

A Perception Survey of Plastic Waste in the Floating Villages on Tonle Sap Lake, Cambodia

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Tonle Sap Lake (TSL) in Cambodia and its many tributaries have a rich biodiversity. Many residents of the floating villages on TSL dispose of household wastes directly into the lake, which has resulted in large accumulations of plastic waste that seriously affect the quality of the watershed and its surrounding soils. It is therefore necessary to manage plastic waste more effectively, especially in rural regions in which there are no basic public waste collection services. The objective of the study was to capture the villagers' perceptions of plastic waste. A perception survey was conducted using in-depth interview based on a standard questionnaire in the target area. The questions were designed to maximise the response rate and participant concentration. The collected data were analysed using statistical methods. The study captured the villagers' perceptions of plastic waste, i.e. the reasons for using specific plastic items for consumption, avoidance of certain plastic items, plastic waste disposal methods and the willingness to participate in plastic waste separation and collection systems. Plastic bags accounted for most (27 %) of the plastic waste discharged into the lake or disposed of on land. Most respondents understood pollution problems were caused by discarding plastic waste directly into the lake. Of the 25 participants, 22 chose incentives (cash) as the most important factor that would motivate them to separate and collect plastic waste. Economic incentives have proven to be the most important factor for encouraging villagers on TSL to undertake waste separation and collection. The results of this study will assist in promoting plastic waste separation and collection in the floating villages of Cambodia.

1. Introduction

The volume of plastic waste has increased globally due to the constant increase in the use of plastic products (Thompson et al., 2009). Due to the extensive use of plastics and the many additives they contain, waste plastic poses a potential hazard to human health and ecosystems (Halden, 2010). Many plastics are not biodegradable and their continued use is unsustainable, presenting a significant burden for future generations (Halden, 2010). Plastic pollution has subsequently become a serious problem in many water bodies worldwide (Shahul et al., 2018). Once waste plastic flows into the ocean it decomposes very slowly, breaking into tiny pieces known as microplastics, which can enter the marine food chain, presenting risks to marine life and, ultimately, human health. The sustainable consumption and management of plastic is therefore crucial. The amount of plastic waste generated has risen significantly in Asian countries due to their rapid economic and population growth. Many developing countries in Asia lack a plastic waste management system (PWMS), which is a consequence of several factors such as politics, legislation, socio-economic conditions and technical problems. The plastic waste management in Cambodia is limited due to a number of challenges, such as the weak legal system, lack of financial support, lack of waste treatment facilities and low levels of environmental education. In the floating villages on the shores of TSL in Cambodia, villagers routinely dispose of garbage directly onto the surface of the water (Figure 1). This plastic waste flows through rivers into the Pacific Ocean. Therefore, in areas where there is no household waste collection service and where used plastic tends to turn into marine plastic waste, it is urgent to establish plastic waste sorting and collection systems involving the participation of local residents. Previous studies have examined issues associated with waste plastic worldwide, i.e. health risks (Halden, 2010),

plastic recycling (Hopewell et al., 2009), microplastics (Schmidt et al., 2017) and the sustainability of plastic products (Motanari et al., 2023). Most case studies in Cambodia have investigated urban plastic waste management and the composition of municipal solid waste (Koeng et al., 2020). Only a few studies have focused on the floating villages in terms of the socio-economic conditions (Keskinen, 2006), plastic transport in the Mekong River (Haberstroh et al., 2021) and a water balance analysis for TSL (Kummu et al., 2014). Little attention has been given to establishing management and collection systems focusing on plastic waste, especially in rural areas such as the floating villages on TSL. The establishment of an environmental consciousness would not guarantee that the plastic pollution problem is solved in the floating villages. Other conditions such as incentives and convenience should also be considered. The objective of this study was to understand villagers' perceptions of plastic waste, i.e. the reasons they use plastic items and whether they avoid certain plastic items, the disposal methods that they practice and their willingness to participate in waste separation/collection systems for plastic recycling.



Figure 1: Houseboat in a village of the Phat Sanday Commune (photo taken in September 2022)

2. Methodology

This study targeted the floating houses in the Phat Sanday Commune on TSL where the basic public waste collection services have not yet been established. The residents of these villages live in boathouses (see Figure 1) during all seasons and most are illiterate, making a formal paper survey difficult. All interviewees were therefore visited by the researchers who conducted in-depth interviews based on a standard questionnaire.

