CHAPTER 4

Findings and Results

Out of total 402 households in the survey, 157 owned their house, 152 households live in rented rooms or houses, and 93 are squatters. In fact, ward and township government offices do not have accurate and updated data on land ownership in Hlaing Tharya. Sample distribution among households with different land ownership is done by estimates of the informants ward admin, ward admin in No.(9) ward, who mentioned that population of own and rent types might have same fold, but squatters population fluctuates among wards, but it will have less population than the formers. In a way, it is allocated 39% for own, 38% of rent and 23% for squatters.

During the survey, another household type, small shops along the main road, was found, though it seems appropriate to add to the list of squatters. There are many small shops like metal, car wash shop, etc. a case study is described below to see the situation.

Box 1: Another form of squatting

Ko Thein Lwin, 29, as well as his wife, 33, has settled in Hlaing Tharya for two years. Before they moved in at the current spot (car washing service shop) beside the road, their home was the hostel. He bought the shop, indeed "squatter house" and a well, with 700,000 Kyats 4 months ago. The shop is their main and only source of earnings, which achieve at least 10,000 kyats per day, According to him, the shops beside the road are not counted as squatters, but as street vendors, by Municipal staffs and then they must pay monthly penalty fees 15,000 Kyats to the office. Only if, they are away from the list of reallocation or destroying and can stay safe.

Despite a regular payment to the government, it is counted as a squatter because of the same living condition and no land tenure.

Most of the household heads are between 40-60 years old. In many cases, household heads are not the main breadwinner while the younger are industrial workers (MMK 150,000 monthly) and motorbike/car drivers (MMK 10,000 daily). The factories prefer young workers. Factories need the old-aged as security guards, but the salary is low, about MMK 60,000 per month. The elderly usually operate small shops supplying basic foods and requirements.

Education is generally the lower secondary and primary level. Some of the elder men (>55) have a monastery education[8]. Graduates are rare, as the matriculation exam (final high school exam) is the most difficult one to pass. Only 28% succeeded in the 2016-17 academic year for the whole of Myanmar. The maximum educational attainment is mostly grade 11.

Most households immigrated to the area within the past ten years. Hlaing Tharya was established in 1990, 27 years ago. Almost 30% of "owner" households moved in at that time. The summarised data shows that the longer the duration of settlement, the more chance the household owns the land. The significant portion of renters moved in within the last ten years. In comparison with owner households, renter and squatter households have less duration of settlement. They are the most recent immigrants. The ward administration remarked that the government tried to stop new squatting in these years.

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[8] They can read and write Burmese, and calculate basic mathematics.
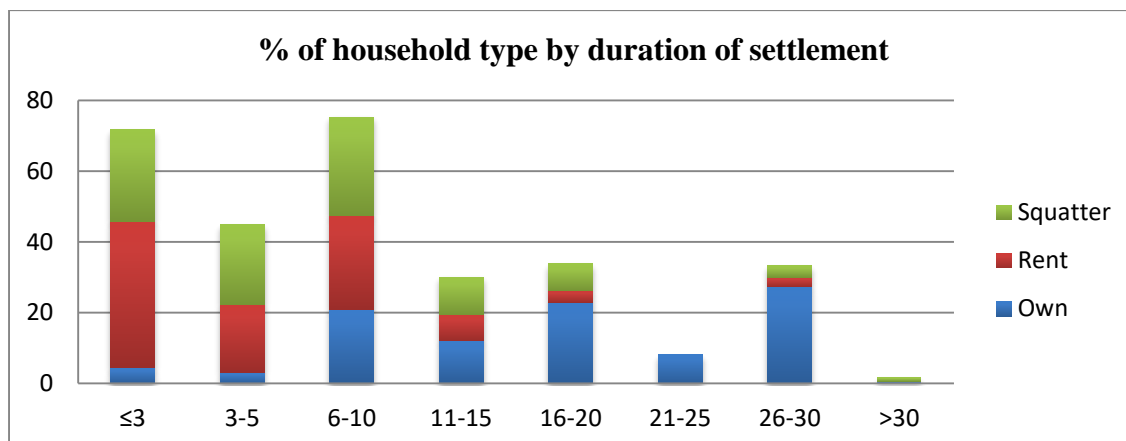
% of household type by duration of settlement

Figure 4.1: Duration of settlement in Hlaing Tharya (years) equal weighted number for each HH type

The average family size of sample household is 5 (exactly 4.7) family members, which is identical with data in 2014 Census. Ethnicity is 91% Burmese, 2% hybrid Burmese and 7% other (Kayin, Muslim, etc.). Religious affiliation is 97% Buddhist and 3% other.

Average monthly household income varies according to household types: MMK 456000[9] for owners, MMK 358000 for renters and MMK 335000 for squatters. The average income of renters and squatters is not much different while that of land-owners is one-fourth higher.

4. 1 Diarrhea

The **hospital** in Hlaing Tharya was upgraded six months ago to a 200-bed facility. Before that, it was a mere 25-beds. Total in-patients range from 500-600 per month. The outpatient department receives about 5000 patients monthly, including AIDS (Auto Immune Deficiency Syndrome) and TB (Tuberculosis) patients. "Diarrhea is not much threatening now as it is controllable if they reach to the hospital in time and mortality is rare, but compared to other townships, Hlaing Tharya needs more efforts in health education and public service improvement", the medical officer said. **Ward health centre** (representative of 6 wards) reported fewer cases of diarrhoea in recent years. The

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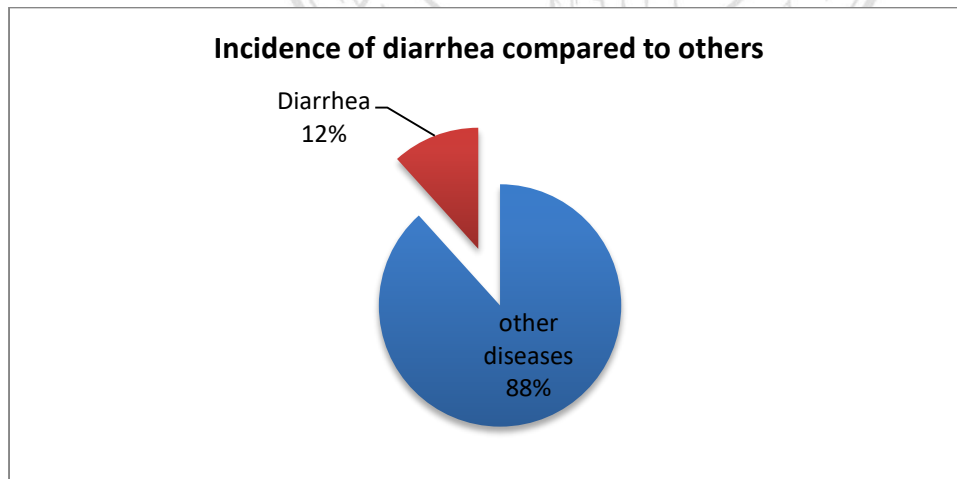[9] 4 outliers, more than 15 lakhs, were moved out of data summarized.

underlying reasons are more health education on TV, Radio and school health programs, and using purified drinking water bottles more and more instead of water underground water and pond source the last 5 to 7 years. Moreover, Cholera has not been found during their experience in last five years.

The hospital data have been well organised only after upgrade in January 2017. In terms, January to June 2017 records are available.
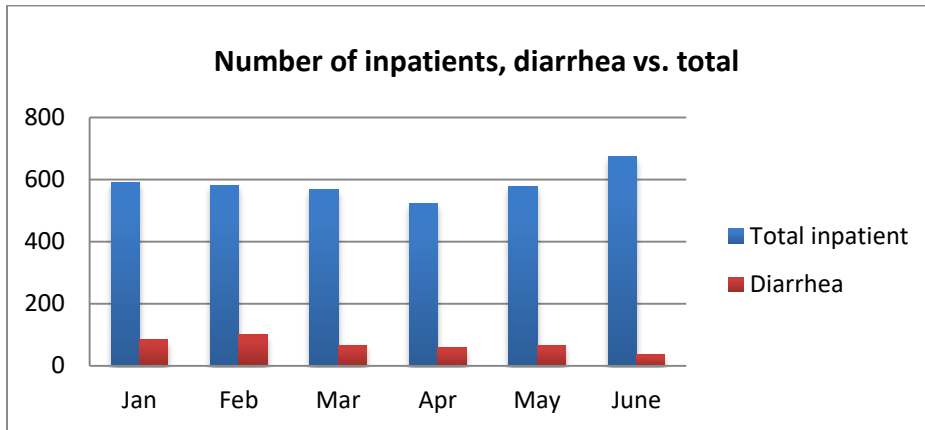
Figure4.2: Total and diarrhoea incidence in Jan-Jun 2017

**Figure 4.3:** Causes of hospitalisation in Hlaing Tharyar hospital, Jan-Jun 2017

A single case of death (45-59 year old) from diarrhoea was in January. Diarrhea inpatient, 12%, for the overall township is not neglectable and a lot compared to the regions. Despite rare mortality, its economic and social impact is diverse. Unsafe

WASH could attribute to a high impact on health care cost, suffering, human resource and productivity during illness.

Household Survey revealed that incidence of diarrhoea with more than three times per day within last two weeks is surprisingly low, 3% (both child and adult) only, regardless of types of households and income. This is quite low, compared to 12% incidence in the study of grade 5 and six students in monastic schools (Emma et. al 2016) and 8% in 24 townships in both rural and urban (UNICEF 2011). However, different age and area are a possible answer to different results. It is assumed that free monastic education is somewhat related to the poor and WASH will be relatively poor.

Sixty percent of respondents gave the right answer to the question about the cause of diarrhoea. 21% confused diarrhoea with loose motion, due to hot, spicy food and indigestion, and 3% gave the entirely wrong answer. 16% of respondents did not know the causes.

