Estimation of the Recyclable Waste amount Collected by Informal Recycling Shops: Case Study in Nay Pyi Taw, Myanmar

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ABSTRACT

The study investigates and estimates the type and amount of recyclable waste collected by informal recycling shops in Nay Pyi Taw by using face to face interview for 23 informal recycling shops in Nay Pyi Taw in May 2020. The descriptive statistics (frequency and percentage) and inferential statistics (two-sample paired t-test and Pearson's correlation) were applied. According to the results, the average estimated waste amount collected by each recycling shop per day before and during the novel coronavirus (COVID-19) pandemic was 1,798 kg (Min. 0 to Max. 1,401 kg) and 856 kg (Min. 0 to Max. 892 kg), respectively. As a result of this study, it can be seen that the amount of daily collected waste has a positive relationship with the daily income of recycling shops, and COVID-19 has impacted the income of informal recycling shops. According to the results, getting an official license, financial problems, and limited land for managing buying recyclable waste, unstable market conditions, no factory in Nay Pyi Taw and no definitive legislation or laws, seasonal changes are the main challenges for informal recycling shops. This study indicates the ways to mainstream the informal sectors in waste management schemes. In addition, the results of this study can be useful in developing national and regional waste management plans and programs.

1. INTRODUCTION

Due to the increasing population and waste generation in developing countries, it is challenging for municipalities, to provide basic infrastructure and waste collection as well (Kyessi et al., 2017; Omar, 2019). Myanmar, one of the developing countries, also faces these kinds of challenges due to the increasing population, lack of effective waste management systems, limited basic infrastructure, etc. Such challenges increase the negative impacts on public health and environment which result from the increase of waste generation in the three largest cities (Yangon, Mandalay, and Nay Pyi Taw) in Myanmar (ECD, 2020).

There is no doubt that the rate of waste generation is beyond the ability of responsible authorities to manage it, especially in the developing countries like Myanmar. Moreover, rapid urban growth in developing countries can also be challenging to the authorities who provide basic infrastructure for their residents. More than 50% of the waste cannot be dealt with in developing countries (Omar, 2019). Municipalities and other formal sectors have financial and organizational limitations for recycling all recyclable wastes (Gerold, 2009).

Currently, city and township development committees are the focal departments in charge of collecting and disposing waste in Myanmar (ECD, 2020). It is clear that in Myanmar, the above-mentioned challenges can also definitely be faced. For instance, the waste amount generated by three major cities (Yangon (2,000 mg/day), Mandalay (955 mg/day), and Nay Pyi Taw (200 mg/day)) were only estimated based on the volume of waste reaching city dump sites, but did not include other uncollected, burned, dumped, recycled, or reused waste (ECD, 2020). Not surprisingly, this is a major challenge to get a complete and realistic estimate of waste generation in this country.

In solid waste management, the informal sector plays a significant role in waste collection activity, especially in low-income and middle-income countries. Informal waste pickers, traders, shops, and recyclers are very important players to establish a strong official waste management system although they are still illegal according to the present legislation, rules and regulations (Schneider et al., 2017). They also contribute effectively to waste management and resource efficiency by collecting, sorting, and trading (Wahab and Ola, 2017).

Informal recycling waste enterprises can contribute to many of the Millennium Development Goals (MDGs) (Gerold, 2009). Therefore, they can also contribute to many of the 17 UN Sustainable Development Goals. Among them, for example, goal (1): end poverty; goal (8): decent work and economic growth; goal (10): reduce inequality; goal (12) ensure sustainable consumption and production patterns; goal (13): deal with climate change; goal (14): improve life below water; goal (15): life on land; etc. could be achieved through mainstreaming the role of informal recycling waste sectors in waste management schemes. For instance, creating jobs and increasing income through informal recycling enterprises can reduce poverty among the community so that the well-being of the local community can be achieved. Moreover, natural resources depletion, reducing waste disposal and required land area for waste disposal, and reducing greenhouse gases can be addressed by recycling waste (Gerold, 2009; Hoornweg and Bhada-Tata, 2012). There is no doubt that the essence of recycling is to conserve and protect natural resources, both life on land and in the water, which means that the SDG goal (14) and (15) can also be addressed through mainstreaming of recycling sectors. Ngoc and Schnitzer (2009) also stated that the recovery of waste materials (reuse and recycle) is the way to reach the goal of "using everything, nothing left".

