

Solid Waste Management In Hambantota Municipal Council, Sri Lanka: Current Practices, Challenges and Prospects

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Abstract- Over the past decade, generation of Municipal Wastes in Sri Lanka has increased due to rapid economic growth, industrialization and urbanization. Thus, management of MSW in Sri Lanka can be considered relatively poor and inadequate. Most of the municipal councils and Pradeshiya Sabhas have been trying to sustainably manage these waste which is seemingly challenging. The inability to provide adequate SWM process has caused significant impact on socio-economy and environment in the country. This paper reviews the problems and challenges of SWM in Hambantota Municipal Council (HMC), Sri Lanka with the result of the conducted research. the characteristics of SWM process in the study area are presented to get the background knowledge. The paper further provides prospects and potentials of MSW management system in HMC. A mixed methodology was used to gather information about the SWM process, its impact on the socio economic and environmental development in HMC.

Index Terms- Municipal solid wastes (MSW); Solid Waste Management (SWM); Hambantota Municipal Council (HMC); Sri Lanka (SL).

I. INTRODUCTION

Municipal solid waste management (MSW) has become a great challenge in development plans in the world, particularly in rapidly developing countries. Sri Lanka is one of the most successful countries in economical transition in recent years especially aftermath of the civil war. However, the rapid urbanization and economic development in most of the areas in the country has given the adverse effects on the environment and socio economic development due to the large number of waste generation. According to Anand (2010) Sri Lanka can be identified as one of the countries where the unbalanced urbanization and modernization have increased the pressure on natural resources and the environment through inefficient and wasteful utilization .

Especially, Hambantota district has undergone a heavy development program in recent years with the government's master development plan. The area is to be developed as second urban hub which may give support for socio cultural and economic development with large commercial opportunities (Cassim, 2013). Thus, these development processes has conversely positive and negative impacts. Especially, Hambantota district is generating large amounts of solid wastes which have direct and indirect negative impact on the socio

economy and environment due to the increasing population density and development. The municipal council, urban councils and Pradeshiya Sabhas in the district struggle to manage these wastes in order to reduce the impact on the environment and the socio economic development.

Hambantota town is one of the largest cities in Southern Province governed by Hambantota Municipal Council (HMC) since 2011. It includes 7 Grama Niadhari Divisions (GNDs); Koholankala, Keliyapura, Siribopura, Samodagama, Hambantota East, and Hambantota West. The total population in HMC is 23090 with 5852 households (DCS, 2012). As newly established MC, HMC confronts many challenges to accomplish its tasks and responsibilities. HMC has the responsibility to regulatory and administrative functions, promote public health and sanitation, environmental sanitation and public thoroughfares and public utility services. Among others, managing Solid Waste(SW) within the municipality area has become a bigger challenge with new development process. Therefore, Solid Waste Management (SWM) has become one of the most important duties Municipal Council tries to accomplish within their governing area. The paper attempts to review the situation of SWM in Hambantota Municipal Council. With this aim, the paper seeks to identify the current MSW management problems and challenges that arise in the study area. SW generation, characteristic, dumping practices, recycling and collection process in HMC are further concerned. Finally, the paper identifies the prospects and potentials for development of sustainable MSW management system in HMC.

II. SOLID WASTE MANAGEMENT IN HAMBANTOTA MUNICIPAL COUNCIL

Solid Waste Management (SWM) is an essential task which has important consequences for public health and well-being, the quality and sustainability of the urban environment and the efficiency and productivity of the urban economy (Schübeler, 1996). Tchobanoglous et al (1993) point out that SWM is a discipline associated with the control of generation, storage, collection, transfer and transport, processing and disposal of solid wastes in a manner that is in accord with the best principles of public health, economics, engineering, conservation, aesthetics and other environmental considerations. Furthermore, Sasikumar and Krishna (2009) comment that Solid Waste management is supervising municipal solid waste from the source of generation through collection or street sweeping, recovery and/or treatment process to disposal. It is an issue of day to day life and involves each and every citizen (Anand, 2010).

