# Recycling and Reuse of Household Plastics

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**ABSTRACT:** The study was undertaken with the objectives to: (1) Study the present status of plastic waste management and the existing Phnom Penh household willingness and their influence factors to segregate plastics for recycling and reuse (plastics & non plastics); (2) Study how other cities encouraged and obtained the participation of their population in plastics recycling and reuse and (3) recommend which policy the government should implement plastic waste recycling in Phnom Penh. The study was conducted in two phases. Phase one involved secondary research such as reviewing of relevant literatures, journals, publications, books, and reports. The second phase involved collection of primary data via structured questionnaires. The study is analyzed based on 429 qualified questionnaires that were collected from households in Phnom Penh by using: percentage, mean and standard deviation. It investigated household's behavior toward their waste and their willingness to separate plastics and non-plastics wastes. The researcher considers the question of waste from households as it is most likely the root of waste behaviors. By looking at the current state of process and recycling plastics waste –an important element of waste equation, the researcher hopes to shed the lights on plastic waste issues.

**Key words:** Green Logistics, Reverse Logistics, Recycling, Phnom Penh

## INTRODUCTION

Logistics are important function of modern transport systems. Contemporary technological and spatial developments have improved the cost, efficiency and reliability of freight and passenger transport system. At the same time, the negative environmental impacts of transportation have gained wide recognition and are at the core of issues of sustainability, especially in urban areas. Inserting the green and reverse logistics into the recycling and the disposal of waste materials of all kinds, including toxic and hazardous goods, has become a major new market. The problem caused by plastics is a world-wide phenomenon. Cambodia is no exception. It has become part of the daily life problems, for urban and also for countryside people alike. As disposal site in Stung Mean Chey (in Cambodia) could still have only

limited life, waste has to be transported at greater distances to the new disposal site. A different approach is where reverse distribution is a continuous embedded process in which the organisation (manufacturer or distributor) takes responsibility for the delivery of new products as well as their take-back.This would mean environmental considerations through the whole life-cycle of a product (production, distribution, consumption and disposal). For example, BMW is designing a vehicle whose parts will be entirely recyclable (Giuntini and Andel, 1995).

There is a clear need for Cambodia to research for the current approach of waste disposal that is focused on municipalities and uses high energy/high technology, to move more towards waste processing and waste recycling (that involves public-private partnerships, aiming

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for eventual waste minimization - driven at the community level, and using low energy/low technology resources. Some of the defining criteria for future waste minimization programs will include deeper community participation, understanding economic benefits/recovery of waste, focusing on life cycles (rather than end-of-pipe solutions), decentralized administration of waste, minimizing environmental impacts, reconciling investment costs with long-term goals. Cambodia should take into account the "3R" which refers to reduce consumption, reuse and recycle. The Royal government of Cambodia's intervention promoting greater environmental regulation appears inevitable. At the same time, individual logistics firms are finding a match between environmental considerations and profitability. It is becoming acceptable within the industry to adopt green measures. Sometimes they reduce costs, but more often than not they lead to more intangible benefits such as image and reputation enhancement. It is here that environmental management systems, such as International Standardization for Organization (ISO) 14000, may offer opportunities to green the logistics industry. The problem caused by plastics is a world-wide phenomenon. Cambodia is no exception. It has become part of the daily life problems, for urban and also for countryside people alike. More than half the plastics are disposed by burning on-farm, with most of the remainder buried or dumped on-farm. Due to inefficiencies of open combustion, emissions from open burning are much greater per mass of material burned than emissions from controlled incineration (e.g., 20 times as much dioxin, 40 times as much particulate matter). These emissions pose risks to human health. (Levitan & Barros, 2003).

Environmental impacts of logistical activities are most severe where population densities are highest; i.e. in cities. Therefore, city logistics deserve special attention. Taniguchi et al., (2003) set three basic pillars as the guiding principles for green city logistics: mobility, sustainability and livability. These pillars should support and enhance the goals and objectives of logistics, such as efficiency, congestion alleviation, energy conservation etc. The harmonization of efficiency, environmental friendliness and energy conservation is vital for ensuring sustainable development of freight transport in urban areas. Consequently, the goal of city logistics should be to deliver and collect the goods for activities produced in a city in an efficient way, without disrupting the sustainable, mobile, livable and environmental friendly character of the city. This study aims to study the existing Phnom Penh household willingness and their influence factors to segregate plastics for recycling and reuse (plastics & non plastics) and study how other cities encouraged and obtained the participation of their population in plastics recycling and reuse and recommend which policy the government should implement plastic waste recycling in Phnom Penh. The findings of this research are to produce the following contribution: 1) it can identify how households in Phnom Penh are willing to segregate plastics waste, therefore, providing valuable insights for green logistics affecting the involvement of households in plastic recycling and reuse in Phnom Penh, 2) it explores on how other cities around the world are practicing with regards to plastics recycling process in order to promote a cleaner city. To what extent is the success of their people's participation and 3) it can select which model is appropriate to implement in Phnom Penh for the plastics waste management?

