Research Article Open Access

Impacts of Solid Waste Management Practices on Environment and Public Health: A Case of Bahawalpur City, Pakistan

Muhammad Mohsin[1,*], Annatoria Chinyama[2]

[1] Department of Geography, Govt. S.E. College, Bahawalpur, 63100, Punjab, Pakistan
[2]Department of Civil and Water Engineering, National University of Science and Technology, P.O. Box AC939, Ascot, Bulawayo, Zimbabwe

Article History
Received
September 27, 2016

Published Online
December 30, 2016

Keywords:
Dumping sites, Environment, Public health, Solid waste management practices, Urbanization.

Abstract: Safe and secure disposal of solid waste is now becoming a major issue for most of developing countries with accelerating urbanization and increasing pressure of populations. A study was conducted in Bahawalpur City; Pakistan. The main objective of the study was to investigate the sources and impacts of solid waste management practices on the surrounding environment and public health. This was achieved by specifically identifying the sources and types of solid waste in the city by identifying the different solid waste management practices and their impacts on the environment and human health. Data about solid waste generation, collection, disposal and their impacts on human health and environment was collected in Model Town C using a structured questionnaire from 80 randomly sampled respondents as well as by field observations. Secondary data from institutional records was also collected. Statistical analysis in the form of descriptive statistics and chi-square test were applied to the data. It was found that the environment in study area was highly polluted with open dumping of solid waste in open spaces and vacant plots. Households contributed the most solid waste generation and open dumping. The solid waste generated at household level consisted of organic waste, plastics and polythene bags. Institutionally, Tehsil Municipal Administration (TMA) and later Bahawalpur Waste Management Company (BWMC) were found to be responsible for solid waste management in the city but the overall situation is not satisfactory. The impacts of poor solid waste management practices were found to be: land degradation, creation of breeding grounds for disease carrying vectors such as mosquitoes, rats, rodents, decrease in land values; and different severe diseases. Furthermore, it was found by statistical analysis, that there was a significant relationship between the poor solid waste management practices and environmental and health problems faced by the community.

Corresponding author: Muhammad Mohsin**:** mohsinshahzad10@yahooo.com

Cite this article as: Mohsin, M. and A. Chinyama. 2016. **Impacts of solid waste management practices on environment and public health: A case of Bahawalpur City, Pakistan.** *Journal of Environmental & Agricultural Sciences.* 9: 69-79.

1 Introduction

Solid waste management is a burning issue in a rapidly urbanizing world. With the accelerated urbanization and industrialization solid waste management practices are having a bearing on public health and the environment in urban areas of many developing countries (Kjeldsen et al., 2002; Laner et al., 2012; Mukherjee et al., 2015). Industrialisation increases the problem as the volume of urban wastes generated per capita also inclines to rise gradually with increasing per capita income (Brennan, 1999; Najam et al., 2015; Han et al., 2016). It was found that socio-economic patterns of household like household size, and income play an important role in solid waste generation (Abel, 2007; Dunfa and Krishna, 2013). For instance, in Lahore, the rate of solid waste generation in high income households was 0.96 kg/capita/day, for middle income 0.73 kg/capita/day and for low income group were 0.67 kg/capita/day (Jadoon et al., 2014). A variety of types of solid waste is generated in developing urban areas; generally domestic garbage, crop residues, and bad food materials (Awomeso et al., 2010; Ojelade and Aregbesola, 2014; Kolekar et al., 2016; Ozcan et al., 2016).