SWM in HMC has been carried on by government sector, non government sector, and both together in many phases. When the Hambantota town was under Hambantota Urban council (HUC), the generated waste within the council area was transported and dumped in to a land situated by the side of a forest reserve and Siribopura Tsunami Housing Scheme. The strategy was open dumping and had no further process. In 2005, Energy Forum Non Governmental Organization established a public private civil society partnership for integrated Sustainable Waste Management called Hambantota Nagara Pawithratha Sangamaya (HNPS). For this approach the WASTE internationals, CORD-AID and VNG internationals provided all the necessary financial and technical supports. The HNPS consisted of government officials, regional chamber of commerce, NGOs and CBOs. With the cooperation of all these stakeholders HNPS implemented the ISWM programme and established the Hambantota Integrated Solid Waste Management Center (HISWMC) for the period 2006 to 2009. After HUC transferred in to HMC, the SWM became more challenging. The Municipality included seven GNDs and its area was expanded. The HMC had to cover more areas for SWM which increased the problems and challenges in many ways.

2.1. Solid Waste generation and its characteristics in HMC

Over the past few years, generation of SW in HMC has increased due to new development process and the population growth. According to WACS survey by SATREPS Project, The areas which were under Hambantota Urban Council generating 23.1 tons SW/MSW per day (see table 4). 10.5 tons of these are on site disposals and 9.9 tons are discharged after collection by HMC. These statistics are only from Hambantota east and Hambantota west Grama Niladhari Divisions (GNDs) and identified especial places. There are more five Grama Niladhari Divisions (GNDS) to be considered for the total waste generation in HMC. These GNDs where the Municipality has not started the waste collection process have significant population.

Moreover, with the new development process and population growth, the generation of waste is expected to be increased within few years. As a fact, the waste generation has become a significant issue in the study area.

Table 1: Waste Stream Breakdown (t/d)

Source	Generation (TONS)	On-Site disposal	Discharge
Households	9,3	5,9	3,4
Commercial	2,4	0,8	1,7
Institution	2,7	0,5	2,2
Industries	3,1	1,5	1,6
Market	0,1	0,0	0,1
Port	1,8	1,8	0,0
Drainage	0,8	0	0,8
Unknown(Recyclables excluding food)	2,8	0,0	0,0
Total	23,1	10,5	9,9

Source: SATREPS (2014).

The characteristic of SW is important when considering proper SWM In HMC. The source of SW included residential and commercial activities in the study area. According to the research, the components of SW from primary sources include paper and carton, plastic, food waste, tins and cans, fibre bags, glass, tree leaves, coconut shells and charks & ash (see chart 1). By implication, the research statistics indicate that the households mostly discarded food waste (22%), tree leaves (21%) and plastics (16%) while business places mostly discarded paper and carton (39%); plastic (29%) and food waste (20%) (see chart 1). However, all together 59% from households (HH) and 61% from business places (BP) discarded organic waste and therefore it is possible to safely manage these wastes with composting process.