2.1 Study area

Phat Sanday Commune is located at the south eastern end of TSL, in the Kampong Svay District of Kampong Thom Province (Figure 2). The commune encompasses the Stung Sen Core Area of the internationally recognised Tonle Sap Biosphere Reserve, which is considered the 'Heart of Cambodia'. There are five official villages in Phat Sanday Commune, with one group of Vietnamese residents in Kaoh Ta Pov Village. According to the Phat Sanday Commune database (2022), which was obtained from the commune leader, the total area of the commune is 225.6 km² with a population density of 24.52 per km². The total number of households is estimated to be 1,229, with a population of 5,849 and an average household size of 4.5. In this study, four floating villages (see Figure 2) were targeted, and their population details are shown in Table 1. The floating village of Tuol Neang Sav was located far from the four target villages and was therefore excluded from the study. Based on a cultural homogeneity of occupation and floating housing characteristics, the research purposively determines a rational sample size from each village (i.e. at least 3 (in fact 4) samples for <100 households; at least 4-6 (in fact 7) for 100-200 households; at least 7-9 (in fact 6 and 8) for 200-300 households).

Table 1: Summary of the population and number of households participating in the survey

No.	Village name	Female	Male	Total population	Total households	Households participating in perception survey
1	Kaoh Ta Pov	186	159	345	81	4
2	Kampong Chamlang	695	679	1,374	268	6
3	Neang Sav	625	504	1,129	266	8
4	Phat Sanday	477	499	976	192	7
Total		1,983	1,841	3,824	807	25

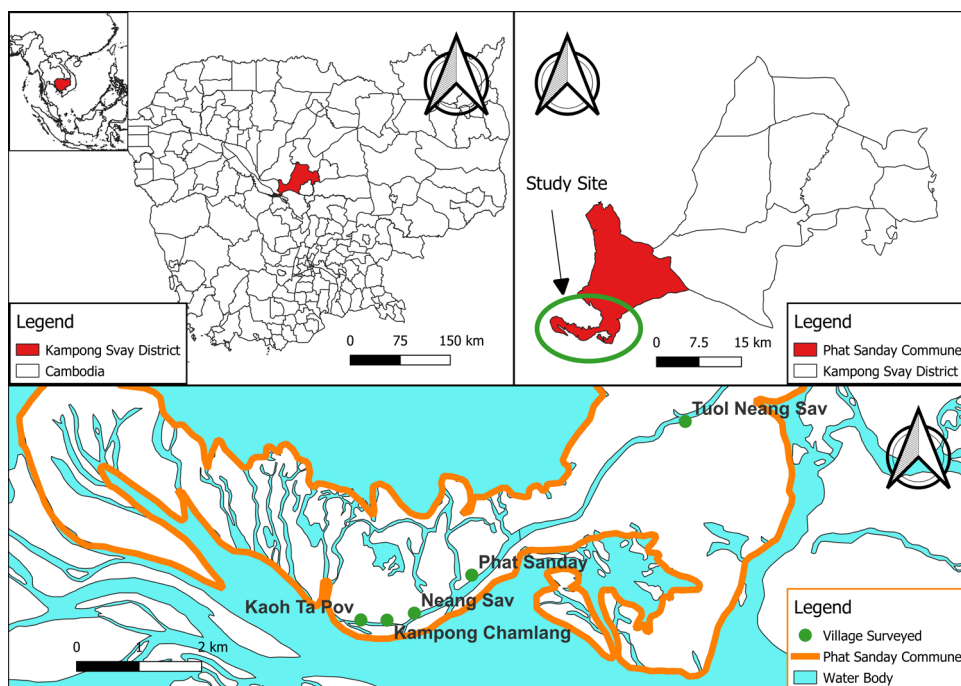


Figure 2: Map of the study area showing the location of the four survey villages

2.2 The perception survey

A total of 25 households participated in the perception survey: four from Kaoh Ta Pov Village, six from Kampong Chamlang Village, eight from Neang Sav Village, and seven from Phat Sanday Village (Table 1). The survey took place over two days, from 2 to 3 September in the rainy season in 2022. The researchers visited each house using a rented boat and conducted the survey in person. Each survey took two hours per household on average, excluding transportation time. The researchers asked questions using a questionnaire sheet in Khmer and the answers provided by the head of the household were recorded in the sheet (Figure 3). Using this kind of survey, it is easy to convey the intention of the question and it is also possible to show samples or explain difficult questions. This ensured reliable responses from the target person even when he/she had difficulty initially understanding the question or how to answer.