The collection and disposal of municipal solid waste is considered an important public service and has crucial impact on public health and the outlook of cities and towns (Hamer, 2003; Sharholy et al., 2008; Coad, 2011; Pires et al., 2011; Chithra et al., 2016). However, the management of the generation, collection and disposal of solid waste is highly inefficient, deteriorating the quality of the environment and posing risks for public health particularly in developing countries regardless of the fact that a huge budget is spent on solid waste

Journal of Environmental & Agricultural Sciences (JEAS). Volume 9

management annually (Altaf and Deshazo, 1996; Zurbrügg, 2002; Abedullah, 2006; Ezebilo and Animasaun, 2011; Anjum, 2013; Ogunyanwo and Soyingbe, 2014). The indiscriminate solid waste disposal in water bodies pollutes potable water sources as well as impacting on the aquatic environment (Boadi and Kuitunen, 2002; Marshall and Farahbakhsh, 2013; Aglanu and Appiah, 2014; Gillespie, 2016). The major constraints for efficient and effective solid waste management in developing countries are lack of funds, lack of technical expertise, weak institutional frameworks and less priority to solid waste management systems (Al-Khatib et al., 2010; Lee et al., 2016). In South Asia, the collection of solid waste facilities is inefficient in main urban centers (Visvanathan and Glawe, 2006; Chithra et al., 2016). Similarly, the collection of solid waste is quite inadequate in Pakistan except few big cities where 51-69% generated solid waste is collected. For instance, in Lahore, the collection coverage is only about 68%. Moreover, recycling system is very rare in the country and little quantity of waste has been recycled mainly by informal sector e.g. only 27% of waste is being recycled in Lahore informally (Mahar et al., 2007; Masood et al., 2014).

Solid waste management systems can be improved by stakeholder participation and awareness as well as involvement of private players in the handling of solid waste. Solid waste handling practices that stimulate the awareness of solid waste characteristics and removal methods and role of reduce, reuse and recycle (3Rs) could be effective informally (Memon, 2010; Jaunich et al., 2016). It is evident in developed countries where 3Rs are frequently utilized in Integrated Waste Management (IWM) and could be hugely lessen the quantity of generated waste up to 70 to 90% (Botkin and Keller, 2011; Haryono, 2015). Educating households about solid waste management and environmental and health issues could prove to be very handy in improving the people's willingness to pay (WTP) (Akaateba and Yakubu, 2013; Alhassan and Mohammed, 2013; Festus and Ogoegbunam, 2012). Moreover, training programs especially capacity building and provision of technical assistance could greatly lessen the problems of the solid waste management (Zhang et al., 2010; Saeid et al., 2014).

In many developing countries (e.g. Nigeria), scavengers of slums especially women and children are actively engaged in collection and recycling of solid waste material informally. This is a successful way of earning a living and has a great potential to bring improvement in solid waste management sector if authorities pay a special focus (Pires et al., 2011; Oteng-Ababio, 2012; Muhammad and Manu, 2013; Bolyard and Reinhart, 2016; Fudala-Ksiazek et al., 2016). There are about 21,000 waste pickers or scavengers, collecting recyclable waste paper and plastics from the surroundings of Karachi Metropolitan Corporation (KMCP) and they recycle about 1,500 t/day of solid waste (ADB, 2006). Therefore, the valuable stuff from the scavenged material turn the scavenging fairly a paying enterprise for the poor people of the cities e.g. slum dwellers (Aljaradin et al., 2015).

Bahawalpur is the 12th largest city of Pakistan having population over 679,455 in 2014 with over 3.08% growth rate per annum (Govt. of Punjab, 2014). City experiencing rapid population growth and development in all sectors of life and resultant change in land use patterns. With high level of development, the issues of mismanagement and deterioration in solid waste generation and disposal, poor drinking water, sewerage, sanitation and others are also hiking. Presently, the management of solid waste is the main responsibility of Bahawalpur Waste Management Company (BWMC) that previously was managed by Tehsil Municipal Administration (TMA) and is being done efficiently but the situation in less developed parts of the city need to pay immediate attention. So, in order to evaluating the current scenario of solid waste management on lower level it would be beneficial to explore the sources, types, collection and disposal of solid waste and their impacts on environment and people's health. Hence, this research is aimed to unveil the causes and impacts of poor solid waste management and proposed few suggestions to overcome the severity of the issue in Bahawalpur City.

Keeping in concern the importance of inform policies regarding the safe collection and disposal of solid waste in Bahawalpur City, the main objective of this study was to investigate the sources, rates and types of solid waste generation and evaluate their impacts on the surrounding environment and public health.