To the question of how to **cure** diarrhoea, 26% answered the application of ORS (Oral Hydrated Solution) and 56% described clinic as a way of diarrheal treatment. Self-description[10] and asking pharmacy is below 20%. One of the expected findings, traditional herbs or domestic cure, is not found much.
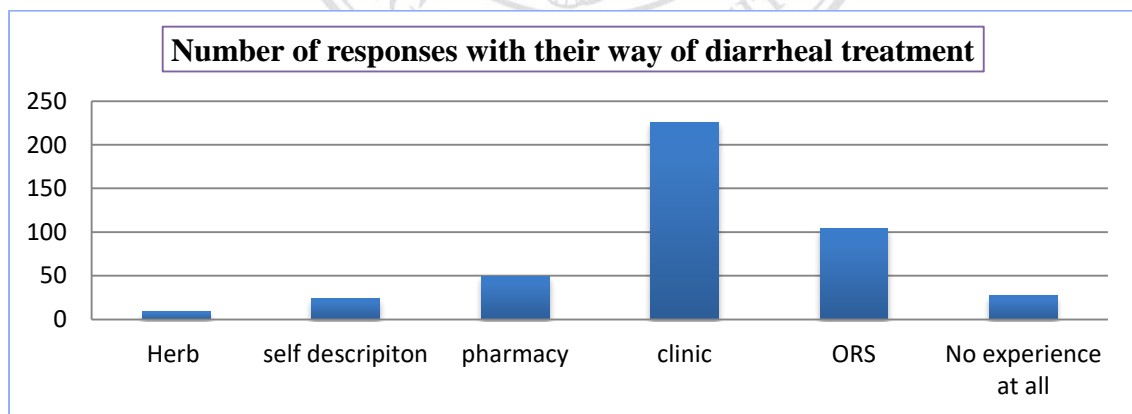
Source: Household Survey, 2017

Figure 4.4: Treatment of diarrhoea disease

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[10] Describe drug themselves, not by physicians and medical officers

4.2 WASH

4.2.1 Drinking Water

For 74% of total households, the largest source of drinking water is (**sealed**) **purified drinking water bottle**, a private commercial 20-liter plastic bottle, with the price of MMK 400. It is widely used by "rental" and "owner" households. Purified drinking water bottles are "sealed" ones with brand names and registration numbers (issued by Food and Drug Administration), and the bottle, usually white or transparent, is left in the consumer's house. There appears to be little emphasis placed on brand name, but simply on the drinking water distributor, as each distributor can sell more than one brand of drinking water. Respondents often didn't remember the brand name during the survey. Nevertheless, "Moe" purified drinking water is the most well-known and long-established purified water bottle in Hlaing Tharya.

The next source, 22%, is (unsealed) purified water, so called "Joe Phyu"[11], mainly consumed by squatter households. It is called purified water, but the bottle is unsealed, without a brand name, and the water is strained into the consumer's storage container via a cloth filter. The price is only MMK 200-250 per 22-liter (yellow) plastic bottle, half the price of Sealed PDW. Among these consumers, 14% boil "Joe Phyu" water as a treatment, while simple filtration (with thin cloth) is the only treatment before drinking.

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[11] Name of famous water reservoir in Yangon

Percentage of each household type with their main source of drinking water
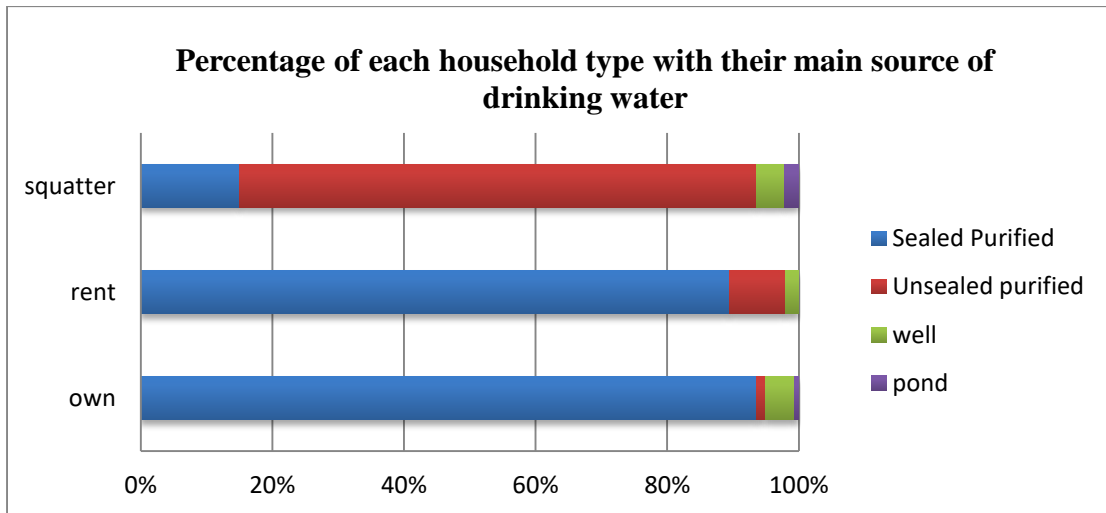
Figure 4.5: Main source of drinking water

"Joe Phyu" purified water

In Hlaing Tharyar, special area integrated with piped water system, so called Joe Phyu, is simply grand housing villa and industrial zone. Some industries were selling out the piped water to private water vendors (using trolley), who then trade water to the final user in the ward and squatter. However, now, according to key informant interviews with water vendors, water from domestic water purifier is getting popular and used, but consumers know still under the name of "Joe Phyu". The case study from water vendor is described below.

Box 2: History of Joe Phyu or Unsealed Purified Drinking Water

He has sold water since last eight years. First, he traded only "Joe Phyu" water (piped water for the industrial zone and housing villa) as drinking water in the wards. Water was bought from industry and sold it out to the residents with an unsealed bottle. Later, 4 or 5 years ago, the purified drinking water (sealed 20-liter plastic) bottle are getting popular among the consumers, and he started to sell both kinds.

So called "Joe Phyu" water from industry is not much so clean as before, with visible particles in water. He changed the water source to "domestic water purifier" and its source is underground water, but well is deeper than normal (500 feet while usual depth in the household use well is around 100 feet), which is later gotten clean with water purification machine. He has to bring bottles (yellow colour, 22 litres plastic), fill water from the seller house, with the price of 80 kyats per bottle and distribute water with his wooden trolley. He sells with different prices, about 100-150 to the nearer households and up to 250 to the far households, depending on the distance he must push the trolley.

"Water use is very fluctuated, depending on the quality of well water and affordability. Some poor households use "Unsealed purified water" for drinking while some well-off ones use "sealed purified water" for cooking and drinking", he said.

Figure (4.5) shows the difference in affordability of safe household water. Less than 20% of squatters can use the same quality source of drinking water, which 90% of normal households consume. The majority of squatters could not drink the standard drinking water.

Average consumption is 1.19 bottle a week for a person, 3 litres a day, which is reasonable and consistent with the core survival water needs mandated by the UN-Humanitarian Charter. However, it is somewhat complicated with water used for cooking, as some households use "Joe Phyu" or purified drinking water for the kitchen. The survey could not measure the extent to which they used it for cooking and drinking.

To run a binary logistic regression, the source of drinking water is grouped into two; "Sealed" purified drinking water and "Not", and regressed in the binary logistic model, using Maximum likelihood estimator. Every increase in average year of

schooling is positively associated with 1.16 times increase in the use of purified drinking water since coefficient is 0.18. When squatter households are used as a reference (coefficient = 0), owners and renters have 47.31 and 40.41 times higher chance of using sealed purified drinking water. In other words, owner and renter households are much more likely to report using safe drinking water than squatter households.

The squatter household is the most vulnerable group to get access to locally standard drinking water.

Table 4.1: Results of binary logistic regression for drinking water source

| Variable	Odd Ratio	Coefficient	Std. Error	z	Prob.	95% confidence interval	
highest year of schooling	1.16	0.14905	0.0648	2.30	0.022	.02186	0.2762
Own	47.31	3.892418	0.43452	8.88	0.000	3.005	4.7085
Rent	40.41	3.66084	0.3965	9.33	0.000	2.921	4.4763
Squatter	Reference						
Constant		-2.62156	0.57595	-4.88	0.000	-3.942	-1.6846

Source: Analysis of the study

Table 4.2: Marginal effect of land ownership status, categorical variable

	Margin of coef.	Std. Err.	z	P>z	95% Conf. Interval	
Own	.9078667	.0260168	34.90	0.000	.8568747	.9588586
Rent	.8940826	.024698	36.20	0.000	.8456735	.9424916
Squatter	.1913934	.0479903	3.99	0.000	.0973342	.2854526

Source: Analysis of the study

Pseudo R2 is .44. AUROC curve shows .87, meaning predicting model is excellent and almost perfect, whereas goodness of fit test of Hosmer Lemeshow is insignificant (prob>chi2= 0.09).
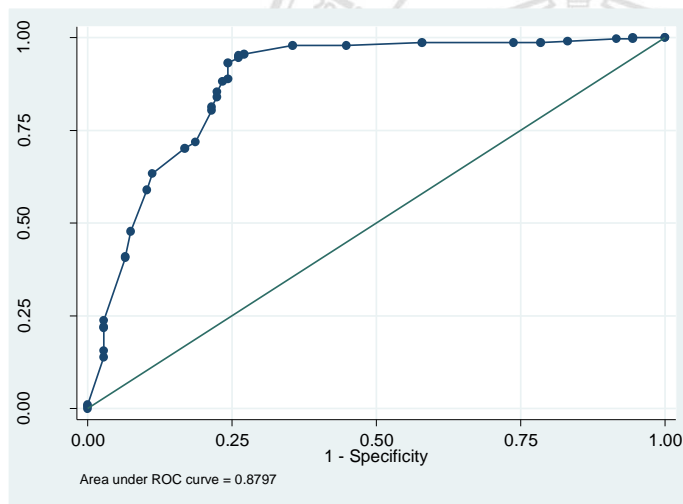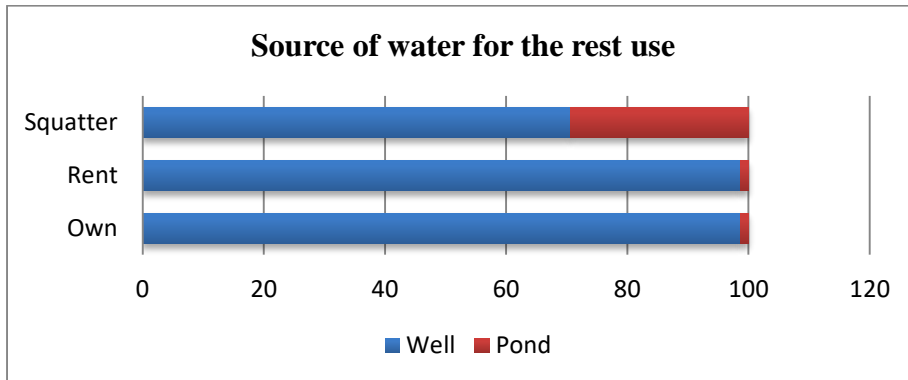

Source: Analysis of the study

Figure 4.6: AUROC of logistic regression for drinking water

4.2.2 Water for general use

Water for general use should be separately marked due to the specific use of household chores, main water for cooking and for cleansing (i.e. washing clothes and dishes and taking a bath). Water for cooking was added in questionnaire according to pilot households as they mentioned water separately for cooking and other uses.