The amount of solid waste generated in Phnom Penh is 890.6 tons per day or an average of 320,616 tons per year. Medical waste accounts around 346.1 tons per year and Industrial waste accounts around 20,962.8 tons per year. Plastic also take up a growing percentage of MSW stream and pose environmental challenges. Plastics wastes accounts for 15.5% of recyclable items which is 27% in total. Its low density, strength, user-friendly design and fabrication capabilities and low cost, are the drivers to such growth. From the view point of proper management of the final disposal site, plastic waste will be an obstacle. Therefore, countermeasures should be considered.

Lourenço and Soto (2002) studied the reverse logistics models and applications on the topic of a recoverable production planning model. The model takes into account the importance of developing new alternatives to improve the performance of the companies. The model takes advantage of the synergies of integration; developing a model for global production planning that generates the

optimal production and purchasing schedule for all the companies integrating a logistic chain. Pringle and Barker (2004) mentioned in their report prepared for Aberdeen Forward and Aberdeen shire Council, about starting a waste plastics recycling business. The report briefly charts what happened over the 16 months, from September 1999. Hannequart (2005) pointed out, in his guide for waste plastics recycling for local and regional authorities, the good and the bad sides of plastics. He said that history may view plastics as one of the most important technical developments of the 20th century. Geroliminis and Daganzo (2005) in their study on "a review of green logistics schemes used in cities around the world" tried to see whether efficient and environmental friendly urban logistics systems can be created. Their paper presents several examples of "green logistics" schemes tried in a number of forward-looking cities around the world.

Singapore Green Plan in 2012 provides 8 key measures: (1) Averting a Waste Land; (2) Living in Harmony with Nature; (3) Ensuring Clean Air; (4) Keeping the Water Flowing; (5) Improvement Public Health; (6) Forging Strategic Partnerships; (7) Enhancing External Collaboration; (8). Singapore's have put efforts in getting residents to recycle have produce results – households participation rate in the National Recycling Program has increased from 15% in 2001 to 45% by end 2003. Industries have also explored more and newer ways to recycle waste, thus contributing to the increase in recycling rate from 40% in 2000 to 47% in 2003.

**MATERIALS & METHODS**

The survey was conducted by using questionnaire. The questionnaire is divided into two main sections: (1) general information and knowledge about plastic waste, (2) what factors would influence the household's willingness to segregate their waste from plastics and non plastics. The 429 questionnaires were randomly distributed door to door in the 7 districts in Phnom Penh. The data collected is analyzed using SPSS software. Likert Scale was applied as it is considered as the one of the most appropriate and reliable measurement scale for such type of questions and is the most widely used scale in survey research .Questionnaires with 5 point rating

scale were used to measure respondent's evaluation by asking them the degree of importance with statements in the questionnaire that ranked from (1) least important or least problem to (5) most important or most problem. The higher the score the most important the variables are as evaluative criteria.

The main study on this research is how plastics collected could be recycle and re-use and whether the separation of these plastics should occur at the source or later in the value chain. A literature review and the case analysis identified a number of properties of reverse distribution channels that influence the performance(Fig. 1).The willingness of household involvement of the plastics separation is most likely the root of waste behaviors. Thus we look into factors that be involved with households willingness to separate their waste from plastics and non-plastics. From the objective of the study, we concluded our conceptual framework of this research as follows: This research was conducted in two phases. The first phase involved secondary research such as reviewing of relevant literatures, research journals, publications, books, official reports and related information. The second phase, the primary research involved collection of primary data via survey research with structured questionnaire that were divided into two parts:

**Part I:** General Information and knowledge about plastics waste, and

**Part II:** What factors would influence the households' in participating with plastic waste segregation.

Sample size had been applied purposively to selected households, plastic collectors and wholesale buyers of recyclable plastics. The total household size was 173,678 (Ministry of Commerce, 1998). Given that it is not possible to survey the whole households, the author concentrated on some proportion of the households located in each district (Table 1), believed to be able to represent each district.