2 Materials and Methods

2.1 Study area

The site chosen for conducting this study was Model Town C in Bahawalpur City. The town is significantly inhabited by middle class and poor residents and slum dwellers (resided in a dwelling named *Gharib Abad* (Living place of poor). It is managed by Tehsil Municipal Administration (TMA) of Bahawalpur City.

Journal of Environmental & Agricultural Sciences (JEAS). Volume 9

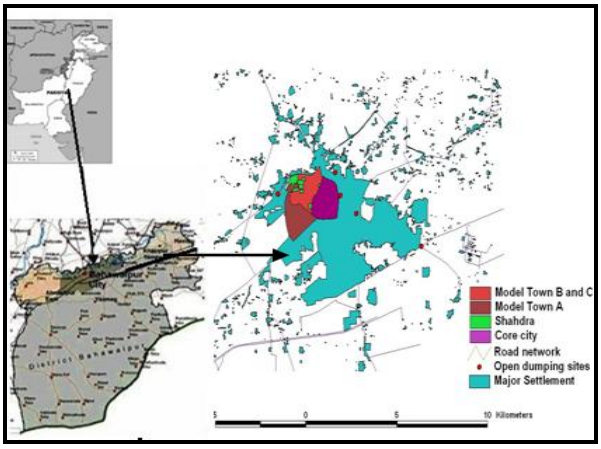

Fig. 1. Location Map of Bahawalpur City (Modified from Shafqat et al., 2014)

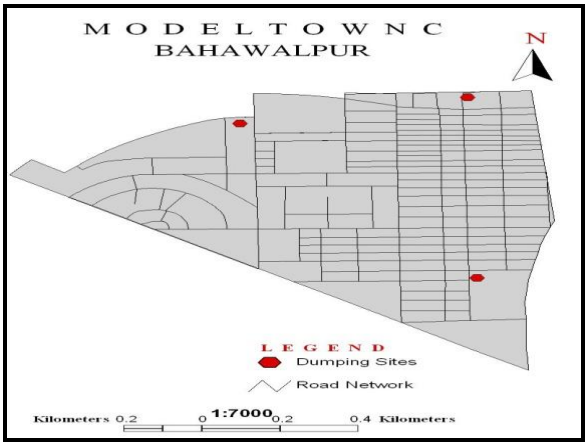

Fig. 2. Dumping sites in Model Town C showing dumping areas (Source: Authors)

Although, much of the area is well developed and provided with basic facilities (e.g. roads, gas, electricity, sewerage) as it is adjacent to Model Town A and Model Town B, (the two most developed towns in the city) some of parts of the area are neglected and not evenly managed in terms of provision of basic services. Model Town C is situated in the northern side of the city and occupies a smaller area of just 80 acres as compare to its neighbours Model Town A and Model Town B (Fig. 1 & Fig. 2).

2.2 Data collection

Primary data was collected through a field survey in the study area during February 2013. The survey was conducted in mostly neglected part of the town (i.e. *Gharib Abad*). A structured questionnaire was used for primary data collection from 80 respondents selected by simple random sampling. Total population of the dwelling was about 800 at the time of survey therefore 10% sample size chosen for sampling process. Respondents were consisting both male and female having corresponding share of 90% and 10%. Most of the respondents' were male and head of the family were at home at the time of survey while a little share of female were also communicated in the absence of male heads. Apart, field observations were also recorded during the survey. Secondary data (from records) was obtained from the responsible institutions such as The Urban Unit, TMA Bahawalpur City and recently the Bahawalpur Waste Management Company (BMWC). Sources and types of solid waste were identified from responses to the questionnaire, while necessary information was obtained from TMA and BMWC officials to identify the solid waste management practices in the city. The residents' perceptions on the practices were also recorded through the questionnaire and communication.

The impacts of the solid waste management practices on the environment and public health were determine from responses to questionnaire, field observations and communication with concerned of TMA and BWMC.