The rest use here represents washing, bathing, etc., which requires a significant amount of water, but less concern for the quality of water. Wells are the most common

source for easy access to abundant water, 92%. Eight percent of households, mostly squatters, don't have a well, and instead, rely on water from nearby "unimproved" ponds.
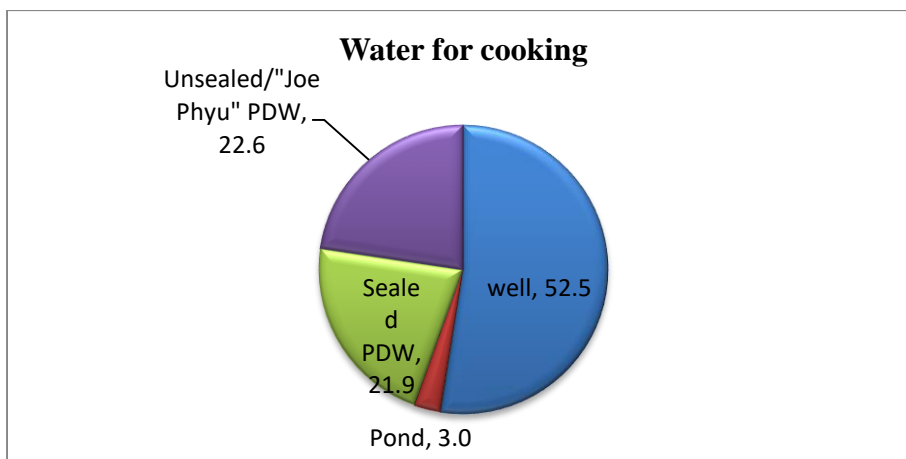

Source of water for the rest use

Figure 4.7: The percentage of Water source for the rest household use against each HH type

Underground water source, main source, is usually with the depth of 80-150 Feet well, and digging new one costs about MMK 70,000 to 140,000, in accord with the depth of well. Motor engines are used for extraction of water (price arranging from MMK 50,000 to 200,000), using public electric power. Squatters, lack of access to Public electricity and well, have to buy well water with a monthly payment (MMK 5000-10000, depending on family size) from the household of own land or squatter with own well and generator (using gasoline). The visual quality fluctuated even on the same street, but about 400-500 feet well are sure for better quality, water purifier factories dig that.

Two ponds, observed in ward No (7) and No (12), are not adequately protected and are considered an unimproved source according to WHO standards. There is no fence and no proper maintenance. Moreover, the pit latrines are built within 30 meters of the ponds. The pond in No. (7) Ward was announced as an infectious source by the local health authority. However, squatters still used its water for washing and cleansing.

Water for cooking

- Unsealed/"Joe Phyu" PDW, 22.6
- Sealed PDW, 21.9
- well, 52.5
- Pond, 3.0

Figure 4.8: Different Source of water for cooking and their shares

Half of the sample household used well water for the kitchen, while the other half used sealed PDW and unsealed PDW/Joe Phyu. They use purified water, as the well water is yellow colour and smells of iron. The squatters use pond water for general use and in No. (7) ward used it despite the announcement of the infectious outbreak. (The pond is now boarded on the embankment and no longer used for cooking).

Table 4.3: Results of binary logistic regression for cooking water

| Variable	Odds Ratio	Coefficient	Std. Error	z	Prob.	95% confidence interval	
Constant		-3.353115	0.2959268	-1.19	0.326	-.93312	.22689
Highest year of Schooling	1.074	0.071	0.04657	2.40	0.075	0.020449	0.20300
Own	.4667	-.761	0.2925916	-2.78	0.011	- 1.38548	-.238542
Rent	.5009	-.6913	0.2807676	-2.67	0.013	-1.299	.1984107
Squatter	Reference						

Table 4.4: Margins of coefficient for land ownership status

	Margin (Coef)	Std. Err.	z	Prob.	95% confidence interval	
Own	.3864067	.0399643	9.67	0.000	.3080781	.4647352
Rent	.4031244	.039597	10.	0.000	.3255156	. 4807332
Squatter	.5724729	.0540986	10.58	0.000	.4664416	.6785042

Source: Analysis of the study

Owner and rental households have a higher negative coefficient for using safer water for cooking such as "Joe Phyu" and Sealed PDW. Squatters use purified water for cooking. The underlying reason is answered in FGD that they have their own well and containers and can manage water for sedimentation and storage. The squatters using an unreliable Average year of schooling has a positive impact on using purified water for cooking. The only rise in the year of schooling is linked with 1.074 times increase the chance of using purified water for cooking.

All coefficients pass Wald test, and Goodness of fit test show the insignificant probability of chi squared (Prob<chi2 = 0.3379), indicating the model is fitted well. AUROC shows .586, which means the bad accuracy of model prediction.
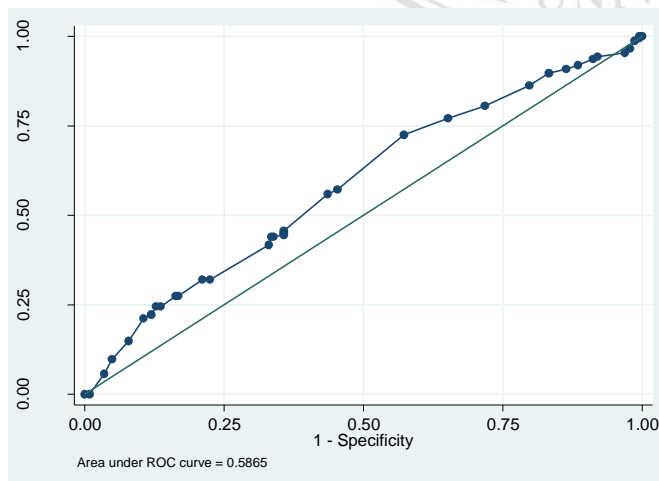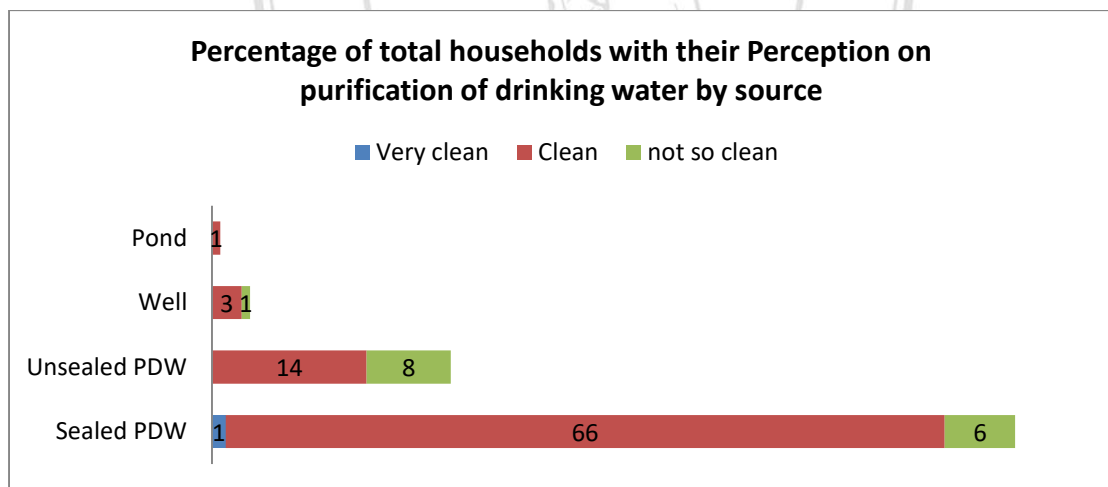

Source: Analysis of the study

Figure 4.9: AUROC of cooking water logistic model

The shortage is not common in Hlaing Tharya for the last 27 years, since it was established. Only 3% of household surveyed reported a scarcity of water from wells, in summer.

Only 7% of total sample households have to pay for water use, including up to 28% of squatters. They usually pay to nearby water distributor with own well, a monthly fee for water access, which varies from MMK 5000 to MMK 10000 depending on family size, and portable pipes connect it. For "rent" household, apartment rental fee already includes water and electricity bill.

150 out of 402 households treat the water in some way to clean. Among them, one-third treats water by simple filtration and two-third by depositing dust for one night.

Only 151 households out of 402, 37%, uses the lid for water storage containers. It shows that effective storage of water is not enough to control another mosquito related disease, which is very common in monsoon season (public health centre).


Percentage of total households with their Perception on purification of drinking water by source

■ Very clean ■ Clean ■ not so clean

- Pond: 1
- Well: 3, 1
- Unsealed PDW: 14, 8
- Sealed PDW: 1, 66, 6

Figure 4.10: Perception on purification level of drinking water

General **perception on purification** on both sealed and unsealed PDW is not very much strong, as some households reported that some visible particles or algae could be seen on the wall of the bottle, after keeping for some days. Ward admin said that he heard, FDA (food and Drug Administration) checked Brand Names of PDW bottles available in the market and banned five suppliers with no proper registration in

Hlaing Tharya. He added that even the registered suppliers could not meet with safe supply, according to with his household's experience.

