6, 4	7.83
8	Salinity	%	-	0.06
9	Resistivity	kΩ.cm	-	7.31

3.1.2 Bio-Indicator monitoring

In addition to the observation of physical parameters of water, the benthic macro-invertebrates were collected to ascertain the water quality. The highly sensitive species belonging to the taxonomic order of Trichoptera (caddis fly) and Ephemeroptera (may fly) were found mostly at upstream. On the other hand, the pollution tolerant species belonging to the taxonomic order Diptera was also recorded. Table 4 and 5 indicates its details.

Table 4: Up-stream Bio-Indicators

Sl. No	Order	Type of insect/macro invertebrates (1 meter square) (FAMILY)	Total count
1	Ephemeroptera (May fly)	Heptageniidae	2
		Baetidae	2
2	Trichoptera (Caddis fly)	Stenopsychidae	3
		Hydropsychidae	2

3	Diptera (True flies)	Tipulidae	3
		Simullidae (black fly)	3



Table 5: Down-stream Bio-Indicators

Sl. No	Order	Type of insect/macro invertebrates (1 meter square) (FAMILY)	Total count
1	Ephemeroptera (May fly)	1. Heptageniidae	5
2	Trichoptera (Caddis fly)	1. Stenopsychidae	8

3.2 Types of effluent and its sources

The automobile workshops under municipal area in Paro in general have maintained well with exception to one or two places. The managements of these workshops were well aware of the implications of the effluents discharge and remedial measures were in place in most of the places. If not taken care, effluents from the workshop can be major contributor to the water pollution.

Table 6: Different Types of Effluent and Point Source

Sl. No	Type of effluent	Point source
1	Used engine oil (Mobil, gear oil, brake fluid)	Change of engine oil
2	Grease	Greasing points
3	Coolant	Change of coolant
4	Waste water	Water servicing
5	Metal Cleaner	All repair works



Although, it is difficult to ascertain the amount of effluent discharge per day by these workshop, a rough estimate has been provided below based on the number of vehicle coming for oil change and water servicing, with the assumption that on average a car produces 4 liter of waste engine oil and use up 150 liters of water for servicing. The data from seven workshops that fall within the municipal area has been collected.

The figure 2 below shows that the lowest number of cars coming for water servicing is five cars per day and for engine oil change it is 5 cars per day. Similarly, the maximum number for cars that come for engine oil change per day is 15 and for water servicing 15 cars per day is the maximum.