2.3 Data analysis

The acquired data was consists mostly quantitative attributes. Different statistical techniques were used to analyse the data such as chi-square test and average. Simple descriptive statistics were used to analyse the responses regarding solid waste types, main sources of waste generation, their impact on surrounding environment (open spaces and land values) and the resultant diseases and problems caused by the solid waste. By using SPSS 16 software, the chi-square test (cross tabulation method) was applied to find out the significance between dumping methods and colligated environmental and health related problems.

3. Results and discussion

3.1 Major sources, rates and types of solid waste generated

Survey results evidenced that about 96% of the solid waste was produced by residents at homes while small industries located in northern and western side of the city produced only 4% of the solid waste (Fig. 3). Among these industries; floor mills, marble industry and furniture industry were the leading contributors of solid waste.

Unfortunately, authentic data is rarely available for the actual generation of solid waste in Bahawalpur and surrounding cities. It is ranges between 0.283 to 0.612 kg/person/day and these calculations based on rough estimates that can be derived from current population X 0.457 kg/person/day solid waste. Hence, the quantity of waste generation for Bahawalpur City is supposed to 0.457 kg/person/day (EPD, 2015).

Journal of Environmental & Agricultural Sciences (JEAS). Volume 9

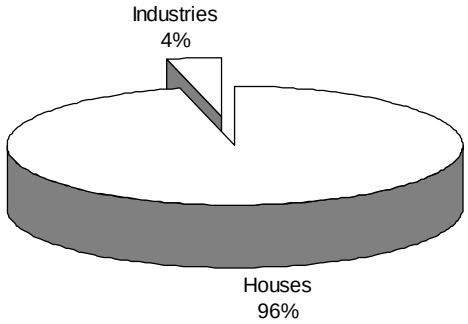

Fig. 3. Source of solid waste in study area of Bahawalpur

According to recent estimates the population of the Bahawalpur City was 679,455 in 2014 (Govt. of Punjab, 2014) and based upon the daily generation rate of 0.457 per person per day, it is currently calculated about 310.54 tonnes/day and 113,347.1 tonnes/year. But these results slightly differ than the outcomes documented by The Urban Unit in 2011 regarding total waste generated per capita and per day (Table 1). This difference is perhaps due to the unavailability of authentic information. Generally, in many big cities of Pakistan, the generation rates of solid waste are considerably higher than other developing countries (Jadoon et al., 2014).

The results showed that the high volume of solid waste was mixed. Almost 88% respondents stated that the solid waste they generated contained food remains, and remaining were polythene bags, plastic scrap and cardboards (Fig. 4). A recent study conducted in Bahawalpur City also certified that about 35.3% waste comprised by organic waste, followed by textile/rags (8.4%) and plastic and rubber (7.3%) respectively (Shafqat et al., 2014). In developing countries, the residential solid waste consist more than 90% of organic waste and this biggest share of organic waste could utilized by composting to gain fertilizer or biogas generation (Al-Khatib and Arafat, 2010; Awomeso et al., 2010).

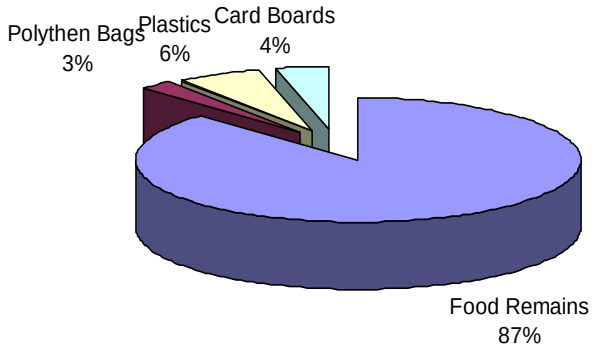

Fig. 4. Types of solid waste in study area of Bahawalpur

3.2 Solid waste management practices in Bahawalpur City

TMA Bahawalpur city was mainly responsible for the solid waste management system of Bahawalpur with limited financial, material and human resources (Table 1). Therefore, due to a large quantity of solid waste, just about 60% of the generated waste in urban areas is being collected and disposed off. Solid waste in the city is disposed without treating near the city (The Urban Unit, 2011).