Joe Phyu water consumers are mostly squatter. (Figure 14) shows that one-third of Unsealed PDW users reported they felt "not so clean" and some informants mentioned, "what we want is (sealed) purified drinking water, but it is beyond our affordability, and the cost is two folds".
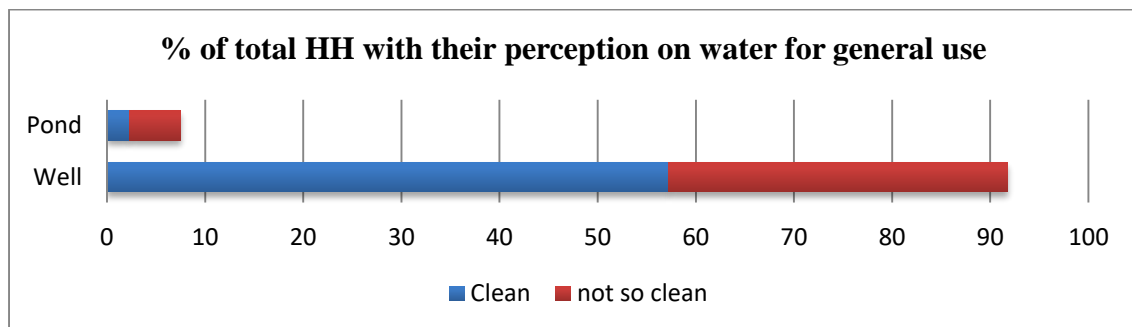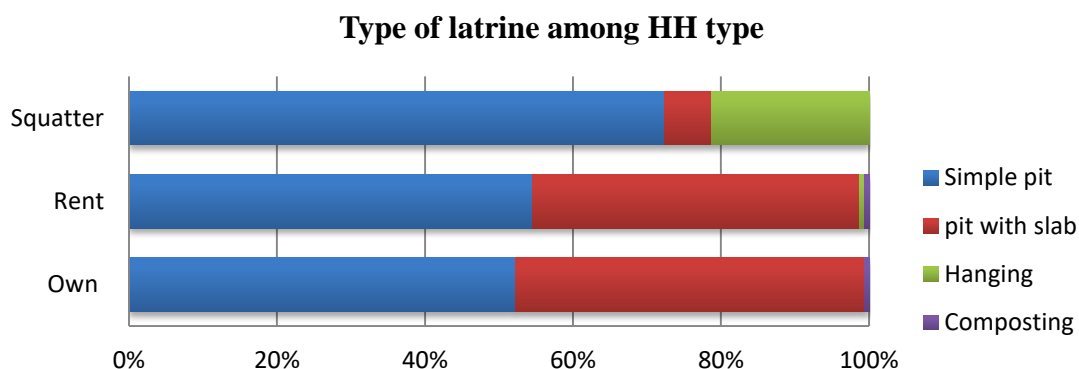

Source: **Analysis of the study**

Figure 4.11: Perception on purification level of water for general use, mainly well and pond

Perception of water for general use shows about 60% for "Clean" and the rest for "Not so Clean". Most of the pond water users reported that the pond quality becomes worse during the recent 4-6 years, owing to crowded population and user fault.

4.2.3 Sanitation

Type of latrine among HH type

Figure 4.12: Type of Latrine

Improved type of latrine is 95% and the rest use hanging latrine, but the quality of the simple pit is doubtful in most of the squatter, and the study could not account the exact number. **The simple pit** is most common among all three HH types, followed by a pit with the slab as a second in own and rent ones. Hanging latrines are used by squatters. According to observation and informants, simple pit in squatters, especially in wetlands and muddy area, are a not a reliable one for safe sanitary. Because of water on the pit and muddy condition all year round, it could not be well dug and sealed, and usually leakage to the surroundings, mainly in the monsoon. It is hard to measure technically what simple pits are safe or not.

Out of 232 simple pit users, only 44 have the lid on the storage containers. All households use water or water and soap as a cleansing facility in the latrine.

One-third of households surveyed have to share the latrine, but a different proportion of each household type. Rent households are the most prominent in sharing a latrine, over 60%, due to the design of the rental building. (In fact, every hostel-type apartment has to share a latrine, 90% of renter households in Hlaing Tharya is in hostel-type rent, the informant estimated.) Here there may be selection bias as only one part was selected as a sample from a hostel, assuming the same condition of WASH. Sharing latrine is prominent in hostels where is very crowded in two storied building. One informant migrated from a rural area said, "the big two hostels in my street is more

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populated than my native village." Though sharing bathroom and toilet, hostel costs less than the individual house, and it becomes a favourite choice of migrant workers after all.
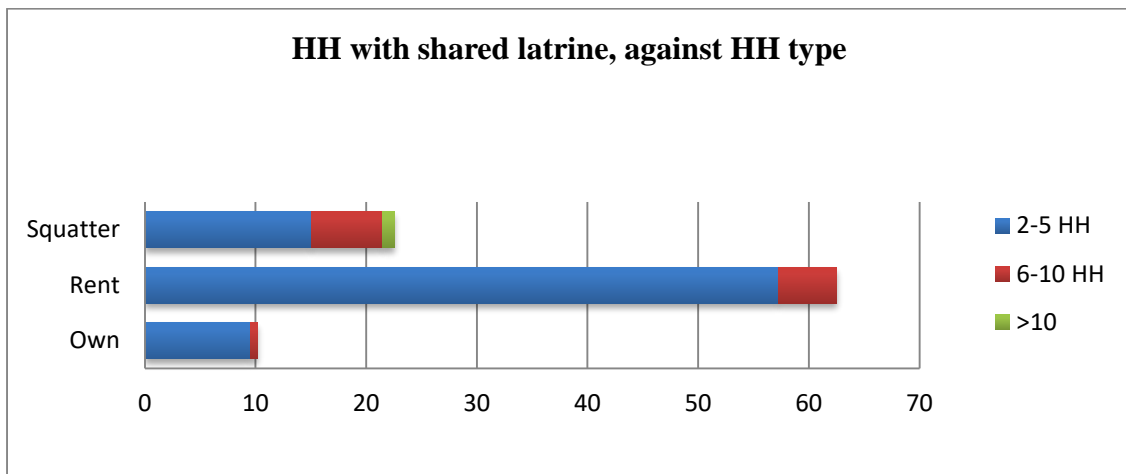
Figure 4.13: Household with shared latrine against specific HH type

It proves that higher income is elastic to better use of a latrine. If monthly income increase in MMK100,000, binary log-odds of using latrine by "individual household" increase in 1.43 units while holding the other variable constant.

The binary logistic coefficient for "own" household relative to squatter household (reference) type is .83 for using latrine individually, while that for "rent" is -1.74. In odd ratio, "own" household is 2.30 times likely to use the individual latrine, compared to squatter household types. "Rent" household are more apt to share a latrine. In other words, a renting family has a higher chance of sharing latrine relative to using their own latrine. Owned households are more likely to use one latrine individually, followed by "squatter" and "rent". Among rental homes, incomes divide into two; who afford to rent a more expensive individual house or not, and thereby share a latrine or not, informants reported.

Table 4.5 Binary logistic regression result for sharing latrine

Variable	Odd Ratio	Coefficient	Std. Error	z	Prob.	Low	High
Own	2.309559	.837056	0.3657747	2.29	0.022	0.1201515	1.55396
Rent	.1752009	-1.741822	0.3003692	-5.80	0.000	-2.330533	-1.1531
Squatter	Reference						
Income	2.30	1.43e-07	6.54e-07	2.19	0.028	1.52e-07	2.72e-07
C		.7111078	0.3171259	2.24	0.025	0.0895525	1.33266

Source: Analysis of the study
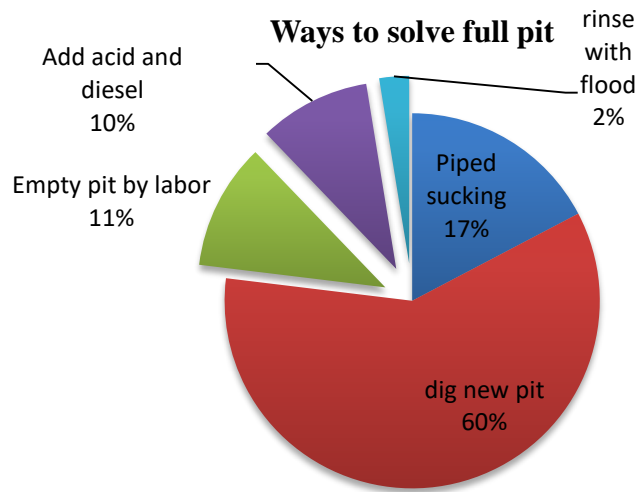
GOF (LH test) showed significantly and concluded that the model is poorly fitted, but it cannot say that in what respect it is poorly fitted. The area under receiver operating characteristics curve (AUROC) is .80, meaning that the predictive probability of the model is excellent in accuracy.
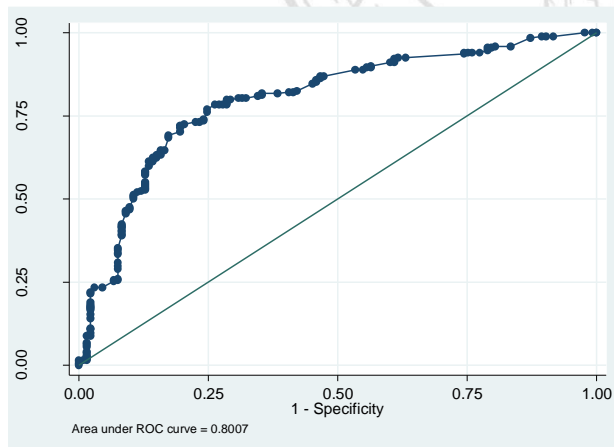
Source: **Analysis of the study**

Figure 4.14 AUROC of Sharing Latrine Logistic Model

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Ways to solve full pit

- Add acid and diesel 10%
- Empty pit by labor 11%
- Piped sucking 17%
- rinse with flood 2%
- dig new pit 60%

Source: **Analysis of the study**

Figure 4.15: Area Under Receiver Operation Characteristics (AUROC) of sharing latrine logistic model

Users of the pit latrine were asked how to address the problem of a full pit. 156 households, mainly rent/hostel, experienced full-pit, answered the way they solved as in the figure (18). Out of 156 responses, almost one fourth (empty pit by labour, pour acid and diesel and rinse with the flood in the monsoon) is not appropriate ways to carry out. Rinsing with water/flood is in squatters in the alluvial area, where water is under house 12 months a year. The inappropriate ways are cheaper than piped sucking (ranged from MMK 20,000 to 40,000) and digging new one (MMK 100,000, including concrete pit and labour). Digging new one, or having two pits, has the advantage of the alternative use of another one when one is full. In some respects, it is cost effective in long run. It is studied that public service (car rent by municipal) for the full pit is not well known among the slums community. One barrier to demand is higher cost, compared to other alternatives.