Yamane (1973) recommended the formula for random sample as below:
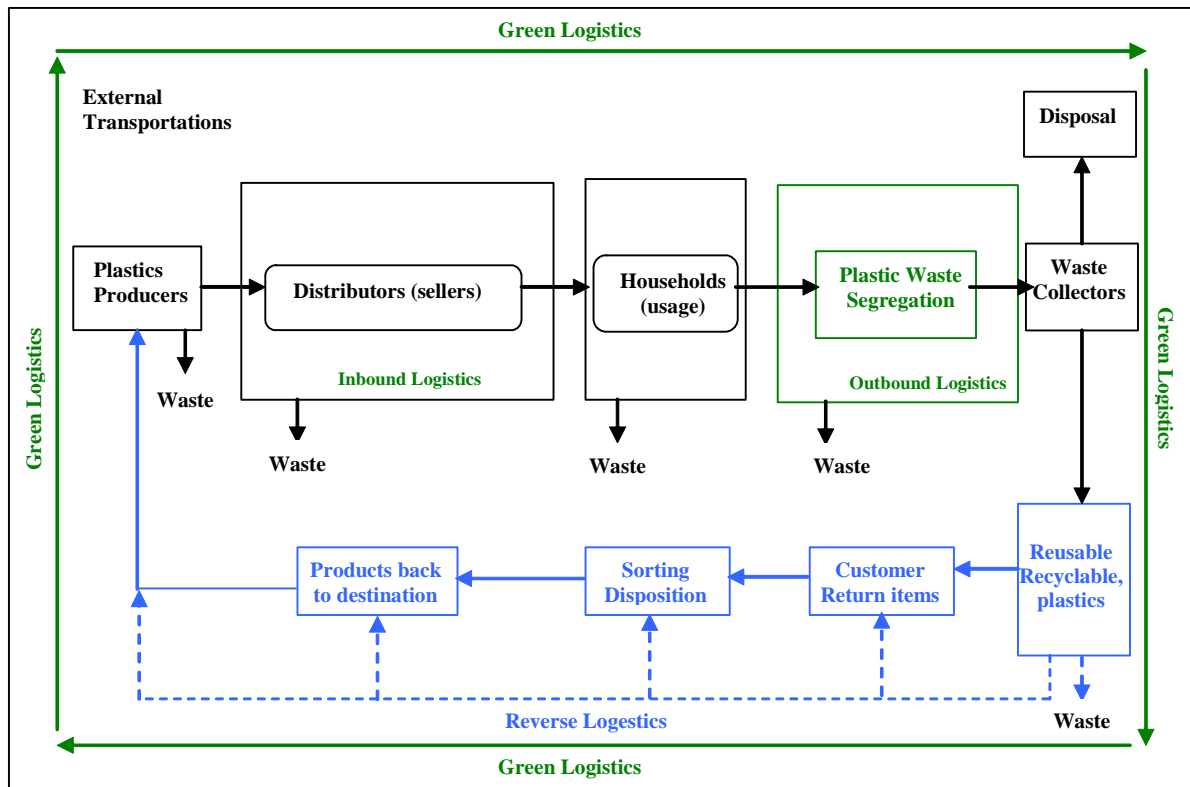
$$n = \frac{N}{1 + N e^2}$$

**Fig. 1. Reverse and Green Logistics Conceptual Framework for Plastics Recycling**

**Table 1. Method of Sample Size Computation**

| Name of District | Total no. of HH in District | % of sample by household district | #of sample by total HH |
|---|---|---|---|
| Chamkar Mon | 32,366 | 18.63% | 75 |
| Daun Penh | 22,203 | 13.00% | 52 |
| 7 Makara | 16,529 | 9.51% | 38 |
| Toul Kork | 26,198 | 15.08% | 60 |
| Dangkor | 17,565 | 10.11% | 40 |
| Mean Chey | 27,443 | 15.80% | 63 |
| Ruessey Keo | 31,374 | 18.06% | 72 |
| **Total** | **173,678** | **100%** | **400** |

Household Source: Ministry of Commerce, Cambodia Data National Resource, Phnom Penh Province (1998)