Chart 1 : Type of waste

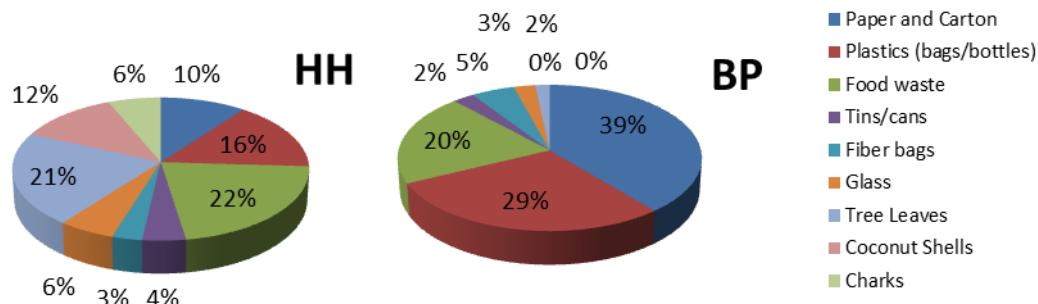


Chart 1: Types of generated SW/MSW

Source: Research Statistics

2.2. Waste storage, disposal practices and collection Process in Hambantota Municipal council

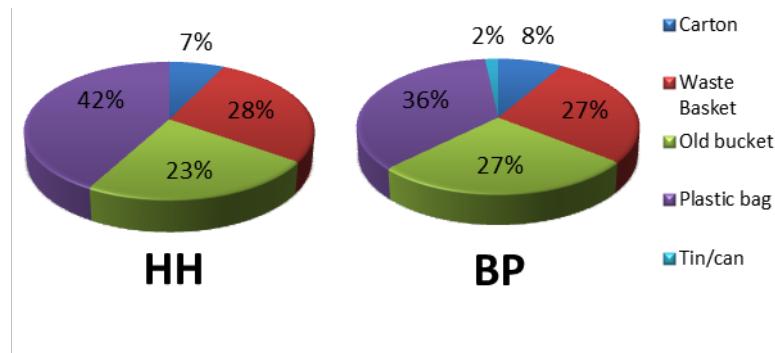
Solid waste Storage and disposal consists one of the most important elements of the SWM process. Safe disposal of solid waste is important for safeguarding both public health and the environment (Ramachandra, 2006). Therefore, it is important to investigate primary storage and disposal practices in the study

area, since the information provides a clear indication of the issues with solid waste management practices. There are issues with waste storage and primary disposal practices in HMC. Most of the Households and Business places do not have proper waste containers to store their waste. Both households and business places are using carton, waste basket, old bucket, plastic bag or a tin/can as a waste container. As shown in chart 2 below, The plastic bag usage as a waste container is higher. 42% of the

households and 36 % of the business places use plastic bags while others use different containers. This indicate that the

community in HMC has no proper primary waste containers to store their discharged waste.

Chart 2 : Type of the container

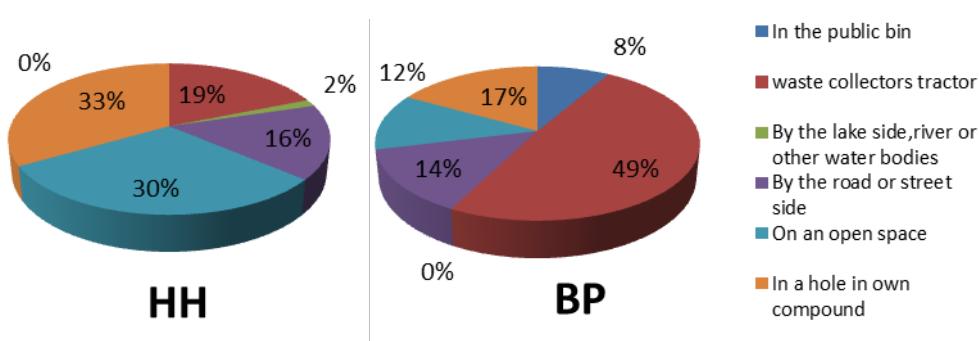


Source: Research Statistics

The improper primary disposal practices can be identified as one of the biggest issues in SWM in the study area. According to research, most of the community members have no proper primary waste disposal method. this has caused significant socio environmental impacts on the area. As shown in chart 3 below, The community; 77% of Households and 91 % of Business Places empty their SW in to unauthorized places nearby water bodies, by roadsides, open spaces and use other unauthorized ways to manage their collected waste. Moreover, the chart shows that the waste collection process by HMC is seemingly inadequate. Hambantota Municipal Council (HMC) has not broadened their waste collection process since they became a Municipality with seven GNDs. Only 19% of the households dispose their waste in to HMC waste collection tractor due to lack of the service. Comparing to households, 49% of business