Disposing or rinsing out the faeces from the full pit of the hostel into the back alley is reported by the neighbour in No.(12) ward. The smell is disgusting. When the neighbour complained about it, the hostel guard did not confess, and the hostel owner does not live here.
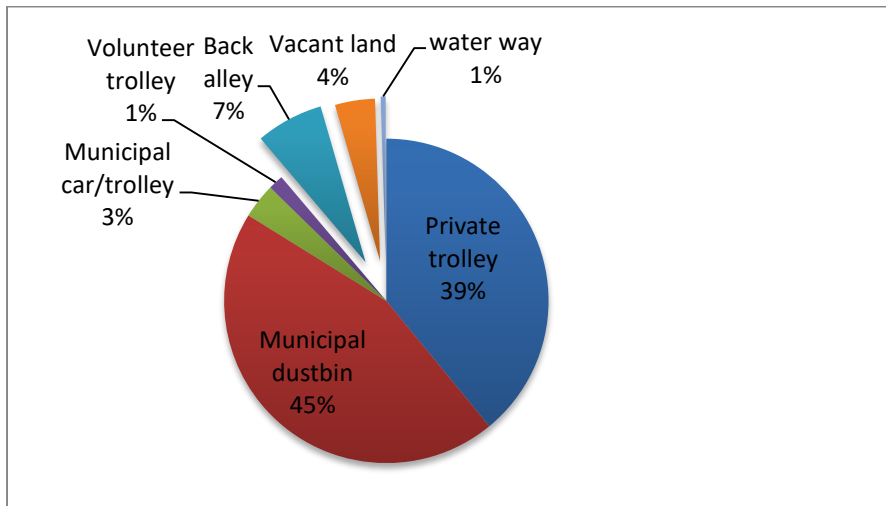
4.2.4 Solid Waste

Three clusters are separated in solid waste management in Yangon; the first is downtown six townships, the second 10 townships in outer rings of Yangon, and the last is outermost and industrialised townships. The tax is also different, MMK 20 per day for first class, MMK 15 for second and MMK 10 for third. (MMK 600, 450 and 300 per month respectively, Municipal dept. collects quarterly) The resource and services are also different. Hlaing Tharya is listed in third class.

Township cleaning department, under Township Department of Municipal and thereby under YCDC, is taking responsibilities of solid waste management in 20 wards and this year extended service to 5 villages (out of nine villages in Hlaing Tharya). Cleaning back alley is concerned with the residents or ward administration and the office provides only truck when they ask for help. Usually, ward administrator leads the activity. Waterways clearance (small) is managed directly by Municipal Management department, with 20 cleaner staffs. For big waterways, it has to ask help from another township department in the same district, Yangon has four districts (North, East, South and West) and this is managed by YCDC head office.

The human resources are 24 cleaners (permanent staffs), and 152 daily labourers (at the position of WA: Ward Authority) paid every five days. The daily wage is MMK 3600. There are 14 tracks and ten three-wheel motorbikes. The latter is more efficient than the conventional trolley, saving time and energy consumed. The head of solid waste department made a comparison to see room for improvement in Hlaing Tharya that in Taiwan the ratio of cleaner to population is 1:100 whereas about 1:4000 in Hlaing Tharya.

The department currently collects waste in two ways; to gather waste at municipal dustbin, where the residents can dispose anytime, and the second is a "bell" system, in which the residents have to dispose at three-wheel motorbikes or trucks in the street while ringing bells. The main difficulty is a lack of discipline. People throw garbage at inappropriate places. They also throw inappropriate types of garbage in municipal dustbins, including branches, old household furniture, old building materials, garbage from industries and so forth, which cannot be disposed of at public municipal garbage dumps. Such debris requires specific disposal by truck to the main waste

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disposal area in Hlaing Tharya. The dustbin allows only daily kitchen waste. Another difficulty for the office is finding cleaners, as most people do not want to work at a dirty and dangerous job while wage is not higher than the other private labourer job. Although the intended number of daily labourers for 2017 is 165, the current number is only 152 and more 13 labourers needed, and the office is still finding the rest up to in the rural Ayeyarwady. Observation study shows that most are old women who cannot find a job anywhere else.

Figure 4.16: Solid waste disposal

In the household survey results, 12% of total households answered that they use inappropriate practices of waste disposal at vacant land, back alley and waterways, whereas 10% is by squatter households and 2% of rent households. Any "own" household did not answer such place as a waste disposal. Still, 12% inappropriate disposal matters a lot for crowded shantytown.

Municipal tax for "kitchen waste" is collected quarterly 900 kyats or 300 Kyats per month. Some households, with the same name of land ownership entitlement i.e. some sold part of the land to other but didn't officially register, have to share the cost. As the tax is not so much, some don't recognise the amount well. The most prominent saying is that any municipal worker does not clean and collect the waste in the street and waterways like service in the downtown, and they just collect waste in the

municipal dustbins by cars. Some respondent explained, "They just collect the tax, not waste".

Poor solid waste management and careless throwing of garbage lead to blockage of waterways and wastewater ponds across the township, creating habitats for mosquito breeding and source of disease. Mosquito breeding becomes much higher in the last 3-5 years, according to some informants, and dengue outbreak is common in the monsoon yearly. The quote of the grocery shop in squatters is, "no longer mosquito-coils in our shop, as no mosquito is killed". Some said that they pour diesel or gasoline onto the ponds or waterways to lessen mosquito habitats, but not much effective. This practice is hazardous for ecological concerns. Everybody seems very unhappy whenever mosquito-breeding rate is asked. The mosquito is a "disgusting feature" of everyday life.

While the municipal department has limited capacity to tackle such waterways blockage, informants speak to various community initiatives. According to ward administrators and elders, community initiatives are rare, except Buddhism sermon ceremony. Collective action, led by Ward admin, for waterways clearance during pre-monsoon season, become inactive after political regime change, precisely after 2012 Ward/village administrator election law. At the age of democracy or elected admin, ward administration does not have much funding (from easy payment and fine, before) and authority and is unable to gather participants and labour contribution. Another factor is that waterways are blocked for a long time everywhere. Even if one area makes a clearance, it is not effective as the other downstream area do nothing. It needs a master plan for the whole township. The only one case study is volunteer group of young residents in No. (7) ward.

Box 3: Collective action for waste disposal

Ko Than Win, 34, and his neighbourhood friends initiated the community oriented volunteer group for waste collection, namely "Laung Myitta", at the end of 2016 and then other youths also involved. Firstly, they contributed some money to buy trolley. Every Sunday the members contribute labour for waste collection in the nearby street and bring it to the municipal dustbin. Some household contributes money to them, which makes it affordable to buy more waste collection tools and snack as refreshment for philanthropic members. However, the area covered is still narrow, and labour is not enough. Labor contribution or budget is rather required to extend to more area and also for waterways clearance.

Table 4.6: Regression results for binary dependent variable of Waste disposal at appropriate place or not

Variable	Odd Ratio	Coefficient	Std. Error	z-Statistic	Prob.	Low	High
highest year of schooling	1.245	0.2193	.056	3.86	0.000	0.1080	0.3306
Duration of settlement	1.0634	0.2598	.024	2.48	0.013	0.0128	0.11010
Constant		-0. 2598	.467	-0.56	0.578	-1.1766	0.65688

Source: Analysis of the study

All explanatory variables have a positive relationship to the dependent variable, waste disposal at an appropriate place or not. Every one-year increase in duration of settlement is associated with log odds of 0.064 for disposing waste at the right place. It is concluded that Urbanization and peer pressure from urban environment urge migrant people to dispose of appropriately, leaving rural practice, with no municipal service. A one-year increase in average year of schooling could make 1.24 times increased odds of appropriate waste disposal. Education and settlement for a longer time could improve people behaviour.

The goodness of fit test shows 0.40 of the probability of chi-squared, saying that the data are consistent with the specified distribution and model is well fitted

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enough. What is more, AUROC is 0.74, saying the prediction of the model is good enough. Wald coefficient test show significant, which means that coefficients are not equal to zero.