In Myanmar, the amount of greenhouse gases (GHGs) emissions could be saved around 1,100 Gg of CO_2-eq per year by changing the waste management system to landfill 65%, recycling 10%, incineration 1%, anaerobic digestion 1%, composting 10%, and others 13% from business-as-usual, open dumping 83%, recycling 2%, incineration 1%, anaerobic digestion 1%, and others 13%. This saving could be achieved by increasing the percentage of recycling from 2% to 10%. To conclude, a huge amount of GHG emissions could be saved in the recycling sector by saving raw materials and natural resources (Tun and Juchelková, 2018).

Nay Pyi Taw became the new capital city of Myanmar in 2005, and it is also the seat of the Union Government. As the late arrival new city, there are limited data and information in all sectors including waste management related to informal waste sectors. As informal waste sectors are crucial not only for developing strong waste management systems but also for creating a cleaner environment, estimating the amount of recyclable waste collected by informal recycling shops would create more understanding of their role in the waste management sector for the relevant decision makers. Therefore, this study aims to estimate the amount of recyclable waste collected by informal recycling shops in Nay Pyi Taw. The result of this study can not only contribute to a better understanding of the role of informal recycling shops, but it can also be used to support the decision makers, especially in terms of how to mainstream them in the waste management scheme through investigating their difficulties and challenges.

2. METHODOLOGY
2.1 Data collection

This study was conducted in Nay Pyi Taw, Myanmar. This is the new capital city of Myanmar with a total area of 70,571 km^2. It is located at 19.75 latitude and 96.13 longitude and situated at elevation 122 m.a.s.l. A total of 1,160,242 residents are living in Nay Pyi Taw which consists of two districts and eight townships as shown in Figure 1 (Department of Population, 2015).

In this study, both snowball and quota sampling methods were used. The snowball method was used to find where recycling shops are situated because there is no secondary data regarding recycling shops in Nay Pyi Taw. According to the initial investigation using the snowball method, there are around 200 recycling shops in Nay Pyi Taw. Based on this estimation, 23 informal recycling shops in Nay Pyi Taw were selected with ±20 margin of error and 95% confidence level (Israel, 1992; Conroy, 2006). In order to cover all the areas of Nay Pyi Taw, the interviewed shops were selected in all eight townships of Nay Pyi Taw. However, there is no exact data relating to how many recycling shops are in each township. That is why the selection of the shops in each township was based on the population size of the respective township, hoping that the more populated township would dispose more waste, and have more recycling shops. Therefore, the interviewed recycling shops were selected as shown in Table 1. The first interviewed shop in each township