Where n is sample
N is population
$e^{-2}$ is probability of error
The sample size can be calculated according to the recommendation as follow**:**

$$n = \frac{173,678}{1 + 173,678 * 0.05^2} = 399.99$$

With N = 173,678, e = 5% (95 percent confidence). Hence the sample size for conducting questionnaire should be 400 households. Factors affecting the involvement of household to segregating plastics waste: study on the green and reverse logistics for plastic recycling and reuse in

Phnom Penh illustrated in Fig. 2. The questionnaires were designed with relevant to the objectives of the study and the conceptual framework. It was kept as short and concise as possible as a short questionnaire with conceptually clear and concise statements. Questionnaires with 5 point rating scale were used to measure respondent's evaluation by asking them the degree of importance with statements in the questionnaire that ranked from (1) least important or least problem to (5) most important or most problem. The higher the score the most important the variables are as evaluative criteria. With 5 point scales, the interval for breaking the range in measuring each variable is calculated as follow:

$$\frac{5-1}{5} = 0.8$$

It means items with scores fall between the range of:
4.21 – 5.00 are considered as the most important or most problem level
3.41 – 4.20 are considered as high important or high problem level
2.61 – 3.40 are considered as medium important or medium problem level
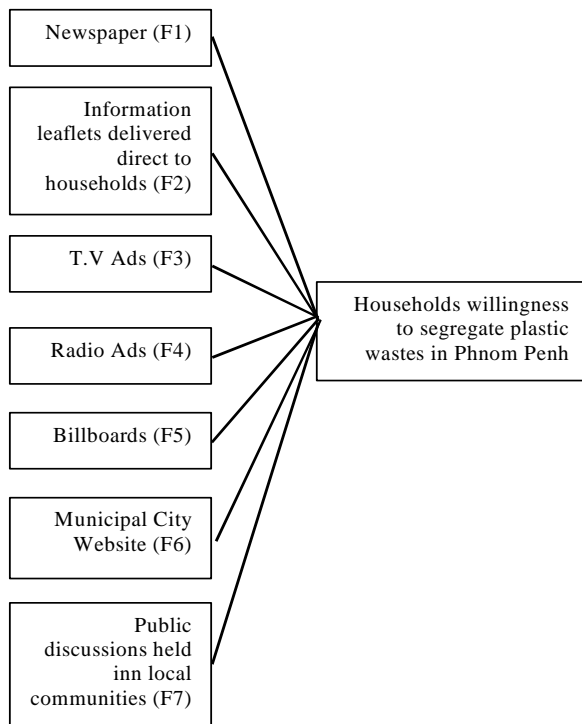
**Fig. 2. Factors Affecting the Involvement of Household to Segregating Plastics Waste**

1.81 – 2.60 are considered as less important or less problem level

1.00 – 1.80 are considered as the least important or least problem level

Likert Scale was applied as it is considered as the one of the most appropriate and reliable measurement scale for such type of questions and is the most widely used scale in survey research (Wikipidia, 2007). Data from questionnaires were processed by SPSS program. To ensure the accuracy, the questionnaires were designed by taking into account the following factors:

a. Academic literature, research articles and publications

b. Pre-tested to ensure that the respondent understood the questionnaire in right perspective.

The pilot test was conducted to access the reliability of the questionnaire and its content validity of the measurement items. A total number of 40 questionnaires were being test (10 % of total questionnaire). The reliability test was based on Cronbachs' alpha coefficient. It is based on question no.2-3 and question 11 which ask on how important each problem was. From the result in Table 2, we can see that both alpha is bigger than

**Table 2. Reliability Test of the Questionnaire Distributed**

| Variable | Number of Variable | Alpha |
|---|---|---|
| Environmental Problem | 8 | 0.6879 |
| Method to inform about recycling | 7 | 0.6296 |

0.6 which means that the questionnaires were fully understood by households, hence real test can be done. After the pilot test was completed, the researcher distributed the real survey by hiring bachelor students in their last year of studies to help distribute and collect from house to house. This was done as it was impossible to collect all the questionnaires alone by the researcher. As the study is for the city of Phnom Penh, all of its 7 districts were to be covered. Those 7 districts do not have the same problems; some are at the center of the city, with over-crowed residents; others are far from the centers with lot of houses having their backyards. 2 students were sent for each district. The target groups were the households living on the busy streets of each district. Each student was instructed to help households understand only the questions, without helping them to fill in the questionnaires. The students reported that most of households were very cooperative in filling the questionnaires, with only a very few people who did not want to join in as they were alone at home and were afraid for their security.