Area under ROC curve = 0.7354
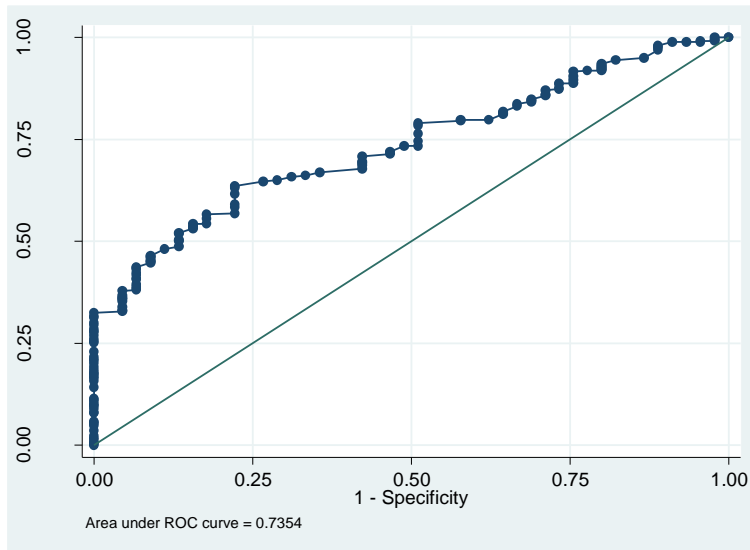
Source: **Analysis of the study**

Figure 4.17: AUROC of waste disposal logistic model

4.2.5 Hand Wash

For Hand washing practice, three hand washing times were measured; namely "before eating", "before food preparing" and "after toilet".

This data is categorised into Hand Wash at all three critical times or not. It is regressed with the type of household, socioeconomic factors, yet it does not show any significant correlation to explanatory variables.

4.3 Contingent Valuation Method

Contingent Valuation method is used to get WTP for public services of piped water, disinfection and efficient waste management. The minimum amount of WTP is gathered using open-ended questions, asking respondents to consider the ability to pay, which means price from the demand side. Water and waste management are assumed as government inevitable basic supply for the public, and thereby the installation fee is not considered. Just monthly tax payment for improvement is included in the scenario.

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Scenario for piped water and solid waste management was described as the same to downtown Yangon, and most of the respondents know about the condition. However, photos (in appendix A) of downtown service were shown to them during an interview to lessen imaginary bias. For who does not know the quality of piped water, it was expressed that it is usually colourless and odourless but often dirt with visible particles especially in the summer, and downtown residents do not drink and have to buy PDW bottles for drinking.

For waste service improvement, the scenario is the same with downtown, and the WTP is taken as a replacement to current MMK 300/month, not an additional payment.

For disinfection is new to the whole Myanmar and it has to explain that this is practice in other countries, which disinfect water in the reservoir before distribution and drinkable water. Moreover, thereby the respondents rationally tried to answer the amount they currently have to spend on drinking water.

Table 4.7: Summary of Response to CV method

	Piped water	Disinfection	Solid waste
No response to question	10	12	8
Disagree to scenario	2	1	1
Unable to guess WTP though agree to scenario	58	88	71
Big outliers	5	2	4
Invalid response	75	103	84
Valid data of WTP (no outliers)	327	299	318
"0" WTP, though agree to scenario	12	45	37
Response rate (%)	81.3	74.4	79.1

Source: Analysis of the study

The WTP data excludes the data of who does not want to answer or is not able to estimate and includes that of who wants to get free of charge, as "0" kyats, despite agreeing to the scenario. The free riders problem is simply low[12]. A household that lives near municipal dustbin and can dispose of easily, simply answered that they do not want to pay more thought service improvement is agreeable for the whole township. Overall,

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[12] Though we asked to who seems very difficult to answer, "it is ok to say "0", most of them don't want to get free.

the response rate is acceptable, as 75% is remarked as good response rate. "Disinfection of piped water" scenario is very new to the respondents who may not know much about it and logically low response rate, compared to others.

The data after adjusted outliers includes observation of 327 for piped water system, 299 for disinfection to piped water and 318 for effective waste management.

Table 4.8: Summary of WTP data

|	**Piped water**	**Disinfected**[13]	**Waste Disposal**
Mean	4457.187	2161.873	1506.918
Median	4000.000	2000.000	1000.000
Maximum	15000.00	10000.00	6000.000
Minimum	0.000000	0.000000	0.000000
Std. Dev.	3026.245	1922.252	1267.433
Skewness	1.259054	1.278242	1.364635
Kurtosis	4.845671	4.827865	4.999681
Jarque-Bera	132.8079	123.0473	151.6812
Sum	1457500.	646400.0	479200.0
Sum Sq. Dev.	2.99E+09	1.10E+09	5.09E+08
Observations	327	299	318

Source: Analysis of the study

It is interesting that WTP is much higher than the actual tax the municipal is collecting, for piped and waste disposal services. The current quarterly payments in downtown are MMK 5400 (1800 per month) per house/apart for piped water and MMK 1800 (600 per month) for waste disposal. Tax for kitchen waste has three classes; downtown six townships as first class, outer ten townships as second-class and outermost industrial townships, including Haling Tharya, are third class. The tax also differs, MMK 600 per month for first class, 450 for second and 300 for third. The full service is not available for all townships owing to limitations on budget and human

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[13] The amount is asked as an additional fee for disinfection in the piped system, and it means the WTP for disinfected piped water is the sum of this column and the previous one.

resource. YCDC plans to improve service in gradient direction from the centre. The WTP for waste agrees to project extension in slums.

In the case of WTP for water, piped water system is also mixed with quality improvement, as the downtown piped water is quite better than well and ponds water. For drinkable level disinfection, the result goes along with the findings of the prior study in developing countries. Willingness to pay for quantity (piped water) is greater than for quality improvement, due to pressing needs of more expense on food and essentials things else (Whittington 2010).

Because WTP data include "0" kyats (7, 41 and 35 for piped system, disinfection and waste disposal improvement respectively), the data cannot have a normal distribution and right skewed.
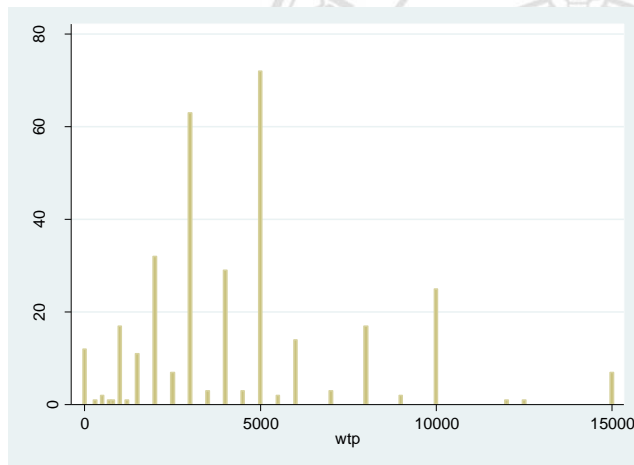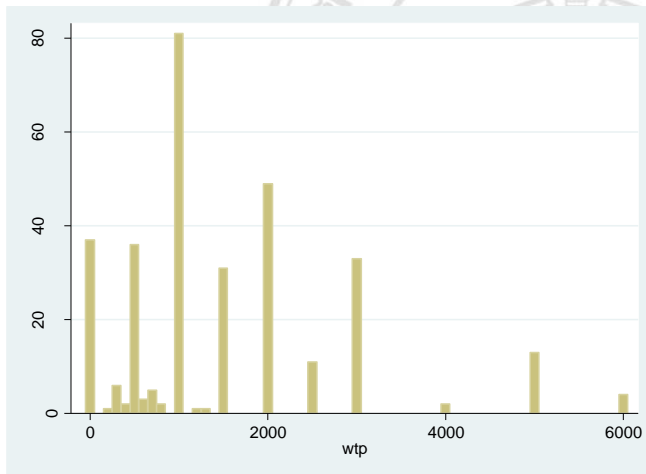

Source: Analysis of the study

Figure 4.18: Histogram of WTP for piped water system
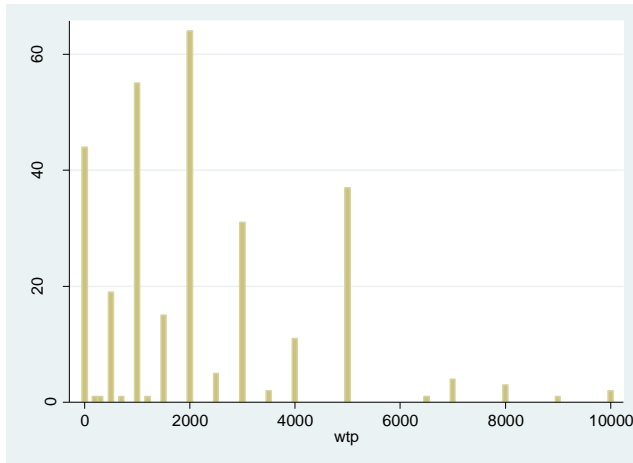
Figure 4.19: Histogram of WTP for disinfection to piped water

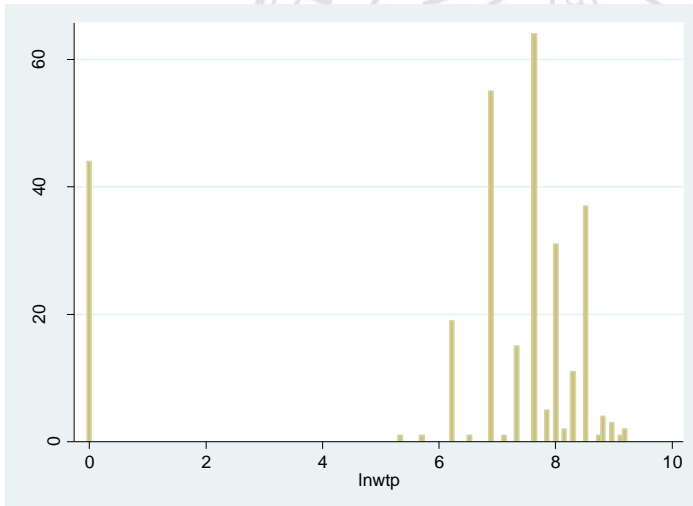**Figure 4.20:** Histogram of WTP for effective solid waste disposal