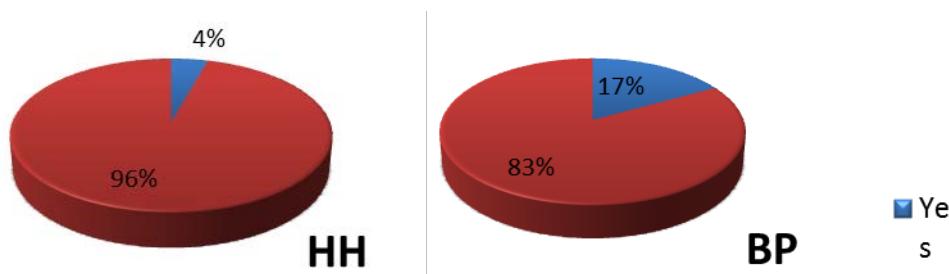
places dispose their waste in to HMC waste collection tractor. Thus, the waste collection process is not sufficient as 51% of business places have no waste collection process provided by the council. This indicates that the HMC has been ineffective and inefficient by providing its waste collection facilities to the community. The ineffective and inefficient waste collection process encourages the community to use improper methods for disposal which causes significant socio economical and environmental impacts in the study area. Moreover, the lack of public waste bins supplied by HMC has encouraged the community to dispose their waste in to unauthorized places. The survey established that about 96% of households and 83% of business places do not have access to public waste bins to dispose SW (See chart 4).

Chart 3: The place of waste disposal



Source: Research Statistics

Chart 4: Availability of Public Waste Bins

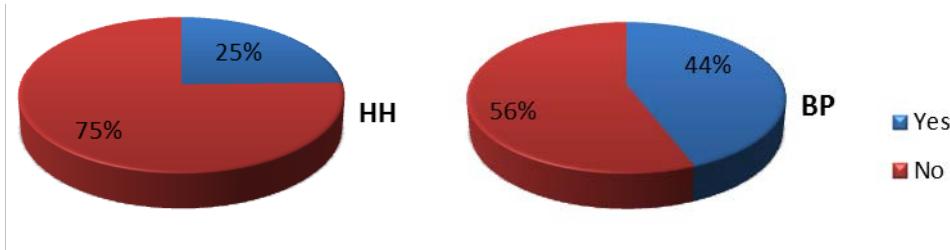


Source: Research Statistics

The state of SWM collection process has considerably affected the satisfaction of the community. As shown in Chart 5, 75 % of householders are not satisfied with the solid waste collection process by HMC. Only 25 % of households are satisfied. according to community members, most of the areas under HMC have no daily waste collection process and thereby people are facing a lot of problems regarding the waste disposal

practices. Nevertheless, comparing to households, 44% of business places are satisfied with the process while 56% of business places are not. Further discussion with community organization members revealed that the state of solid waste collection process is inadequate for the community within all GNDs in HMC and therefore causes the low rate of public satisfaction.

Chart 5 : Satisfied with HMC waste collection process



Source: Research Statistics

This situation therefore has led people to find various ways to dispose of their collected solid waste. The self observation of the research study discovered many illegal dumping sites in the study area. The photo 1 below shows unauthorized waste disposal by water bodies in HMC. The photo 2 shows the roads where people used to dump their waste while the photo 3 illustrates an illegal waste dumping site near Bundala National park where solid waste is scattered everywhere. The researcher investigated that most of the unauthorized waste dumping sites has the windblown polythene which caused a myriad of nuisances to residents, to the public and to the environment.

Moreover, the community members mentioned that the unauthorized disposals have also been done by the tourists, travelers and visitors to the area. Most of the local and foreign tourists that have stayed within the HMC area have disposed a significant amount of waste to the open environment. The interviewed community leader pointed out that this is due to lack of public waste bins in the area. As there are no sufficient waste bins, visitors to the city just throw away the waste to the open areas and continue their journey (Field work, 2014).

Photo 1: Unauthorized waste dumping by water bodies



Photo 2 : Unauthorized waste disposal by the side of road



Photo 3 : Illegal waste dumping site near Bundala National park



Source: Author (Self Observation)

III. PROBLEMS AND CHALLENGES FOR SUSTAINABLE SOLID WASTE MANAGEMENT IN HMC

Hambantota Municipal Council in Sri Lanka has been challenged to carry out sustainable Solid Waste Management due to the lack of financial and technical support, the lack of Public Awareness, information and education, the Lack of collaboration and public participation and the Lack of Legal instrument and policies. Therefore, in this phase, the paper discuss about these identified problems and challenges for sustainable Solid Waste Management process in HMC.