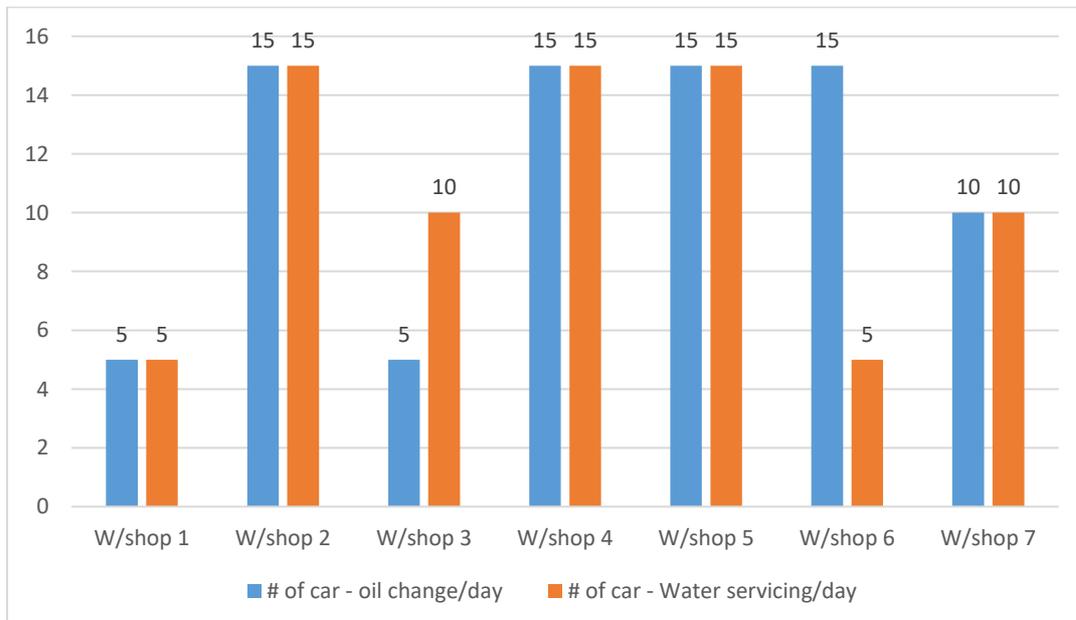


Figure 2: Number of Car Wash & Oil Change per day per workshop

Thus, in total from the seven workshops 80 vehicles come to change engine oil and 75 vehicles come to for water servicing. Based on the average of utilizing 150 liters of water for servicing and 4 liters of waste engine oil generated, the following assessment has been presented.

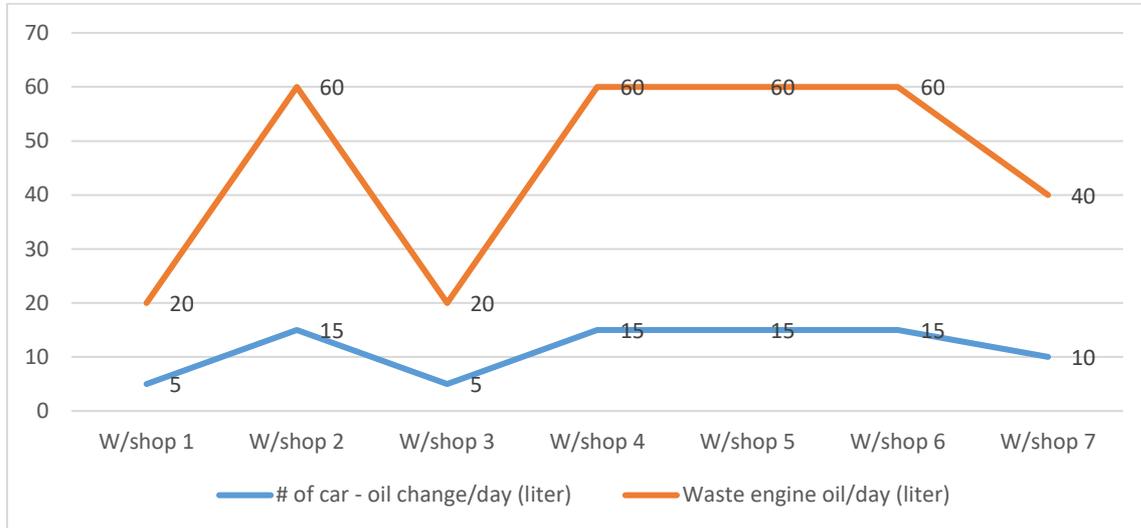


Figure 3: Automobile Workshops Generating Waste Oil, Per Day

As indicated in the above figure (3), the maximum waste engine oil generated by an automobile workshop per day is around 20 liters. The maximum waste engine oil generated by an automobile workshop in a day is around 60 liters.

Although, during the focus group discussion and also questionnaire interview, it was reported that the engine oil is collected in a large container and sold to the neighboring country, there are evidences of spillage of these oil on the ground. It is assumed that most of the spillage flow out in to the water bodies or contaminates the soil.