Because of skewness and a non-normal distribution, WTP is transformed into log form. For the presence of "0" WTP, the whole data sets are added with one before changed into log form.
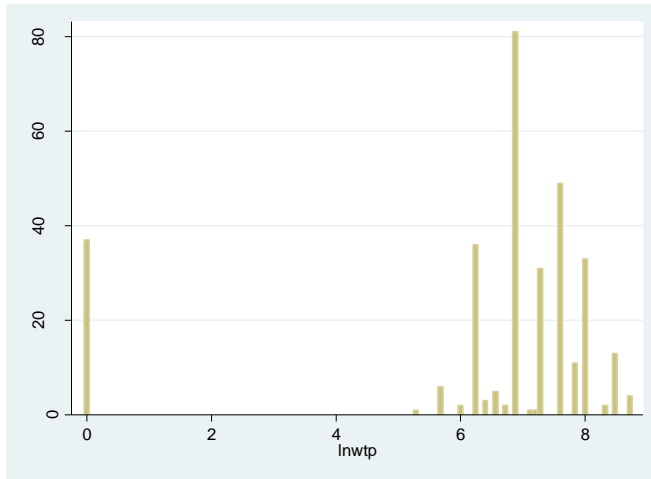
$$lnWTP = \log(WTP + 1)$$

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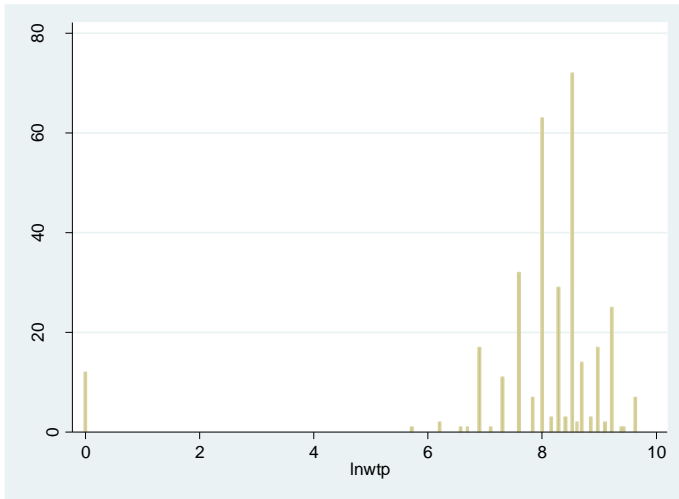
Figure 4.21: Histogram of log (WTP+1) for piped water

Figure 4.22: Histogram of log (WTP+1) for disinfection to piped water

Figure 4.23: Histogram of WTP for effective waste disposal

"0" is still in the way of efficient regression and thereby lower-truncated regression is desirable to fit the empirical data in to get unbiased estimator.

4.3.1 Willingness to pay for Piped Water

12 observations of "0" log of WTP is truncated during regression, and total 315 observations left.

Table 4.9: Regression Results of WTP for piped water system

	Coef.	Std. Err	z	Prob.	| [95% Conf. Interval]	
"own"	-.282071	.0949219	-2.97	0.003	-.4681146	-.0960276
"rent"	-.4633991	.0966577	-4.79	0.000	-.6528448	2739534
"squatter"	Reference					
Constant	8.524285	.0761281	111.97	0.000	8.375076	8.673493
/sigma	.6414666	.0255566	25.10	0.000	.5913765	.6915567

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Table 4.10: Marginal effect of each household type

	Exp.	Margin	Std. Err	z	Prob.	[95% Coef. Interval]	
Squatter	3797.94	8.242214	.0566982	145.37	0.000	8.13108	8.35334
Rent	3168.096	8.060886	.0595587	135.34	0.000	7.94415	8.17761
Squatter	5035.585	8.524285	.0761281	111.97	0.000	8.37507	8.67349

Source: Analysis of the study

The variable of residual is predicted and regressed against critical data, land ownership, which shows insignificant (prob>F 0.91) or accept null hypothesis of no correlation between residual and independent variables. Correlation between predicted and observed WTP is 0.1249. Wald test and equivalent coefficient test are passed, with significant p-value (0.0003)

Log of WTP is changed into WTP by exponential, and surprisingly squatters have higher WTP relative to "own" and "rent" households. The underlying reason is concluded into two. First, they do not have their own well and have to rely on private distributors, water vendors and ponds nearby. Expenditure on water for general use is higher, compared to others. In this respect, their WTP for piped water is simply high. Secondly, public piped water system is seen as land tenure strategy. Currently, any squatters are not legally allowed to get access to public services, electricity, waste collection, etc. Access to public piped water in the scenario means that the government authorizes their residence.

4.3.2 Willingness to pay for disinfecting the piped water

Table 4.11: Truncated Regression results for WTP for disinfection to piped water

	Coef.	Std. Err.	z	Prob	(95% conf. Interval)	
Income	4.87e-07	1.57e-07	3.09	0.002	1.78e-07	7.95e-07
User of Purified water for cooking	.2318061	.0903042	2.57	0.010	.0548131	.408799
Constant	7.280143	.0898206	81.05	0.000	7.104098	7.456188
/sigma	.713128	.0316399	22.54	0.000	.6511149	.7751412

Source: Analysis of the study

Table 4.12: Marginal effect for Dummy of Purified water for cooking or not

	Exp.(coef.)	Coef.	Std. Err.	z	Prob
Purified	2254.418	7.720647	.0679942	113.55	0.000
Not	1787.979	7.488841	.0594274	126.02	0.000

Source: Analysis of the study

Willingness to pay for disinfecting is high by those households using purified water for cooking, rather than who using pond or well water for the kitchen. It reflects people's risk perception on water quality. Individuals who care about the quality of water are more willing to pay for disinfected water. Those who use purified water for cooking paid almost 500 kyats higher WTP rather than who do not. The other limitation on WTP is lower income. The higher income, the higher WTP. Since the coefficients are log value of WTP, it is transformed into non-log, to interpret the results.

An increase in MMK 100000 of monthly income is correlated with MMK 4.8 increase in the log of WTP, which means 119 Kyats of WTPThe WTP measurements agree with the theory of income elasticity that demand increase with income.

The regression residual squared against explanatory variables describes insignificant p-value (0.3045), or it accepts that error term is in a random mood and has no specific structure. Wald and equivalent coefficient tests reject the null hypothesis. Likelihood ratio test, for one with both explanatory (Purified water and income) compared to the model with only one explanatory (income), shows less AIC and BIC (557<564). So, the model with revenue and dummy of cooking water is chosen as the best fitted, while all coefficient tests are significant. However, WTP for disinfection does not show any major linkage to land ownership and education.

4.3.3 Willingness to pay for Solid Waste Disposal

The right model is chosen using likelihood ratio test. The model with land ownership and income variable is better fitting than one with only income or land ownership, AIC (589<592).

Table 4.13: Results from truncated regression of WTP for effective solid waste disposal

	Coef.	Std. Err.	z	Prob.	(95% conf. Interval)	
Own	-.2747688	.1159409	-2.37	0.018	-.5020089	-0.0475287
Rent	-.2776606	.1133211	-2.45	0.014	-.499765	-.0555553
Squatter	Reference					
Income	3.19e-07	1.50e-07	2.13	0.033	2.55e-08	6.12e-07
Constant	7.301319	.1050751	69.49	0.000	7.095376	7.507262
/Sigma	.6786555	.0286274	23.71	0.000	.6225469	.7347641

  Source: Analysis of the study

Table 4.14: Marginal effect of each household type, categorical variable

	WTP	Coef.	Std. Err.	z	Prob	95% conf. Interval	
Own	1287	7.159774	.0645303	110.95	0.000	7.033297	7.286251
Rent	1283	7.156882	.0645959	110.79	0.000	7.030277	7.283488
Squatter	1693	7.434543	.0942722	78.86	0.000	7.249773	7.619313

  Source: Analysis of the study

Wald test is successfully passed, and coefficients are not equal each other. There is no correlation between variance squared and explanatory variables (p-value 0.5664)

Again, Squatter has higher WTP than "own" and "rent" households, as predicted value of WTP is about 1700 Kyats by squatter while about 1300 Kyats by "own" and "rent". The income's correlation on WTP is not very much, only 1.375 increase by 1 lakh increase in income. The squatter has 400 Kyats higher WTP than others. This is explained by the case study Box (4) in No.(7) ward below.

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Box 4: Municipal service as a way of problem-solving

The squatters settling at the outer rings of the industrial zone has found difficulty for waste disposal. The leader of almost 200-squatters households has been finding the ways of proper waste disposal. He wants municipal staffs to collect waste in the street and ensures the residents be able to afford the service fees. Nevertheless, his effort was faded away as the local rules said squatters are not worthy to receive any municipal service, such as water, electricity and waste disposal.

One squatter resident on the street said, "we want municipal service and want to keep the street clean and tidy so that we are not in the list of reallocation by the new government." The leader also added, "We voted for NLD and Daw Aung San Su Kyi. Hopefully, we are not put in the tight corner; it didn't happen even at the age of junta government."

It explores that squatters also have their respected elder or leader, who was not formally elected like ward administrators. It is exciting that they try to make their place livable to get rid of relocation by the government. Public service tax does not matter if they are allowed to get access.

Predicted WTP for all households is *minimum* 1200 Kyats, four folds the current tax and two folds the tax in downtown. It is so sure that the government should invest in the improvement of the service in slums like the scenario/downtown since the benefits of the whole society are high.

4.5 Information Angle

A common source of health information is broadcasting media, mainly Television, while published media and formal health care centre are far behind, figure (28). The simple source from friends or neighbours is followed by secondary sources. The sources do not vary by type of household or land ownership. However, diarrhoea, water and sanitation related are longer actively promoted by health education programs (HE) on TV. It may be old and unexciting, but diarrhoea remains one of the top five causes of death for children under five. Although people know that uncleanliness contributes to diarrhoea, HE programs could remind them of the risks and hazards, and prioritise WASH spending among household expenditures.