3.1. Lack of financial and technical support

HMC has many issues due to lack of financial and technical support to provide its services to the community, especially to provide SWM services. The Hambantota Integrated Solid Waste Management Center was established to provide proper SWM process in the area. Thus, the center has significant challenges since the day it became under HMC's authority. HMC financial support is not sufficient for the management of daily generated SW in the area. The researcher discovered that there are not even basic facilities to maintain a proper waste collection process , proper disposal process or an effective SWM center. There are no sufficient buildings and the ones have, are not covered well and the floors are not concreted. Moreover the roofs of the buildings are damaged. No signs of the equipment needed in a

fully operational and well-structured SWM. There were no weighbridge, gas recovery system and leachate collection system.

Furthermore , the lack of technical support has cause the SWM process inefficient and ineffective. SWM should be carry out to support integrated waste management in the area. Thus the technical support from the beginning to the final phase is seems to be lack in HMC. The landfill site has not met the requirement of a sanitary landfill in HMC and therefore could be described as an open dump. Though the landfill had a recycling process and a composting process; they are not functioning well due to lack of technical and financial support.

3.2. lack of Public Awareness, information and Environmental Education

Awareness among the public about the importance of SWM generally is not adequate in HMC. The Lack of adequate information regarding the adverse impact of solid waste is a major barrier for a successful waste management process and causes low rate of public awareness. This is due to lack of environmental education which gives basic knowledge on the importance of SWM. The way humans respond and co-operate on waste management issues is influenced by their education. Therefore, the public's education is an essential element of the success of any waste management program. However in the study area, 80 % of the household respondents to the questionnaire mentioned that they were not educated or given

information about proper waste management, recycling or waste separation by the authorities. Further research revealed that the people's willingness to separate waste and recycling of waste depends on their level of knowledge and availability of information. Reaching the community effectively with information regarding waste management was all that participants expect from authorities. due to the lack of information and education on solid waste management and environmental issues has significant impact on the poor SWM practices by the community in HMC.

3.3. Lack of collaboration and public participation

Collaboration between the local authorities, the Municipal council, development authorities, and community members are important for successful waste management practice. According to research study the cooperation with HMC and the community is lack in the study area. this has caused low level of public participation and support for successful SWM process. The local authorities and development authorities have their own independent process and have no interaction with other organizations. The officials do not exchange information with each other and therefore do all the activities independently. Moreover, the lack of intersectional collaboration in the waste sector is evident with the research area. Feeling of responsibility is one of the most important pillars of sustainable implementation of an ISWM system (Klundert, 1999). Thus, Overlapping of responsibilities with different responsible persons are significant in the study area. Sometimes the responsible persons hand over the responsibility to others and causes ineffective and inefficient process. The lack of responsibility among officials and also the community makes the SWM process ineffective. Therefore, the issues of collaboration and responsibility has lead Hambantota Municipal Council's Solid Waste Management in to an inefficient and ineffective process.

3.4. Lack of Legal instrument and policies

There is a gap in environmental coverage of the waste management law, since there are no requirements for reduction, recycling or other alternative options. The community is not well aware of the laws and regulations and therefore it is difficult to act with the legal instruments. The need for regulations and policies regarding SWM is a prevalent concern of community leaders and the council members. The absence of an integrated waste policy with development strategies is identified significant issue in the study area. Low recognition of the importance of environmental problems in general and lack of understanding of the importance of waste issues and their potential with development has not been identified. It should be noted that the development of waste management policy has also been hampered and will remain as a problem because of the lack of adequate information and data. As long as accurate and timely information is not available, decision making and the enforcement processes will be unfeasible. For the reason that, it is almost impossible to develop waste management plan, and consequently operational options without information on municipal waste flow. Moreover, due to lack of political priority and lack of national initiatives and fund allocation, waste management and resource recovery is still a low priority. The Policy framework is not comprehensive and updated to

effectively cover the increasing waste problems due to economic growth.