was selected by asking people who live in that township, and determining where these shops are located. The next destinations were also selected based on the first interviewed shop. The quota sampling method was applied to meet the target of respondents in each township. The questionnaire was composed of both open-ended and close-ended questions, and it was completed with face to face interviews.
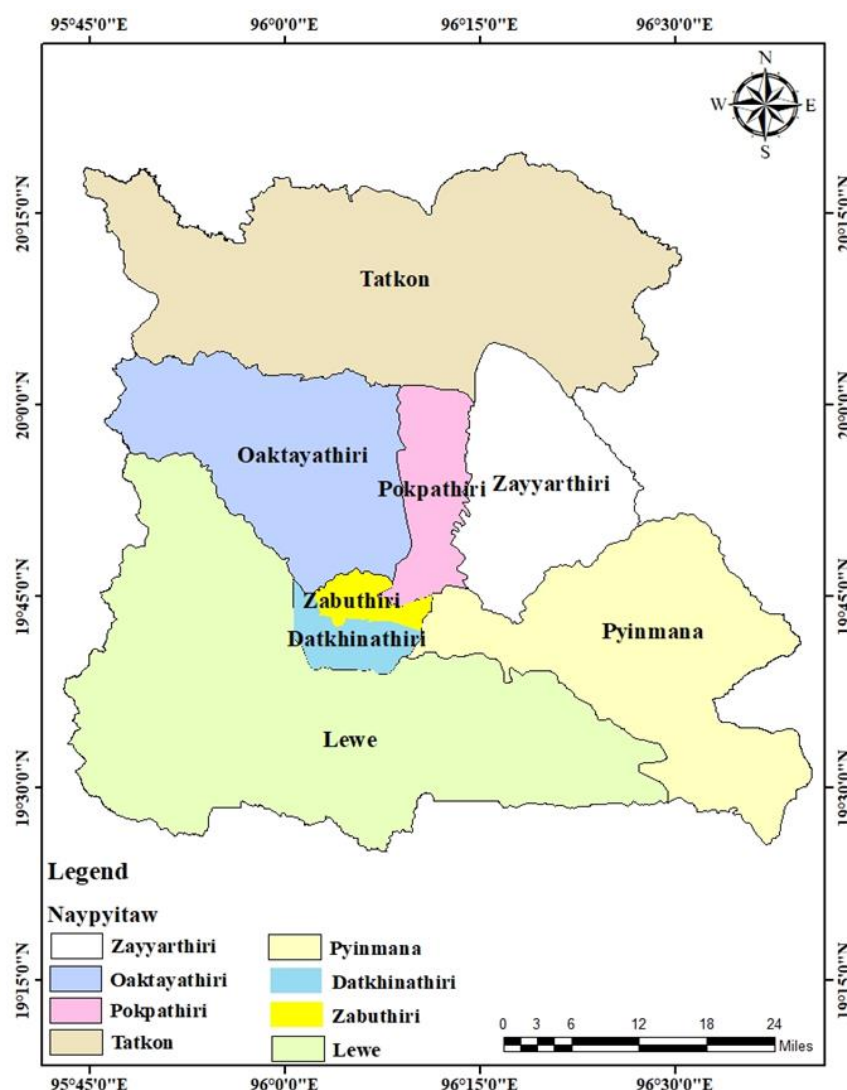
Figure 1. Map of the study area

Table 1. Selected number of recycling shops in each township

No	Township	Population	Selected number of recycling shops
1	Lewe	284,393	5
2	Tatkon	217,093	4
3	Pyinmana	187,565	4
4	Pokpathiri	116,491	2
5	Zayyarthiri	111,293	2
6	Zabuthiri	110,459	2
7	Oaktayathiri	81,620	2
8	Datkhinathiri	51,328	2
Total		1,160,242	23

Source: Department of Population (2015)

2.2 Estimation of the recyclable waste amount collected by informal recycling shops

The data resulting from the field survey was analyzed with the aid of the Statistical Package for Social Sciences (SPSS) software (Version 24), and presented using descriptive statistics in the form of frequency distribution of the types of waste collected by recycling shops in order to estimate how much recyclable waste was collected by informal recycling shops.

To determine the relationship between the daily income of waste recycling shops and the amount of daily collected waste by them, the Pearson's correlation (equation 1) was used. The value of

correlation coefficient is between -1 and +1 (Obilor and Amadi, 2018; Ceylan et al., 2018). Interpreting the correlation coefficients are accepted based on the following points: 0 and 0.3 (0 and -0.3) indicate a weak positive (negative) linear relationship; 0.3 and 0.7 (0.3 and -0.7) indicate a moderate positive (negative) linear relationship; 0.7 and 1.0 (-0.7 and -1.0) indicate a strong positive (negative) linear relationship (Ratner, 2009).

$$r = \frac{S_{xy}}{S_x \, S_y} \qquad (1)$$

Where; r is the correlation coefficient, S_{xy} is the covariance of variable x (daily collected waste amount-kg) and variable y (daily income in Myanmar kyat-MMK), S_x is the standard deviation of variable x (collected waste amount-kg) and S_y is the standard deviation of variable y (income-MMK).