Number of response on mian source of health info
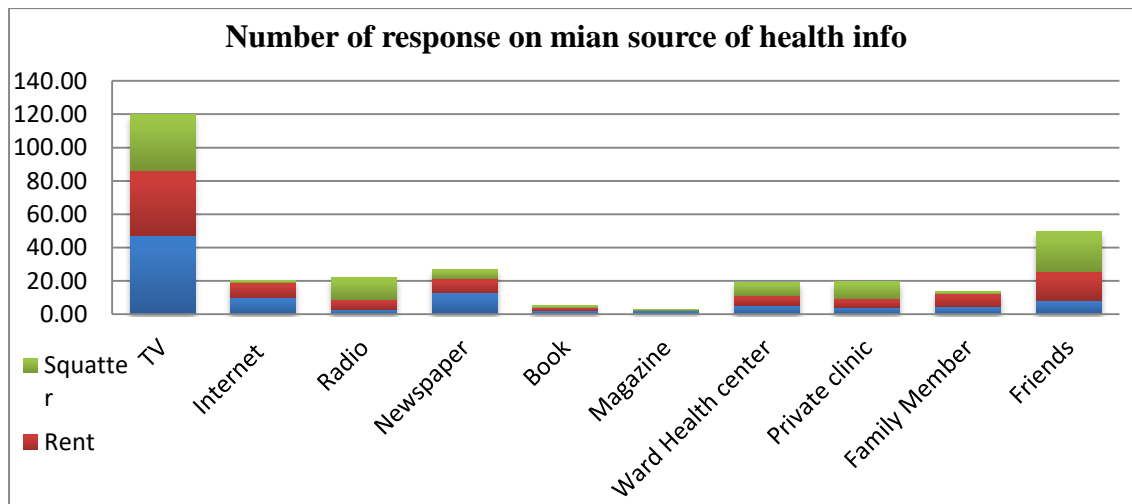
Source: Analysis of the study

Figure 4.24: Source of health information for different household type

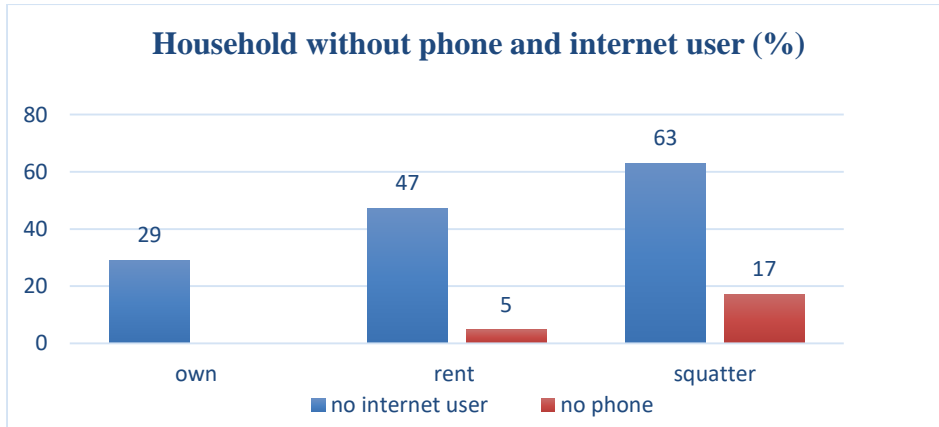**Percentage of phone and internet user out of populaiton**
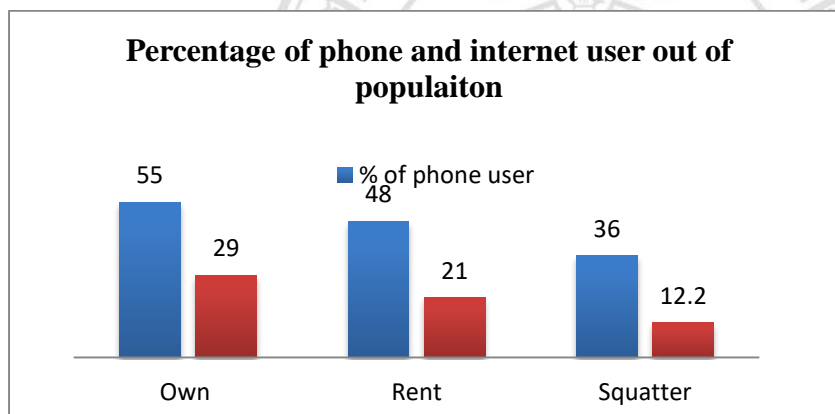
Source: Analysis of the study

Figure 4.25: Percentage of phone and internet user out of population in each household type

Figure (4.22) shows the data for individual mobile phone and internet users of different household types Comparing land ownership status, the percentage of mobile phone and internet users are different and shows descending trend in lack of land ownership and reflection to the level of poverty and affordability on expenditure. Nevertheless, the overall mobile phone user for the whole population in sample household (15 years old and above), 67%, is so much for the time being, compared to the recent past, about 2010. The finding is unfailing to GSMA and LIRNEasia' joint report, which says 40% of Myanmar population own mobile phone, according to a

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national survey in March 2015. Different study area (Nationwide vs. Yangon slums) and two years of timing could reasonably double the subscribers.


Household without phone and internet user (%)

Figure 4.26: Percentage of Household with no mobile phone and internet user at all

A home without a phone at all is 24 (7 rent and 16 squatters) out of 402, or overall 6%. A household without internet user at all are 177 households out of 402 (46 out of 157 "own"_29%, 72 out of 152 rent_ 47% and 59 out of 93 "squatter"_63%), that means overall 44% does not have internet user within the family.

To get the statistical model, a portion of mobile phone use among family members (number of cell phone users denominated by total family members and so ranged 0-1) is used as dependent variable. The mean is 0.5341.
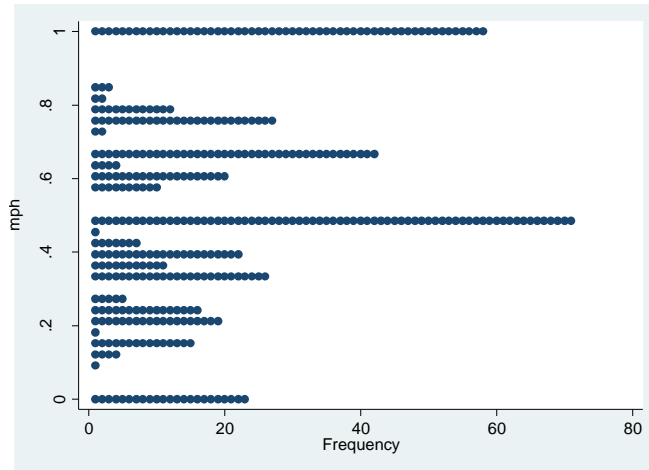
Figure 4.27: Frequency distribution of mobile phone user portion within family members

The graphical normality test of plot is applied for mobile phone use, dependent variable, because of high frequency at two ends (0 and 1), censored regression (Tobit regression) or truncated regression has to be used to regress portion of mobile phone user (among family members) against land ownership, monthly household income and highest grades in the family. To choose specified model, information criteria is used and truncated model has lower information criteria (AIC = -166.7586 and BIC = -147.9014), rather than Tobit (AIC = 389.7726 and BIC = 409.7548).

What is more, theoretically, censored model is used because some "true" value of dependent variables are not observed. Truncated model is for outcome variables of "known" but accumulated frequency at the end of the value range, at upper or lower end or both. The data set is simply more reliable with truncated estimator.

Eighty-one observations out of 402 are truncated during regression. 321 observations are left for regression. The probability of Chi squared is 0.041, meaning the whole model is significantly specified. As R squared is not provided in regression result, predicted value is calculated and correlated with observed mobile phone use (mph), getting correlation 0.29. R squared is .085.

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Table 4.15: Truncated Regression Result for mobile phone user portion of family member

Variable	Coefficient	Std. Error	t-Statistic	Prob.	95% confidence interval	
Own	.0818359	.0304941	2.68	0.007	.0220686	.1416031
Rent	.0502246	.0306482	1.64	0.101	-.0098448	.1102939
Squatter	Reference					
Income	8.05e-08	4.24e-08	1.90	0.058	-2.62e-09	1.64e-07
Constant	.401413	.0286611	14.01	0.000	.3452382	.4575877
/sigma	.193629	.009131	21.21	0.000	.1757325	.2115254

Source: Analysis of the study

Each coefficient passes Wald test and shows significant probability. When residual squared is regressed against explanatory variables (land ownership and income), prob>F is .3856 and probabilities for individual coefficient are also insignificant, which accepts that there is no correlation between residual and explanatory variables.

The result is that "own" and "rent" households, compared to reference "squatter", have a positive correlation with mobile phone use, and precisely have 8.1 and 5 percent higher, respectively.

Every MMK 100,000 increase in monthly income is associated with 0.8 % increase in cell phone usage in the family. This positive correlation is another proof to the finding of GMSA and LIRNEasia report, reporting the attribution of low household income to low mobile phone use.

Table 4.16: Marginal Effects of land ownership status

	Coefficient	Std. Error	T-statistics	Prob.
Own	.5166453	.0177041	29.18	0.000
Rent	.485034	.018761	25.85	0.000
Squatter	.4348094	.0244896	17.75	0.000

Source: Analysis of the study

Each marginal effect of land ownership status is categorised and the coefficient for own leads, followed by "rent" and "squatter".

In sum, wealth accumulation (higher spending on housing and income) and education level are apparently linking with the use of the mobile phone at 5% coefficient interval. Wealth is necessary for buying the mobile handset. Although cell phone subscribers are dramatically increasing in Myanmar, the WASH vulnerable population such as squatter residents and low-income families have relatively less access to cell phone usage, compared to households with more wealth accumulation. Nonetheless, overall 94% of families with at least one cell phone agree to the potential of health intervention in slums. Diffusion rate might be high as neighbours or friends nearby are the second health information source.

4.5 Limitations

The data is worth being critized to predict the actual size of the issue, due to self-limit to tell the true practice to the enumerator, mainly in hand wash, wash facilities and so on. Nonetheless, the findings still show dangerous conditions: 12% dispose waste at wrong places, and one fourth do not hand wash at all three critical times (before eating and preparing food and after using the latrine). It can be assumed that the findings are underestimating the issues and reality might be higher than these.

Concerning with econometric, adjusted R squared is not reported by truncated regression, and also assumed it is not valuable for studying human behaviours, which is hard to predict. It is argued that regression is to check whether there is a correlation or match, and not "causality", not necessarily to show R squared.