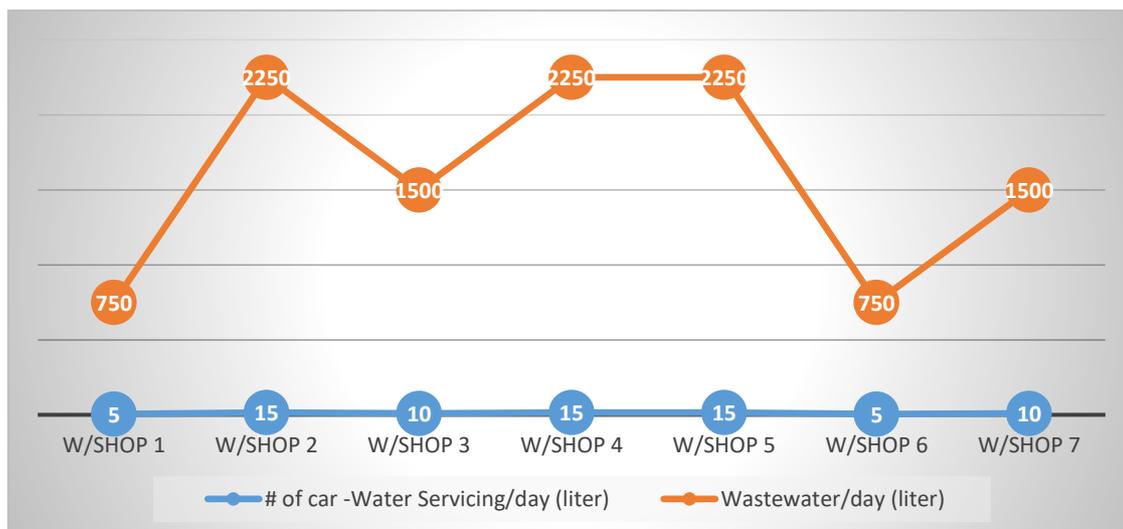


Figure 4: Automobile Workshops Generating Wastewater Per Day

In terms of the wastewater generated from the water servicing of vehicle, the lowest amount of wastewater is 750 liters per day and highest is 2250 liters of wastewater per day. During the focus group discussion, most of the automobile workshop owners reported to having sedimentation tanks, during the observation, only three workshops had sedimentation tanks. Most of the wastewater seems to flow into the waterbodies.

3.3 Effluent Management Systems

In Chapter 8, Article 41 A to E of “The Water Act of Bhutan 2011” indicated that anybody responsible for producing effluent should be responsible to treat it before releasing it into water bodies. It is therefore, essential for all automobile workshops to be responsible in managing the effluents and should have management systems in place. It can be either at individual level or collective one. However, in reality, compliance to such regulations doesn’t seem to be 100%.

The effluent management in the automobile workshops in Paro seem to be in better shape. Many of the workshops have the following systems that have actually minimized the effluents discharging into water bodies.

- Collection of engine oil in drums
- Sedimentation tanks to collect oil from servicing points
- Waste collection bins for proper disposal of waste
- Toilet facilities to prevent open defecation

As such, both the physical and biological indicators showed fairly acceptable quality of water even at the downstream of the workshop areas.



To prevent open defecation and urination, all workshops should have modern toilet. However, from the eight workshops assessed only 71 percent of the workshop had modern toilet and 29 percent of the workshop did not have modern toilet.