The questionnaires were distributed to households during second week of February 2007 to first week of March 2007. A total of 429 questionnaires have been sent and have been able to collect all questionnaires that were distributed. This led to a response rate of 100%. Of this returned questionnaire, none questionnaires were disqualified.

The researcher analyzes data from questionnaire data by using SPSS program to compute for the results. The outputs of the program have been presented in chapter 4 and chapter 5. The result of survey is presented as follows:

1. Descriptive statistics to describe the demographic variables such as the households opinion on Phnom Penh environmental, their behavior and willingness to segregate waste issues by mean, frequency distribution and percentage.

2. Statistics including mean, frequency, percentage, standard deviation, are employed to analyze the household's opinion about the influence factors to segregate plastics for recycling and reuse.

## RESULTS & DISCUSSION

Households are aware that the city as a whole is polluted and solid waste is a major problem. They are aware that the use of plastics items or products will continue to grow, hence creating another environmental problem. This has made them to understand that there is a need to recycle or reuse plastics as much as possible. Out of 429 questionnaires distributed, 315 respondents agree that by recycling plastics will contribute to a clean city. This represents a 73.4% of the total respondents. About 39.4% of total household respondents sometimes separate their waste. 13.3% often and 3% always separate their plastics waste. This makes up 55.7% of total households separates their waste. The 44.3% never or rarely separate their waste. But the good point is that 95.8% of the respondents are willing to separate if there are companies that collect their plastics by paying them the recyclables, even at cheap price. Also the level of agreement with the Municipal City to divide waste from plastics and non-plastics has a mean of 4.45 and S.D is 0.82. To sum up, households are willing to separate their waste if appropriate method is being developed, including incentive like paying the recyclables. Almost all factors are highly important towards the involvement of households' participation in the recycling process, including segregating their

plastics wastes. Figure 3 shows that more than half of the respondent opinion on the overall environment problem in Phnom Penh is polluted which represented 52% of total respondents and only 0.2% thinks that the environment in Phnom Penh is clean.

Figure 4 shows the respondents' opinion on the importance of the environmental problems in Phnom Penh in 2007.
The Mean score for solid waste is 3.75 (less than last year 0.29), and S.D of 1.10. This means the environment problem in Phnom Penh for solid waste is still considered high important level. Whereas Air Pollution is now considered as high important level (Mean=3.57, S.D.=0.94).
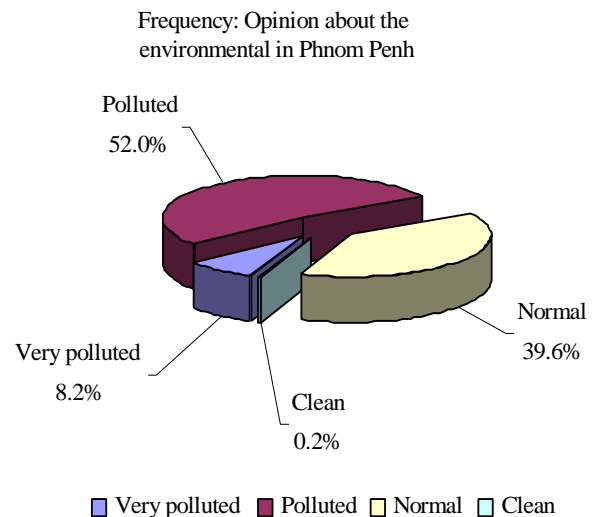
Frequency: Opinion about the environmental in Phnom Penh