The novel coronavirus (COVID-19) pandemic has impacted on both health and different business sectors of Myanmar (The Asia Foundation, 2020). Because the informal waste recycling shops are also included in the income generating business sectors in Myanmar, it was assumed that the pandemic would also impact on this sector. To test this notion further, in this study, the effect of COVID-19 on the amount of waste collected by recycling shops was also investigated by using equation 2 (inferential statistics: two-sample paired t-test). A paired t-test can be used when the observed data are in pairs (McDonald, 2014). Due to the data collection being carried out during the COVID-19 pandemic, the respondents were requested to estimate the amount of waste collected both before and during the pandemic at the time of the interview to determine the statistical significance of variations in the amount of waste collected by them due to the pandemic.

$$t = \frac{\bar{d}}{S_d / \sqrt{n}} \qquad (2)$$

Where; t is the calculated t value, $\bar{d}$ is the difference within a pair, S_d is the standard deviation of differences, and n is the sample size (Constance and Robert, 2012).

Moreover, in this study, job creation (employment to population ratio) of informal recycling shops was also calculated by using the equation 3 (Department of Population, 2015). In equation 3, employed means the average number of employees working at each recycling shop, and total population is the total population of Nay Pyi Taw in 2014.

$$\text{Employment to population ratio} = \frac{\text{Employed}}{\text{Total population}} \times 100 \qquad (3)$$

3. RESULTS AND DISCUSSION
3.1 Types and amount of waste collected by informal recycling shops

Table 2 shows the summary of types and amount of waste collected by informal recycling shops before and during the COVID-19 pandemic. According to the results, it can be clearly seen that the total waste amount collected by the shops before and during the pandemic differ. This means that there was a negative impact on the recycling shops, especially in the decreasing collection of recyclable waste which led to a decrease in income. Like the pandemic's effect on the recycling shops, it also had serious negative impacts on the other business sector in Myanmar. According to the survey of the Asia Foundation on the impacts of COVID-19 on business in Myanmar, 218 enterprises out of 750 were closed

Table 2. Type and amount of waste collected by informal waste recycling shops

No.	Type of waste	Average amount of waste (Before COVID-19) (kg/day)	Percentage (%)	Average amount of waste (During COVID-19) (kg/day)	Percentage (%)
1	Plastics	510 (Min. 0-Max. 2,450)	28	219 (Min. 0-Max. 2,450)	25
2	Cardboard	197 (Min. 0-Max. 1,388)	11	85 (Min. 0-Max. 694)	10
3	Metal	282 (Min. 0-Max. 2,450)	16	111 (Min. 0-Max. 1,225)	13
4	Paper	138 (Min. 0-Max. 490)	8	41 (Min. 0-Max. 163)	5
5	Aluminum	20 (Min. 0-Max. 63)	1	9 (Min. 0-Max. 82)	1
6	Glass	599 (Min. 0-Max. 3,919)	33	380 (Min. 0-Max. 2,450)	44
7	Tins and cans	38 (Min. 0-Max. 245)	2	9 (Min. 0-Max. 38)	1
8	e-waste	14 (Min. 0-Max. 105)	1	2 (Min. 0-Max. 35)	1
Total		1,798 (Min. 0-Max.1,401)	100	856 (Min. 0-Max. 892)	100

at the time of survey (between April 28 and May 10, 2020) (The Asia Foundation, 2020). It can be concluded that the income generation of these affected enterprises also declined because of the effects of the pandemic.

All the recyclable waste was collected from households, street recycling collectors, municipal staff, and other places such as restaurants and construction sites. After collecting the recycling waste, 44% and 39% of recycling shops sent their waste directly to recycling factories in Yangon and Mandalay, and big recycling shops in Nay Pyi Taw. The remaining 17% sent their collected waste to both of them. According to the Table 2, among the two (before and during the COVID-19 pandemic), the average composition of glass accounted for the highest proportion: 33% and 44% respectively. In a similar study conducted in Yangon, Myanmar, among the daily recyclable waste amount collected by waste dealers, glass occupied the highest amount of proportion for 57% (Premakumara et al., 2017).