Figure 3: A research visit to conduct an in-depth interview with a printed questionnaire sheet

The questionnaire was divided into four sections. Section 1 consisted of general information, including 12 questions about age, gender, occupation, education level, income etc. Section 2 was a plastic waste audit survey, including 17 questions about the household's plastic consumption and waste production. Section 3 was an awareness survey using a Likert Scale questionnaire form to assess each respondent's attitude, burden, environmental consciousness, subjective norms, level of environmental education and behavioural intentions. Section 4 was a willingness survey, including seven questions about the use of incentives and willingness to manage waste. The questions were designed to maximise the response rate and participant concentration. The entire survey was conducted by the researchers through in-depth interviews with the study participants.

2.3 Data analysis

The collected data were analysed using MS Excel, and correlations were determined by the IBM Statistical Package for the Social Sciences (SPSS) version 22.0.

3. Results and discussion

3.1 Demographic profile of respondents

The survey results revealed that 64 % of respondents were fisherman, and 12 % were waged labourers. In terms of age, 28 % of respondents were 61–70 year's old, 28 % were 51–60 year's old, 16 % were 41–50 year's old, 16 % were 31–40 year's old and 12 % were 21–30 year's old. Most households consisted of 4–6 persons. In terms of education, 20 % of residents had a basic education background from secondary to high school, with 4 % having higher education, 20 % of villagers were illiterate, and for 56 % primary school was their highest educational level. Therefore, 76 % of villagers had an educational level of primary school or below. According to the household income statistics from the Cambodia Socio-Economic Survey (MP, 2020), the average monthly income in Cambodia is 551 USD; 620 USD in urban areas and 442 USD in rural areas. Based on the survey, the average monthly income of the residents of the floating villages was 369 USD, i.e. much less than the average monthly income in rural areas of Cambodia. It was also found that the monthly income of five households (20 %) were higher than the national average, and all of them were fisherman. The monthly incomes were therefore found to be highly variable.

3.2 Plastic waste audit survey results

In the plastic waste audit survey, information such as reasons for using specific plastic items, avoidance of certain plastic items, and the methods used to dispose of plastic waste at the household level were investigated. When asked why they used specific plastic items, 72 % of respondents stated that it was due to cost, availability and convenience. The average monthly household expenditure was 300 USD, of which 10 % was spent on bottled water for drinking, including small (500 mL) and large (20 L) bottles, due to the lack of a safe drinking water supply system on the lake. Most residents explained that they used small (500 mL) bottles because they were light and easy to use. Half of the respondents reused the polyethylene terephthalate (PET) bottles, 23 % of them kept them to sell on, 11 % disposed of them in the lake or on land, and 8 % give away to other villagers (Figure 4 (a)). Plastic bags were kept by 60 % of the respondents for reuse i.e. storing trash or carrying items home from the market. Plastic bags accounted for 27 % of all plastic waste discarded into the lake or disposed of on land. According to the answers regarding the avoidance of specific plastic items, 56 % of respondents had experiences of avoiding one or more types of plastic item; 32 % had experience on avoidance of plastic container, 28 % had experience on avoidance of forks and cups, and 20 % had experience on avoidance of plastic bags (Figure 4 (b)). There are alternatives to items such as forks, containers, cups and bags and their use would reduce the amount of plastic waste. There was no alternative for the use of PET bottles given the need for a safe drinking water source in the villages of TSL. Also, there were no alternatives for the use straw and other wrapping materials. When residents were asked why they did not avoid certain items, 44 % of the respondents stated that there were no alternative choices. This implies that if there were more alternatives for plastic items, the respondents would be likely to use less plastic in their daily lives.