**Fig. 3. Distribution of the Opinion on the Environmental in Phnom Penh**

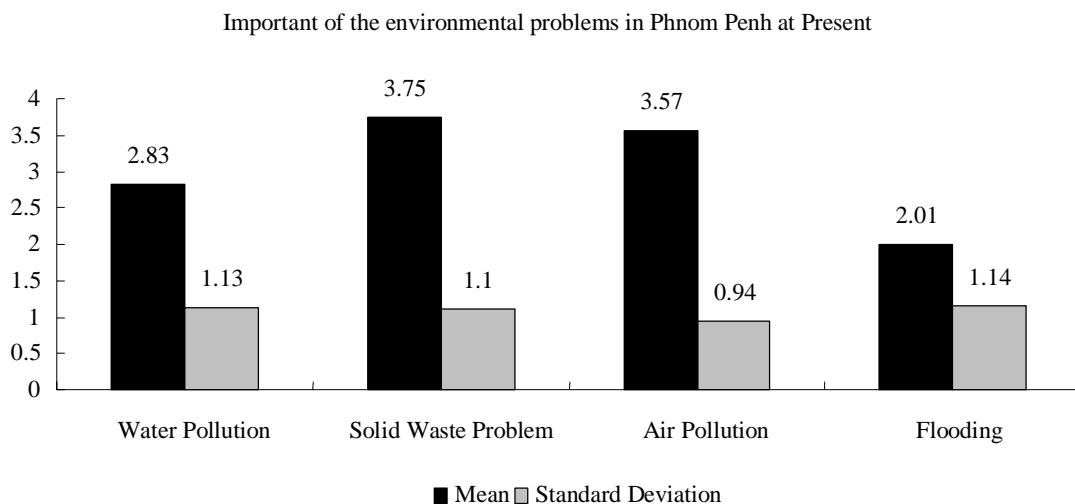Important of the environmental problems in Phnom Penh at Present



**Fig. 4. Distribution of importance of the environmental problems in Phnom Penh, 2007**

While Water Pollution and Flooding remains the same as last three years, considered as medium important level and less important (Mean=2.83, S.D.=1.13 & Mean=2.01, S.D=1.14 respectively). Although there is a slight decrease in mean of 0.57 for Water Pollution.

Figure 5 shows the willing for households to segregate their waste if companies were collecting plastics products for recycling them. 95.8% are willing to do so and only 4.2 says they are not willing to do so as it is a waste of their time.

Table 3 shows the respondents' opinion on the use of plastics items growth. Almost all respondent says "Yes", representing 98.8% and only 0.9% believes it will not grow. Table 4 shows the respondents' opinion related to the growth in using plastics items growth. The researcher designed this questionnaire to get the answer from respondent indirectly. The intended question was if respondent really did believe that by using too many plastics items would create a high environmental problem. The researcher believed that if asked directly, most of respondent would answer "Yes". In conclusion, the level concern on the growing number of plastics items is considered as high problem level (Mean=3.59, S.D=1.27). Table 5 shows the level of agreement with the Municipal City if they require households to separate their waste from plastics and non-plastics products.

Distribution of the acceptance to divide garbage from plastics and non- plastics (if companies were buying)
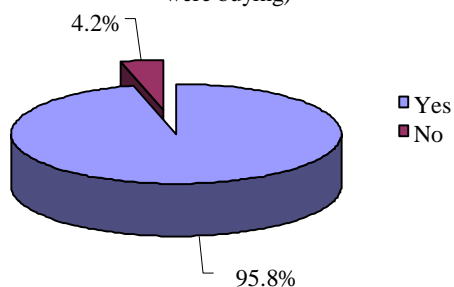


**Fig. 5. Distribution of Respondents**

**Table 3. The Use of Plastics Items**

| Description | Frequency | Percent |
|---|---|---|
| Yes | 424 | 98.8 |
| No | 4 | 0.9 |
| Not answer | 1 | 0.2 |
| **Total** | **429** | **100.0** |

**Table 4. Importance of Accumulation of Growing Number of Plastics**

| Description | Mean | Standard Deviation | Indicator |
|---|---|---|---|
| Important level | 3.59 | 1.27 | High problem |

**Table 5. Agreement Level with the Municipal City**

| Description | Mean | Standard Deviation |
|---|---|---|
| Agreement level | 4.45 | 0.82 |

**Table 6. Appropriate Method of Informing Recycling**

| Description | Mean | SD | Indicator |
|---|---|---|---|
| TV advertisement | 4.66 | 0.66 | Most highly appropriate |
| Public discussions held in local communities | 4.57 | 6.55 | Most highly appropriate |
| Radio advertisement | 4.44 | 0.83 | Most highly appropriate |
| Newspaper | 3.73 | 1.03 | highly appropriate |
| Information leaflets delivered direct to households | 3.67 | 1.28 | highly appropriate |
| Billboards | 3.52 | 1.24 | highly appropriate |
| Municipal City website | 2.45 | 4.83 | less appropriate |