3.2 Job opportunities and income generation of informal recycling shops

The results show that 61% of recycling shops have been working only in informal recycling, and 34% have been working together with others including taxi drivers, needlework, shops, etc. Others 4% are employed also as farmers. During the survey, the number of years that each interviewer has been working in this business was also recorded. According to the results, 48% of respondents have been working in recycling shops for 10 years and above, and 30% of respondents have 1 to 5 years of experience in this business. The remaining 13% and 9% have 6 to 9 years and less than 1 year of experience respectively.

Regarding job creation, the results show that each recycling shop created job opportunities for 14 employees on an average. In a similar study conducted in Myanmar, the average number of 13 daily-wage laborers is working at recycling business (Chelsea, 2019). A total of 1,160,242 residents are living in Nay Pyi Taw (Department of Population, 2015). Therefore, using equation 3, employment to population ratio (per recycling shop) is 0.001. If the number of employed is considered based on all estimated recycling shops (200 shops) in Nay Pyi Taw, the ratio is 0.24. In Nay Pyi Taw, the number of government employees was 87,003 (Department of Population, 2015). This makes

the employment to population ratio 7.5. By comparing these two ratios, unfortunately, although the employment to population ratio of recycling shop is smaller than the ratio of government employees, it is still clear that the recycling shops are providing and generating job opportunities for the residents. Once again, Wahab and Ola (2017) also showed that job opportunities, income generation, and reduction in uncollected waste can be created by informal recycling sector.

During the survey, the respondents were requested to estimate the income of the recycling shops before the pandemic because of the difficulties to estimate the income during the pandemic as almost all the respondents operated their recycling shops only one to two weeks before interviewed. The result shows that each recycling shop earned approximately 400,000 MMK (Min. 150,000 MMK and Max. 1,000,000 MMK) net income per month. According to the Pearson's correlation, a significant positive relationship (r^2=0.65, p<0.001) was observed between the daily income of informal waste recycling shops and their daily collected waste before the pandemic (Figure 2). This can intuitively be understood as the more waste collected, recycling shops would earn more income.

Moreover, as a result of the paired t-test, the daily amount of waste collected by the recycling shops was significantly different (t(22)=3.62, p<0.05) before and during the pandemic. Therefore, this means that the pandemic affected the daily collected waste amount of recycling shops. As discussed above, as the income of the recycling shops was directly connected with the collected waste amount, the pandemic affected the income of the recycling shop, too. Another study also showed that the income of different enterprises was also negatively affected by the pandemic just like the income of recycling shops (The Asia Foundation, 2020).

3.3 Main challenges of informal recycling shops

During the interview almost all of the respondents answered that the main challenge they have been facing was getting an official license. Although they are very willing to get the license by paying appropriate license fees, the problem is the limitation of the current law, policy and legislation. Chelsea (2019) also showed that most of the recycling business accepted that being registered has positive impacts.
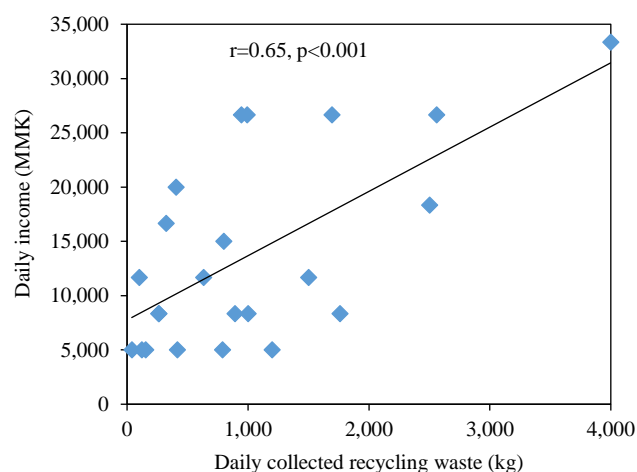
Figure 2. Relationship between daily collected recycling waste and daily income

In Myanmar, waste pickers, waste collectors and dealers are considered as informal sectors. Newspaper, metal, plastic bottles, and other waste from different places such as households and streets are gathered by waste pickers and waste collectors. Waste dealers buy these collected items from them and sell and send them on to recycling industries (Premakumara et al., 2017). They cannot borrow money from private and government banks without a license. Mostly they borrow money from microfinance institutions. The interest rates of microfinance institutions and informal lenders are higher than the interest rates of government and private banks (The Asia Foundation, 2020). To conclude, it can be said that policy and institutional factors are still weaknesses relating with informal recycling shops to run their business officially with a license because they are still recognized as an informal sector.