IV. PROSPECTS AND POTENTIAL ON SWM IN HAMBANTOTA MUNICIPAL COUNCIL

Hambantota is been developed as second urban hub in Sri Lanka which may give support for socio cultural and economic development with large commercial opportunities (Cassim, 2013). With this development process, it is necessary to propose and develop targets of a sustainable environment in order to achieve certain progress towards sustainability. For that, Sound Environmental Solid Waste Management is a necessary step. Especially waste generation, collection and disposal systems should be improved and interlinked very closely to achieve this target. However, as discussed above there are many problems and challenges for SWM in the study area and they should be addressed in a successful way. The responsible personal should consider on finding solutions and mitigate the impact of SW on the environment and finally socio economic development. In this phase , the paper discuss about prospects and potential on SWM in HMC in order to achieve sound environmental development in the study area.

4.1. Introduce the integrated Solid Waste Management system

The Integrated Solid Waste Management (ISWM) is a new, broad, international consensus that has come to Manage SW/MSW in sustainable ways (UN Habitat, 2010). ISWM provides a frame of reference for designing and implementing new waste management systems and for analyzing and optimizing existing systems (UNEP, 2005). A successful waste management is inclusive, fully integrated with economic and social practices, and incorporate with all sectors of society. In order to achieve this target, an integrated approach should be considered. Integrated thinking for materials are the keys to waste management systems that can shift the waste sector from being the source of environmental problem to becoming the environmental problem solver (Hansen, 2010). Therefore, in order to improve SWM in HMC, waste prevention and minimization and Waste recycling and composting should be developed with the focus on ISWM. Moreover, Landfill System should be improved to successfully manage the final disposed waste to achieve sound environmental development in the study area.

4.1.1. Waste Prevention and Minimization

The best preference for waste management is by preventing and minimizing the waste from the primary source. There are two principles in minimizing wastes. Firstly reducing the quantity of generated waste, and secondly adopting effective system to manage unavoidable waste (Pitt and Smith, 2003). The benefits of waste reduction activities are preventing the waste generation and reducing cost for waste management including cost for waste transportation, recycling and disposal. Since this the only way to reduce the growth of waste amount, waste prevention should have the highest priority in waste strategy (Staniskis and Stasiskiene, 2005). Therefore, it is important to improve and focus on waste prevention and minimization at the primary level in order to have ISWM system in the study area.

However, the confusion of public due to lack of information , education and awareness has become main barrier to waste prevention. Therefore, The education on SWM is a necessity in the study area.

4.1.2. Waste Recycling and Composting

In order to develop ISWM system, resource recovery and reuse is essential. Therefore, HMC should promote waste separation, recycling and reuse. Recycling is cheaper and more environmentally friendly alternative than seeking new landfill site and extend the lifespan of the existing landfill. Besides, the ISWM system is more economical by replacing raw materials with used materials, and creates jobs. To ensure the successful of recycling, people must know how to recycle and be motivated to recycle. Implementation of recycle campaign is a way to reduce waste disposal problem. Holding workshops and awareness programmes are necessary in HMC. The lack of opportunities to sell collected waste decreases the interest of people towards Recycling. HMC should introduce a process where people can sell their recycled waste. In this way the council can encourage people to separate their waste. Moreover, it will help to carry on effective and efficient recycling process in HMC while reducing the waste amount in the land fill site.

Moreover, when the waste is been separated, the organic waste can be reused by making compost. Composting can be identified as one of the best methods to manage organic SW in HMC since comparably high amounts of organic wastes are discarded by the community. Through a composting process, it is possible to reduce the landfill waste. It will provide more sound management as well as improvement of environmental conditions in the waste management site.

4.1.3. Improve on Landfill System

The landfill site should be properly managed to avoid heaping of waste and burning. HISWMC should be adequately resourced by the government to ensure efficient and effective waste management in the area as the area is developed under a government development project. As the land fill site is to be relocated, the development authorities should give the priority for that as soon as possible before the SWM becomes a significant issue in HMC. The HMC should coordinate with other corporate bodies like National Solid Waste Management Centre as well as with the NGOs to pull technical support and financial resources to sustain the institutions managing. Moreover, the polluter pay principle should be introduced. In order to provide the necessary resources to sustain good landfill practices, businesses population should be encouraged to send their wastes to landfill sites as an option to manage their waste. Charging tipping fees on industries for waste disposal to increase motivation on waste minimization and can strengthen the economy of the HMC. Furthermore, there should be a monitoring process for the management of the SW collection process, HISWMC and landfill site.