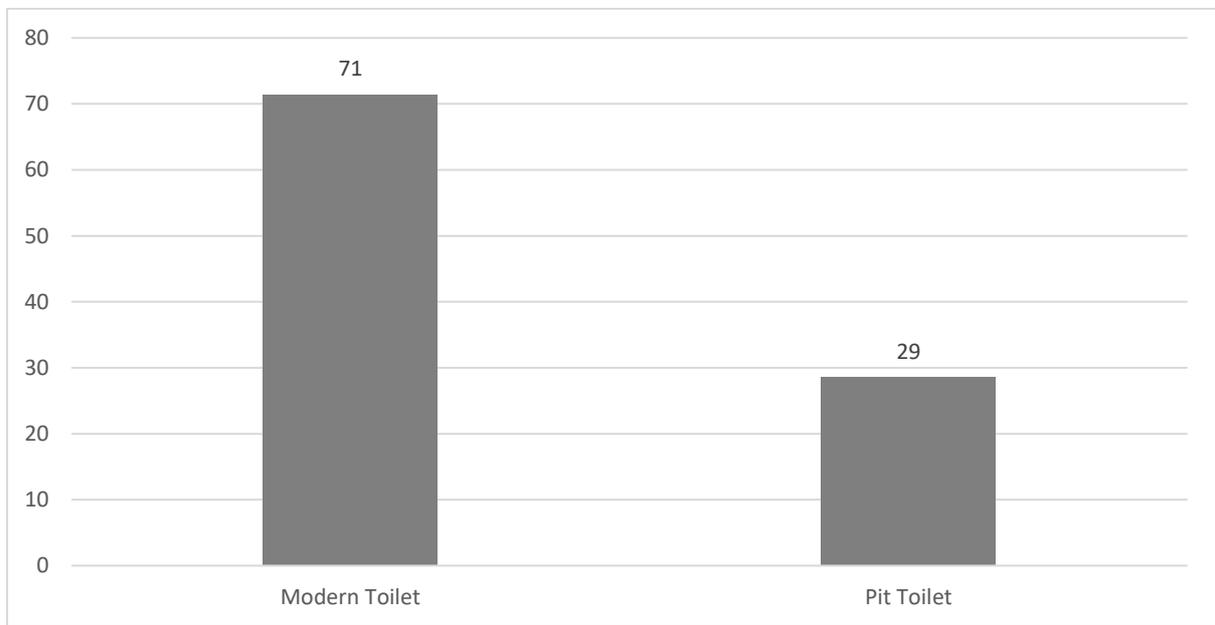


Figure 5: Automobile Workshops with Modern and Pit Toilets

3.4 Effluent management facilities

The study sought to identify facilities used for the management of effluent in the automobile workshop. However, during the focus group discussion, most of the automobile workshop owners indicated that the current location of their establishment to be rather temporary. As reflected in the above discussion, most of the workshops had very semi-permanent structures and only two or three automobile workshops has permanent infrastructure. None of the workshops had effluent treatment plants, oil interceptors or oil water separators. Most of the waste engine oils were collected in large drums.

Out of eight workshops visited, four of the workshops did not have concrete flooring, which allowed the effluents to seep into the soil. It is assumed that majority of effluent discharge going into the water bodies, some level of soil contamination could be happening.

3.5 Frequency of effluent quality monitoring

This assessment also sought to establish the frequency of effluent quality monitoring by the automobile workshop owners. The results are presented in figure below.