Apart from getting a license, the others challenges are financial problems, limited land for managing buying recyclable waste, unstable market conditions, etc. During the survey, the perceptions of respondents were polled in order to know which difficulties should be addressed step by step by decision makers relating to informal recycling shops. According to the results, as shown in Figure 3, most of the recycling shops (39%) are willing to accept the appropriate financial support to invest in their business. In a similar study, 42% of informal recycling collectors have faced inadequate fund (Wahab and Ola, 2017). Currently, the owners of shops borrow money from microfinance institutions. The second sector which needs to be improved is updating the current law or some other measure for getting safety

business sectors because almost all of the respondents have experienced in unsafe situation in the past. The third challenge of recycling shops is the unstable market system because, for example, sometimes they had to buy the recycling waste at a higher rate compared with what they sold it for them. Providing land for managing collected recyclable waste and establishing a recycling factory in Nay Pyi Taw is what the respondents would like the government to improve.

Additionally, seasonal variations have also influenced the informal waste collectors, especially in their collected waste amount and income earned (Wahab and Ola, 2018). Therefore, it is also assumed that seasonal variation could affect the informal recycling shops, too. To test this idea further, the seasonal variation impact on the recycling shops was also recorded. According to the results, 74% of respondents have been affected by seasonal impacts, especially in the types and volume of recycling waste. For instance, they do not collect cardboard in the rainy season because it can easily be destroyed in the rain if it is stored outside because of limited storage area. Chelsea (2019) also stated that recycling business in Myanmar have faced the challenge dealing with limited storage area.

In order to investigate the perception of the owners of recycling shops in regard to their feelings on working in this business, their feedback was recorded. The results show that 44% of the respondents would like to quit the current work because of the above- mentioned challenges, especially when they face weak protection by law. This result is similar to the finding of another study. Wahab and Ola (2017) mentioned that 38% of informal waste collectors are willing to quit the work because of the social stigma.

The next challenge that is created by recycling shops themselves is the poor safety standards for workers. According to the survey result, although 100% of respondents answered that the employees always clean their hands with soap after work, only 30% always use protection equipment during working hours. It could be said that most of the respondents have a low level of health awareness. In another study, 55% of the informal waste collectors did not wear protective equipment during working hours (Wahab and Ola, 2017). Providing personal protective equipment is not the major concern of the owners of recycling business because they assume that it is the extra assistance to their staff (Chelsea, 2019).
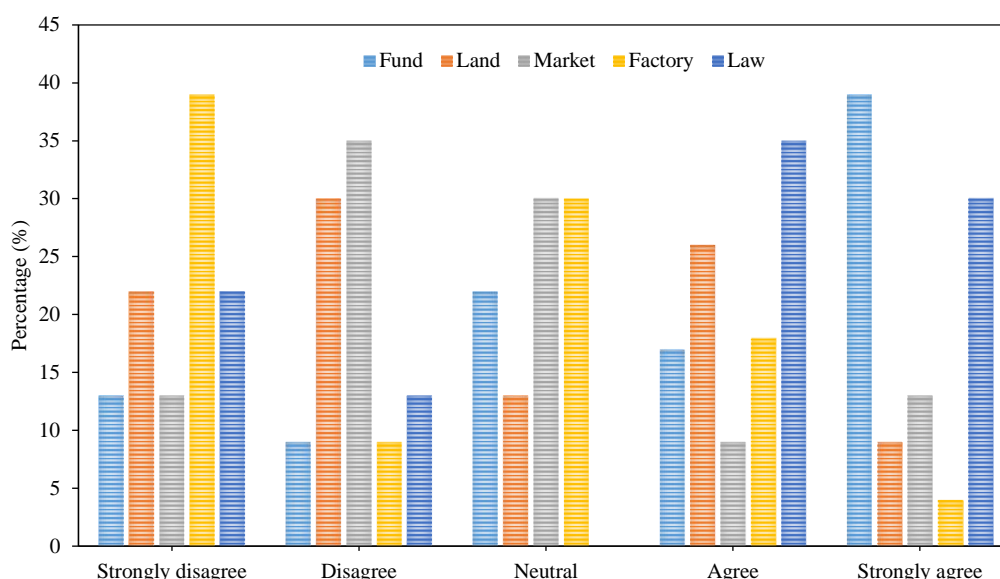
Figure 3. Main sectors needed to be improved