4.2. Improve financial and technical support

The lack of financial support has caused ineffective and inefficient SWM process in HMC. Therefore, the government should consider on providing sufficient finance to carry on ISWM system. HMC also should focus on the methods which

can help to improve economy in the council such as polluter pay method and charging assessment tax. Moreover, there should be adequate core waste management equipment and technical support for efficient and effective SWM process. The weighbridge, gas recovery system and leachate collection system must be established in the land fill site. the technical support should be provided in each phase of SWM to improve proper waste management system in the study area.

4.3. Improve Public Awareness, information and Environmental Education

Understanding public behavior is critical in ISWM process. Lack of knowledge among the society and social norms often the significant obstacles that negatively affect solid waste practices (Begum, 2009). Environmental attitudes, behaviors and participation are highly influenced by knowledge. Therefore the council should consider on improving information and environmental education in the study area. the environmental education is a necessity in the first phase of the SWM process since the study found that the lack of information and education has significant relationship with proper waste management in HMC. According to Zurbrugg (2002), The public's willingness to cooperate and participate in waste management relies on their awareness and attitude. Therefore improving awareness in HMC should be given the highest priority. The most effective method of educating public differs according to location, types of waste management system in use, and socio-economic factors (Grodzinska-Jurczak et al, 2003). Therefore, the education and awareness campaign planned should take these factors into account for maximum effectiveness. Policies should be formulated to focus on promoting knowledge, education, and skills on environmental friendly waste management.

4.4. Improve cooperation, public participation and collaboration

It is important to cooperate with the community when they carry on any kind of process that affects the society and its wellbeing. The researcher proposes that the action plan should be built with citizen participation. The HMC could start lobbying system in order to interact with the community groups. Creating waste management community groups and give them the responsibility to keep the specific area cleaned is suggested. In that way, the community will act more properly as the responsibility is on them if the waste is discharged in improper ways. Moreover, the development authorities' should ensure more interaction and collaboration with the local governments when they are doing development processes as the development accelerates the SW generation. Therefore, the development authorities have the responsibility to interact with the responsible persons for SWM and develop strategies for better SWM processes with the development policy. The responsible persons for SWM should get involved in the process more actively. Especially the political bodies in HMC and managerial persons should involve themselves in the activities more actively in order to carry out a better SWM in HMC. The mayor as the leader of the HMC should focus on how to act not only as a political body but also as a responsible person for the HMC and to the community with his duties.

4.5. Develop Legal instrument, policies and Monitoring process

Laws and regulation should be improved for proper waste management practices at local levels and at national levels. The community would be more willing to practice proper waste dumping, waste separation and recycling once such a regulation is in place. The media, posters and public notices should be used more in order to increase the awareness about the laws and regulations. Moreover, the waste management should be integrated with development policies. There should be SWM in each every development policy in order to fulfill their eco friendly strategies. Finally HMC should introduce monitoring process. Most of the SWM systems have been ineffective and inefficient due to lack of monitoring system. In HMC, the waste management has not been monitored in a proper way. Therefore, monitoring process for the management of the HISWMC and landfill site in HMC should be developed.

4.6. Usage of Sound Environmental Development strategy with development process

There should be more environmentally friendly processes combined with development processes to mitigate the significant impacts. Sustainable use of environmental resources and services are important for sound environmental development. Therefore, to achieve sustainable development goals, the development authorities should enlarge their attentiveness towards sound environmental development and mitigate impact on the environment. Especially mitigating SWM impact is necessary for sustainable development. Therefore, as discussed above, the development practitioner in collaboration with Local government should develop a process for SWM. That would help to promote eco friendly strategies towards sustainability in new development processes. Most of the people believe the environmental conservation is important for sustainable development. Therefore, authorities should encourage people to promote more environmental friendly behavior.