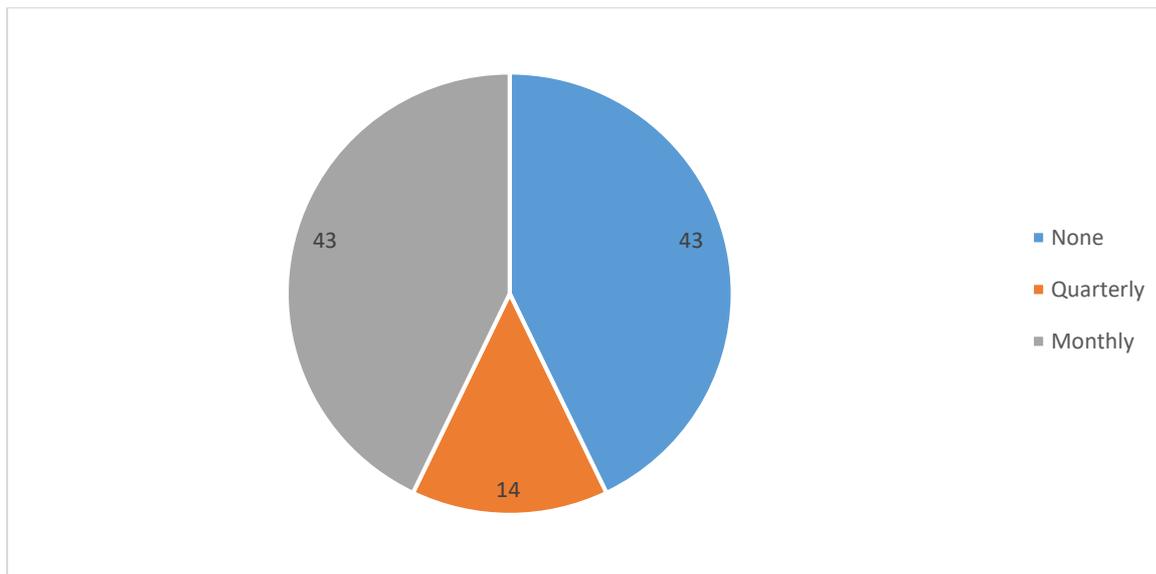


Figure 6: Frequency of Monitoring Effluent Discharge by Automobile Workshop Management (in %)

It was reported at that focus group discussion, that the automobile workshop owners did not have an elaborate system of effluent quality monitoring. Their effluent quality monitoring entailed, waste and garbage clean-up activities of establishment and some level of awareness about effluent discharge among the mechanics and their staff. 43 percent of the automobile workshop owners conducted clean-up activities on a monthly basis and 14 percent of them conducted such activity on a quarterly basis. However, 43 percent of the automobile workshop owners did not initiate any clean-up activity.

The workshop owners were also asked about the waste vehicle battery and 71% of the respondent said that they recycle the old batteries and 29% of the workshop owners said that they don't take any action with the old batteries.