Since the scale used is a 5-point scale, the Means between 2.61 and 3.40 represent the medium level of agreement with the Municipal City. The Mean score for the level of agreement to separate waste if required by the Municipal City is 4.45 and S.D is 0.82. This means that the majority says they will separate their plastics waste if it is required by the Municipal City. Table 6 shows the appropriate method for the government to inform about recycling. Since the scale used is a 5-point scale, the Means between 2.61 and 3.40 represent the medium level of appropriate method for the government. The household respondents believe that T.V advertisement is the most highly appropriate (Mean=4.66, S.D=0.66) as well as Public discussions held in local communities and Radio advertisement (Mean=4.57, S.D=6.55 & Mean=4.44, S.D=0.83 respectively). Newspaper, Information leaflets delivered direct to households and Billboards were chosen as highly appropriate (Mean=3.73, S.D=1.03, Mean=3.52, S.D=1.24). Municipal City website comes last as less appropriate, giving a Mean of 2.45 and S.D equals to 4.83.

**CONCLUSTION**

The study took into consideration both of the primary data and the secondary data to identify factors that have influence for household's willingness to segregate plastics and non-plastics waste. The percentage and descriptive statistics were used to analyze the primary data. The secondary data is processed by comparing how other cities around the world are practicing green logistics and its waste management. In order to explore the factor that has influence for household's willingness to segregate plastics and non-plastics waste, 429 questionnaires were distributed out in the 7 districts (*Khans*) in Phnom Penh. All questionnaires were collected back as it was distributed at random and collected door to door. By percentage analysis, the household demographics are revealed and by descriptive analysis the level of importance of every factors. This was evaluated in terms of mean and standard deviation. Factors were rated from least important level to the highest important level.

Households are aware that the city as a whole is polluted and solid waste is a major problem. They are aware that the use of plastics items or products will continue to grow, hence creating another environmental problem. This has made them to understand that there is a need to recycle or reuse plastics as much as possible. Out of 429 questionnaires distributed, 315 respondents agree that by recycling plastics will contribute to a clean city. This represents a 73.4% of the total respondents. 39.4% of total household respondents sometimes separate their waste. 13.3% often and 3% always separate their plastics waste. This makes up 55.7% of total households separates their waste. The 44.3% never or rarely separate their waste. But the good point is that 95.8% of the respondents are willing to separate if there are companies that collect their plastics by paying them the recyclables, even at cheap price. Also the level of agreement with the Municipal City to divide waste from plastics and non-plastics has a mean of 4.45 and S.D is 0.82. To sum up, households are willing to separate their waste if appropriate method is being developed, including incentive like paying the recyclables. Almost all factors are highly important towards the involvement of households' participation in the recycling process, including segregating their plastics wastes.

Household believes that TV advertisements, public discussions, Radio advertisements are the most highly appropriate method to inform them about plastic recycling, with a mean of 4.66 and S.D is 0.66; mean 4.57, S.D is 6.55 and mean of 4.44 with S.D of 0.83 respectively. Though Public discussion has a high standard deviation of 6.55, this is because some believe that it less appropriate method, while the majority believes it is one of the most appropriate methods, which gives the S.D a high result. While Newspaper, leaflets and billboards are considered the second method (highly appropriate) to inform about plastics recycling; giving the mean of 3.73, S.D 1.03, mean 3.67, S.D 1.28 and mean of 3.52 with S.D of 1.24 respectively.

The less appropriate method chosen is the municipal city website; having a mean of 2.45 and S.D 4.83. This is because Internet is still very expensive, does not play important role as yet in daily life in Phnom Penh; besides, not all households have access to the Internet. Households believes that Phnom Penh should have a recycling collecting system with more recycling centers in order to encourage people to recycle more; giving a mean of 4.58, S.D 4.63 and mean 4.21 and S.D 4.69 respectively. Moreover School/educational recycling program campaign and more information of what kind of plastics can be recycled and where to recycle should be introduced (mean=3.93, S.D=0.97 and mean=3.90, S.D=0.96). Lastly, households believes that laws and regulations should be introduced to induce people to recycle more (Mean=3.44, S.D=1.17).

From the analysis there are clear indications that the residents in Phnom Penh are aware that:
1. Phnom Penh is polluted;
2. The use of plastics is going to grow very much;
3. Plastics must be recycled;
4. They see that TV programs, newspaper ads and discussion among the communities are the best methods to inform about recycling;
5. They are also ready to participate in the separation of waste for recycle.