V. CONCLUSIONS

Hambantota has experienced rapid urbanization and development over the last few years. This situation has increased the generation and changes the characteristics of MSW. Therefore the SWM should be developed as an effective and efficient process in order to achieve sustainable development in the area. Thus, the lack of financial and technical support, the lack of Public Awareness, information and education, the Lack of collaboration and public participation and the Lack of Legal instrument and policies challenge SWM process in HMC. The fundamental aspect that needs to be considered to mitigate these challenges is implementing Integrated Solid Waste Management System in HMC. MSW prevention, minimization, and recycling should be put at the top hierarchy in MSW management. The national and local government should focus on providing financial and technical support. The council should consider on improving information, environmental education and awareness in the study area. The HMC could start lobbying system in order to interact with the community groups. Policies should be formulated to focus on promoting knowledge, education, and skills on environmental friendly waste management. In order to develop a comprehensive waste management program, The

responsible persons for SWM should get involved in the process more actively. Especially the political bodies in HMC and managerial persons should involve themselves in the activities more actively in order to carry out a better SWM in HMC. Finally, the development authorities should enlarge their attentiveness towards sound environmental development in HMC.

REFERENCES

- [1] Anand, S., (2010).Solid waste management, Mital publication.
- [2] Begum, R. A., et al. (2009). Attitude and Behavioral Factors in Waste Management in the Construction Industry of Malaysia. pp. 321–328.
- [3] Cassim, N., (2013). Future of Hambantota as a hub: Progress so far and unfolding new opportunities : [Accessed on 2013/09/18]. <http://www.ft.lk/2013/09/13/future-of-hambantota-as-a-hub-progress-so-far-and-unfolding-new-opportunities/>
- [4] DCS Sri Lanka (2012).Population of Sri Lanka by District: [Accessed on 2013/10/18].http://www.statistics.gov.lk/PopHouSat/CPH2011/Pages/sm/C_PH%202011_R1.pdf Grodzinska-Jurczak, M., M. Tarabula, and A.D. Read. (2003). Increasing Participation in Rational Municipal Waste Management:A Case Study Analysis in Jaslo City. pp. 67–88.
- [5] Hansen, J. A. (2010). Cities as Sustainable Development Drivers. Waste Management & Research. pp. 383–38
- [6] Klundert A.V., (1999). Integrated Sustainable Waste Management: the selection of appropriate technologies and the design of sustainable systems is not (only) a technical issue: [Accessed 2013/03/12]. http://www.worldbank.org/urban/solid_wm/erm/Annexes/US%20Sizes/Annex%204B.3.pdf
- [7] Pitt, M. and A. Smith. (2003). Waste Management Efficiency at UK Airports. Journal of Air Transport Management . pp. 103–11
- [8] Ramachandra, T.V., (2006). Management of municipal solid waste. TERI press.
- [9] Sasikumar, K.,Krishna,S.G., (2009).Solid Waste Management. PHI Learning
- [10] SATREPS (2014).Waste amount and composition survey in Hambantota MC. JICA.
- [11] Schübeler, P., (1996). Conceptual Framework for Municipal Solid Waste Management in Low-Income Countries, World Bank: [accessed on 2013/09/25]. http://www.worldbank.org/urban/solid_wm/erm/CWG%20folder/conceptualframework.pdf
- [12] Staniskis, J. K. and Z. Stasiskiene. (2005). Industrial Waste Minimization-Experience from Lithuania. Waste Management & Research. pp. 282–290
- [13] Tchobanogous et al ., (2002). Introduction.In, Tchobanogous, G and Kreith, F., Handbook of Solid Waste Management, McGraw Hill Professional.
- [14] UN Habitat (2010). Solid waste management on the world cities: water and sanitation on the world cities. Earthscan publication.
- [15] UNEP (2005).Solid Waste Management. [Accessed 2013/03/12]. <http://www.unep.org/ietc/Portals/136/SWM-Vol1-Part1-Chapters1to3.pdf>
- [16] Zurbrugg, C., (2002). Urban Solid Waste Management in Low-Income Countries of Asia How to Cope with the Garbage Crisis, in Scientific Committee on Problems of the
- [17] Environment (SCOPE), Urban Solid Waste Management Review Session: Durban, South Africa.

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