During the survey, in order to understand the perception of the respondents about how to mainstream the recycling shops in waste management activities, their perceptions on the participation of voluntary activities were also recorded. As a result, although 91% of respondents have not experienced on the participation of voluntary work, they are strongly willing to participate in future activities, and they requested to be invited in the future to voluntary activities. Moreover, one of the respondents recommended that, in order to create better cooperation within informal recycling sectors or, if possible, between the informal recycling sector and government, the committee of recycling shops or some special group should be organized in Nay Pyi Taw.

3.4 Recommendation

- The amount of recyclable waste collected by informal recycling shops in Nay Pyi Taw estimated in this study can be contributed to a better understanding of the role of informal recycling shops in the waste management systems.

- The government should provide some kind of special support to informal recycling shops, especially those who have lost their jobs and income because of the COVID-19 pandemic.

- The government or respective decision makers should consider tackling for getting a license as a priority because informal recycling shops have borrowed money from microfinance institutions at high interest rates instead of borrowing money from private and government banks at lower interest rates because of not having a license.

- According to the perception of the respondents, financial support and formulating appropriate legislation and laws need to be implemented as a very first step by the government because, for instance, no definitive legislation or laws to protect informal recycling shops when they face problems are also challenges.

- The government should provide appropriate land to store recyclable waste collected by informal recycling shops at reliable fees because they have faced the impacts of seasonal changes. For instance, the problem of not being able to collect cardboard in the rainy season because of insufficient storage.

- Do's and don'ts concerning with waste management should be disseminated via television programs, magazines, newspapers, and online media (Facebook, YouTube, etc.) because employees in informal recycling shops seem to have less awareness of health protection system: they do not use the protective equipment at the time of working hours.

- The government should try to create better cooperation with informal recycling shops by organizing the committee of recycling shops or some special group of recycling shops in Nay Pyi Taw because this could contribute to mainstream the informal recycling shops in waste management schemes.

- The government should provide some technical support and capacity building programs for

improving the current status of informal recycling sectors (e.g., providing technical assistance for creating new items from waste). As a result, this could contribute to implementing goal C, proposed activities 2.8 of Myanmar National Waste Management Strategy and Action Plan (2018-2030): "Build on existing small-scale entrepreneurial recycling by integrating the informal recycling within the mainstream waste management sector".

4. CONCLUSION

This study calculates the amount of recyclable waste collected by informal recycling shops in Nay Pyi Taw before and during COVID-19. The study estimates that each recycling shop collected 1,798 kg (before the pandemic) and 856 kg (during the pandemic) of recyclable waste per day. This study also showed that the informal recycling enterprises were impacted by the pandemic.

This study indicates the challenges for informal recycling shops. Among them, getting an official license is the main challenge even though they all are willing to pay appropriate license fees because of the current legislation and policy. In addition, financial problems, limited land for managing buying recyclable waste, unstable market conditions, no factory in Nay Pyi Taw and no definitive legislation or laws are also challenges for informal recycling shops. Apart from these issues, some of the interviewed shop owners have faced the impacts of seasonal changes, too. In order to mainstream the role of informal sector into the government solid waste management system, the first step needs to promote cooperation with these sectors.

Estimating the recycling waste amount collected by informal recycling shops and recommendations based on the results of this study might provide the basic background information for policymakers, especially in order to mainstream informal sectors in the solid waste management system with consideration: they are important players in waste management schemes. Moreover, policymakers can also make a better strategy and plan to cope with and solve the waste management problems step by step, based on the findings of informal recycling shops' challenges.

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