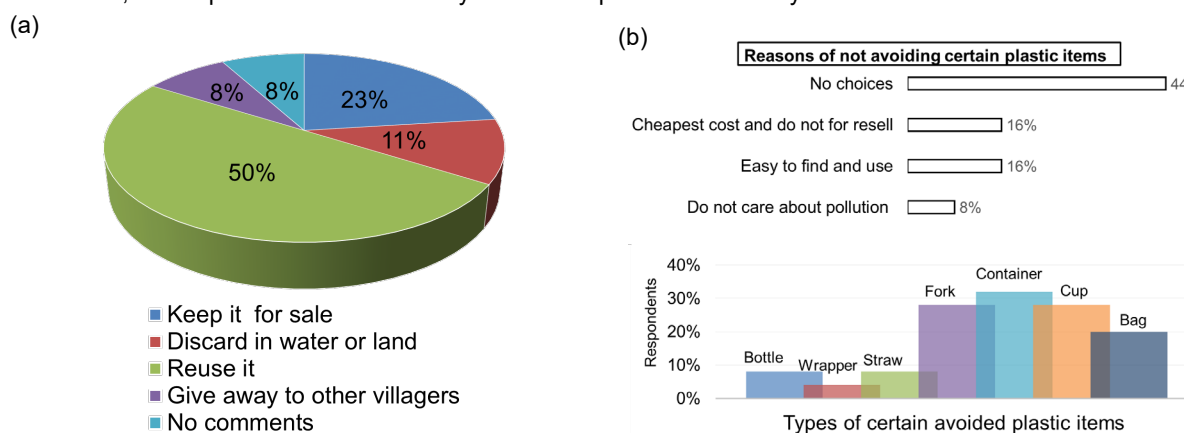


Figure 4: (a) Methods used to dispose of used PET bottles, and (b) types of avoided items and reasons for not avoiding certain plastic items

For the ways used to dispose of plastic waste, there are an obvious gap between two seasons. Compared to that in dry season, only 4 % of villagers discharge their plastic waste directly to the lake, the 40 % discharge directly to the lake in rainy season.

3.3 Awareness survey results

Of the 25 respondents, 19 were aware of the negative impact of plastic waste on the environment. This shows that majority of the respondents at least understood the pollution issues caused by disposing of plastic waste directly into the lake. Through the Likert Scale questionnaire, it was also found that the respondents felt that participating in plastic separation and collection placed a high burden on their lives, despite their environmental consciousness, strong attitudes, awareness of surroundings and good social intentions. The respondents knew about the environmental consequences of plastic waste from many sources. The details are presented in Figure 5. According to the survey, it was found that most of this knowledge was gained from the commune committee, followed by local authorities. It is therefore important to spread awareness using different methods so that as many people as possible experience it and share it with their household members and friends.