From the results, we wish to point out the following:
1. While 60.2% of the households find that Phnom Penh is polluted or much polluted, still 39.6% find

it normal and 0.2% find it clean. This is a good basis for tackling waste problems. But this calls for more awareness campaign about pollution created by waste.

2. They are clearly aware that the use of plastic is going to grow very much. This is indeed one of the major problems to be tackled, as the aim of waste management is to reduce it.

3. 73.4% of the households are of the view that plastics should be recycled. It is a very good basis. However, we should also take into account the benefits they gain from the recycled plastics: this means that they can sell them more.

4. A good percentage says that they separate waste: plastics and non-plastics. For this point, we know that they separate only those plastics they can sell, the remaining they put in the same bags of non-plastic waste.

Cambodia is still at the beginning stage of waste management, as can be shown by the above-mentioned Anu-Kret (Sub-Decree). As mentioned earlier, not many studies come out. There are from JICA (Japan International Cooperation Agency) and some papers. It is therefore incumbent on the Royal Government of Cambodia (RGC) and its relevant institutions to tackle this problem in a most urgent and comprehensive ways. From the literature reviews surveyed on the practices on green and reverse logistics and how some other cities around the world are practicing for its green world, compared with the research result, a combination of practices that would best suit for Cambodia. Experiences in many cities around the world are of great values for Cambodia. One major topic would be the study of the reverse logistics. As for waste management in Phnom Penh, there is no short cut. It calls for an "Integrated Waste Management". It needs to go through the process of Reduce-Recycle-Incinerate/Landfill. It also needs to go for composting.

It will be recalled that Reducing waste-preventing it from needing to be dealt with at all-is generally the most favored management tool; Recycling-next in order of preference-helps to divert wastes from landfills and incinerators and provide the reuse of resources; Incinerating/ Landfilling are next in the waste hierarchy. While incineration reduces the volume and can recover energy, it can also have some risks associated with

it. Landfilling while necessary to handle wastes -as is now the case of Phnom Penh- is very costly, and locating landfill sites is a problem as well. It is interesting to note that in Phnom Penh, the components of construction wastes are reused for new construction, and that composting starts to gain ground. There must be short-term, which is to implement as soon as possible, and long-term action plans.

*Short-Term Action Plan:*
As there is a need to cope with daily waste problems, the Phnom Penh Municipality will continue to do its work in cooperation with CINTRI. But it must also have an awareness campaign of the problems caused by wastes and the wealth produced by wastes. Proposed Action Plan for the current situation to reduce, recycle and incineration/landfilling, and composting:

1. <u>Awareness Campaign</u>: through TV, Newspapers, and discussions among the communities (at Sangkat or district level). Here the TV ads, especially done by popular artists, have proved to be effective against litters on the streets or in public gardens/parks. They should be used to do the same for the reducing and recycling of wastes. The ways newspapers campaign against bird flu can be used as an example for the participation of citizens on waste management;

2. <u>Improving the collection and green logistics</u>: This is an important component of waste management. Here, importance must be given to collect the recyclables. As of now, people separate waste in a way as to put sellable items in one bag and the remaining in another bag (plastic bags!). Encouragement must be given to further separate recyclables and non-recyclables. This needs to come out with specific list for recyclables. The one given by the US EPA can be used as a basis for such a list. Besides, studies must be done on the frequency of collection, whether once a day or twice a day or other ways to improve the collection and the transport to landfills.

3. Find partners that are willing to set up incinerators for energy. This is very helpful to the city that has experienced electricity shortage, as it has been cut off once or several times per day that make people angry with the authority. Incineration must comply with environmental regulations in order to minimize the risk caused by gas emissions.

4. <u>Encourage composting</u>: Composting is very important as Cambodia, an agricultural country, most needs it. And this is a problem that the Municipality can and must tackle as parks or gardens are public, while other wastes from back-yards will be encouraged to do composting as well.

*Long-Term Action Plan:*

The "Integrated Waste Management" calls for a long-term action plan, which needs to be reviewed from time to time in order to tackle the problems: How to transform Waste to Wealth, Refuse to Resources and Trash to Cash?

1. To emphasize on reducing the quantity of waste, here we focus on plastics, and the hazard it poses;
2. To improve the knowledge about pollutants;
3. To Find easy ways for households to sort their wastes;
4. To look at the future

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