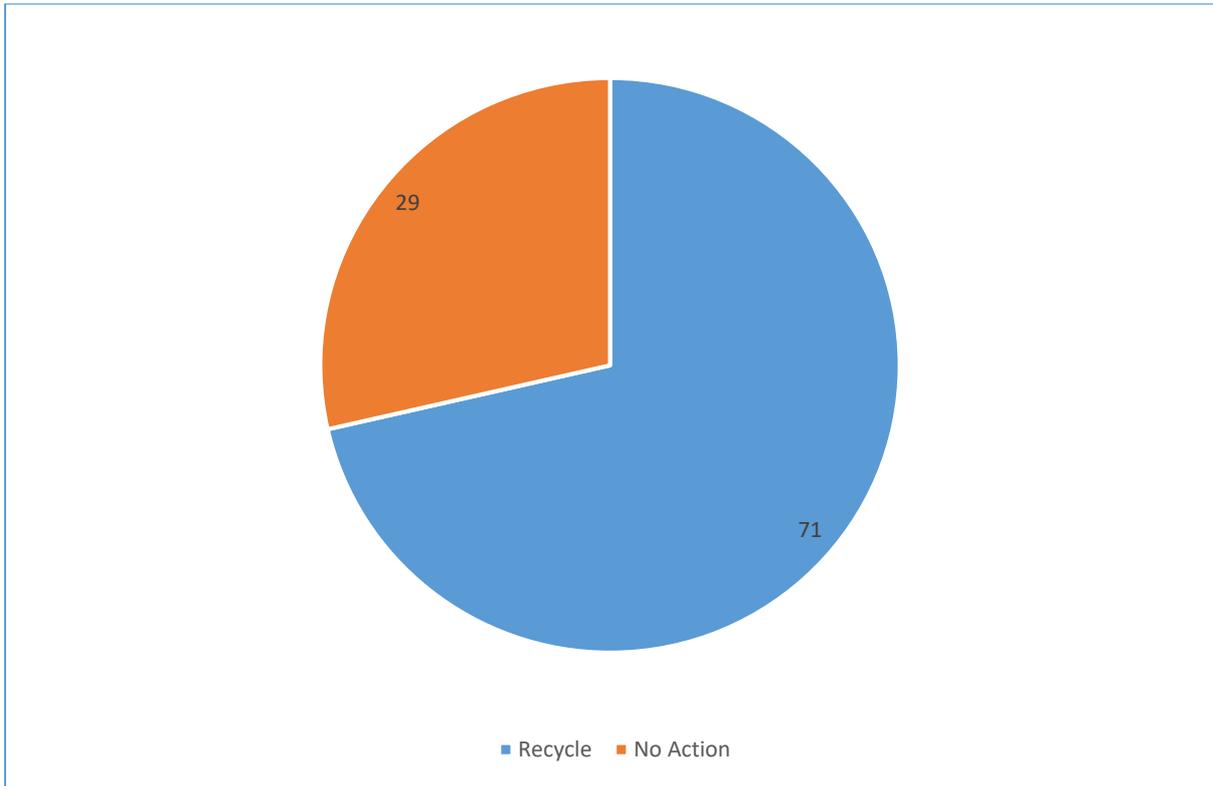


Figure 7: Waste Vehicle Battery Recycled and No Action (in Percentage)

4. Summary and conclusions

The broad objective of this assessment has been to, investigate and describe the effluent discharge and management systems of the automobile workshops and draw comparison of the water quality upstream and downstream of the automobile workshops. The assessment found that the effluent discharge from these automobile workshops fairly low. This could be attributed to only seven such workshops established along the PaaChu River and also 50% of the workshops have well maintained facility. It was also observed that due to economic value, waste engine oil is collected and sold. Although the waste water for vehicle servicing does flow out to the water bodies, the quality of water is in fairly good condition with slight higher incidence of pollution down-stream of the automobile workshops.

During the focus group discussion, majority of the workshop owner expressed their concern in terms of getting environmental clearance on time to be able to renew their automobile workshop licenses. This delay in the environment clearance issuance has caused them delay in renewal of their license. Most of the respondents also mentioned that their workshops had semi-permanent structures as there were plans of relocation of these workshops.

5. Recommendations

It was observed that, there is no oil & grease separator and effluent treatment plants, thus, the Dzongkhag/Municipal Office and the workshop owners should look into installing such facilities before it is too late.

The automobile workshops should follow and comply with the Effluent Discharge Standards.

All the automobile workshops that provide water servicing should have sedimentation tanks and a proper oil/water separation process.

Annexure I: Focus Group Discussion

Sl. No	Name	Name of workshop	Contact number
1	Sonam Phuntsho	S.P Automobiles	17608128
2	Sonam Wangchuk	Sonam Auto Workshop	17601614
3	Tenzin Norbu	Ugyen Workshop	17610663
4	Chencho Wangchuk	C-Way workshop	77299655
5	Karma	Karma Auto Workshop	17116571
6	Phuba	Khamsa workshop	77110909
7	Rinchen Khandu	Kuenchap Engineering Workshop	77289469
8	Chencho Rinzin	Brothers workshop	17882575
9	Deepen Giri	Keti Tyre shop	17997307
10	Shibu	Dawa Tyre shop	17929796
11	GK Choppel	BhWP	
12	Tenzin Wangmo	BhWP	
13	Chhimi Dorji	BhWP	
14	Chukey Wangchuk	BhWP	
15	Ugyen Lhendup	BhWP	
16	Passang Dema	Water technician - NEC	
17	Tenzin Lakjay	Water technician - NEC	

Annexure II: List of Workshops visited

Sl. No	Name of workshop
1	S.P Automobiles
2	Sonam Auto Workshop
3	Ugyen Workshop
4	C-Way workshop
5	Karma Auto Workshop
6	Khamsa workshop
7	Kuenchap Engineering Workshop
8	Brothers workshop
9	Keti Tyre shop
10	Dawa Tyre shop

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