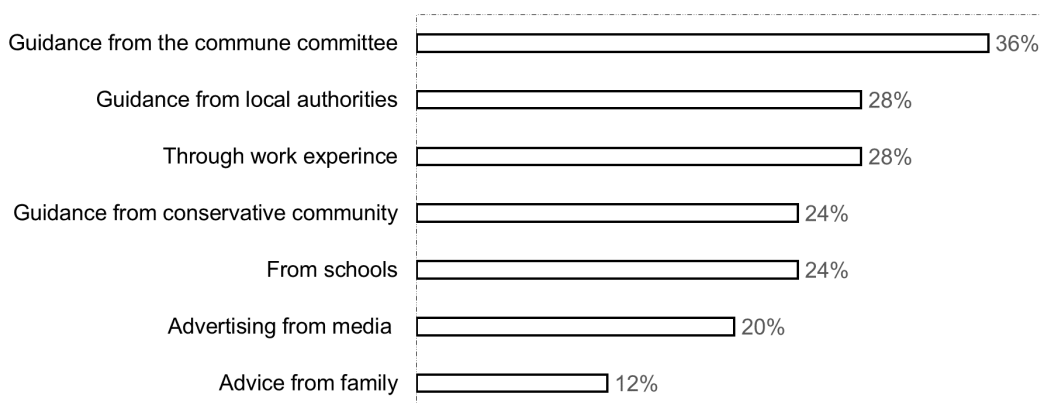


Figure 5: Sources of environmental knowledge among the villagers

3.4 Willingness to participate in waste collection

Among the 25 respondents, 22 selected incentives (cash) as the most important factor to motivate them to separate and collect plastic waste. Another two stated that it should be easy to do and one selected a reduction in the time required to collect waste as the most important factor to motivate them to participate in plastic waste collection. The results in Figure 6 show that the villagers' willingness to participate in plastic waste collection was actually very high. A large majority (96 %) of respondents, including those with and without incentives, indicated that they would like to participate in the separation and collection system. Among those who wanted to participate in the separation and collection system, only 12 % would cooperate if there were no incentives provided. Another 84 % were only willing to participate if cash incentives were provided. Compared to cash incentives, the exchange of goods as an incentive reduced the willingness to participate in the separation and collection system. When asked if they were willing to pay for a plastic waste collection service provided by outsiders, 76 % of respondents were opposed to the idea. Economic incentives were found to be the most important factor that would encourage villagers in the Phat Sanday Commune on TLS to participate in waste separation and collection activities.

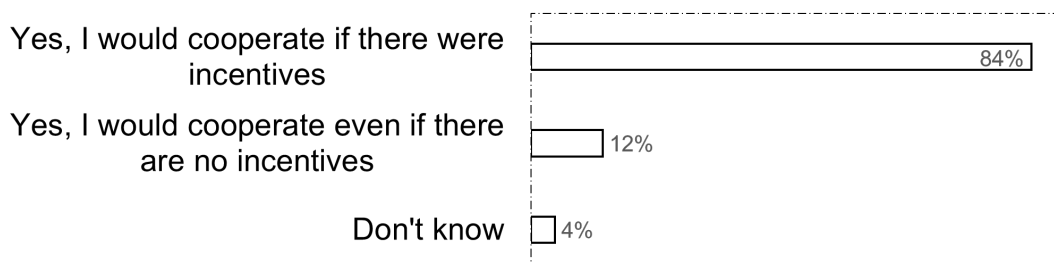


Figure 6: Willingness to participating in a plastic waste collection system

4. Conclusion and recommendations

An in-person perception survey was conducted by researchers interviewing the heads of 25 households in the four floating villages of Kaoh Ta Pov, Kampong Chamlang, Neang Sav, and Phat Sanday. The study captured the villagers' perceptions of plastic waste, i.e. the reasons for using specific plastic items for consumption, avoidance of certain plastic items, plastic waste disposal methods and the willingness to participate in plastic waste separation and collection systems. It was found that 64 % of respondents were fisherman, and 12 % were waged labourers. In terms of education, 76 % of villagers had an educational level of primary school or below. The average monthly income in the floating villages was 369 USD, which was much less than the average monthly income in rural areas of Cambodia. When asked why they used certain plastic items, 72 % of respondents specified cost. Half of the respondents reused PET bottles, 23 % of them kept them to sell on, 11 % disposed of them in the lake or on land, and 8 % kept them to share with other villagers. If there were more in the way of alternatives for plastic items, the respondents would be likely to use them. Of the 25 respondents, 19 were aware of the negative impact of plastic waste on the environment. This indicated that the majority of respondents at least understood that pollution was caused by discarding plastic waste directly into the lake. Among the 25 participants, 22 chose incentives (cash) as the most important factor that would motivate them to separate and collect plastic waste. Economic incentives constituted the most important factor that would encourage the villagers to participate in separation and collection activities. Most respondents were aware of the consequences of plastic waste pollution, yet many still believed that incentives were necessary to encourage participation in a separation and collection system. Based on these results, the following recommendations are proposed. (a) A mandatory plastic waste management scheme should be initiated, i.e. a payment for plastic bags. (b) More alternatives for plastic items should be developed. (c) To establish a collection and sorting system for plastic waste with the participation of villagers, incentives (cash) should be offered. Besides, all stakeholders including villagers, junk shop owners, buyers, recycling facilities and commune members have to ensure the cooperation. One of the limitations of this study was that of the low sample numbers compared to other types of survey (e.g. web questionnaires), leading to a lack of statistical validity. Additionally, a face-to-face interview can lead to the prompting of answers or responses being given that are unrealistic. In future studies, a survey of the composition of plastic waste would be useful to clarify the exact amounts and types of plastic waste that are discarded in the villages of TSL.

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