Sanitary sweepers collect solid waste by means of hand carts and donkey carts to secondary collection points from where it is transported to open dumping sites at five different places in the city (Fig. 2). In 2013, the city district government of Bahawalpur (CDGB) established Bahawalpur Waste Management Company (BWMC) under the section 42 of the Companies Ordinance 1984. The company has a website and an emergency helpline for redressing complaints. The company utilized a Vehicle Tracking and Monitoring System (VTMS) in their waste transporting equipments and vehicles to ensure quick and satisfactory waste collection operations.

Table 1. Existing solid waste management system profile in Bahawalpur City

1. Collection and Disposal	
Waste Generated	322 Tons/day
Waste Collected	208 Tons/day
Generation Rate	0.5 kg/capita/day
Waste Generated per HH	3.5 kg
Waste Disposed Off	167 Tons/day
Temporary Disposal Sites	5
Landfill sites	No
2. Equipments	
Hand Carts/Push cart	120
Donkey Carts	13
Secondary Containers	60
Tractor Trolleys	13
Arm Roll Trucks	0
Truck	0
Excavators	0
Bulldozer	0
Vans	0
Tractors with Bucket	2
Tractors with Blade	1
Tractors with container carrier	3
Mechanical Sweeper	1
3. Sanitary Staff	
Chief Sanitary Inspector regular	1
Chief Sanitary Inspector contract	0
Chief Sanitary Inspector work charge	0

Source: The Urban Unit, 2011.

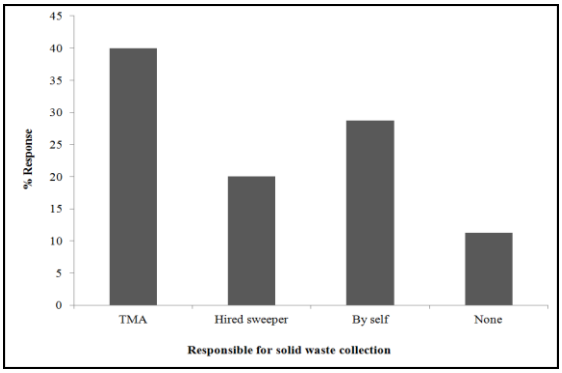

Fig. 5. Parties responsible for solid waste collection in Bahawalpur

Currently, BMWC is providing this service in the 18 urban Union Councils (UCs) of the Bahawalpur City including waste collection (manual and mechanical), sweeping of main and arterial roads (manual and mechanical), streets and squares with vacuumed vehicles, waste removal, storage, collection, transport, and transfer of waste, resolution of residents' complaints, ensure health and safety measures and clearance of waste disposal plots (BWMC, 2015).

3.2.1 Collection of solid waste

According to the respondents, 40% of the generated solid waste is collected by municipal collectors by the means of hand carts and donkey carts. About 20% respondents have hired private sweepers and collectors for waste collection. About 28% responded that they clean and disposed off waste by themselves and the remaining 12% just throw away the waste in streets (Fig. 5).

These results indicate that the collection of solid waste in study area by the responsible authority is poor as they only collect 40% of the waste generated. A previous study indicated that inappropriate solid waste collection and disposal methods are common practices in urban and rural communities of developing countries (Awomeso et al., 2010).

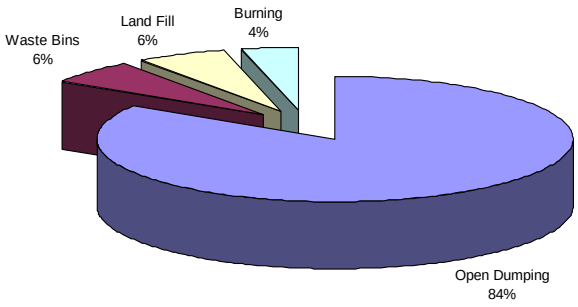

Fig. 7. Solid waste disposal strategies in Bahawalpur

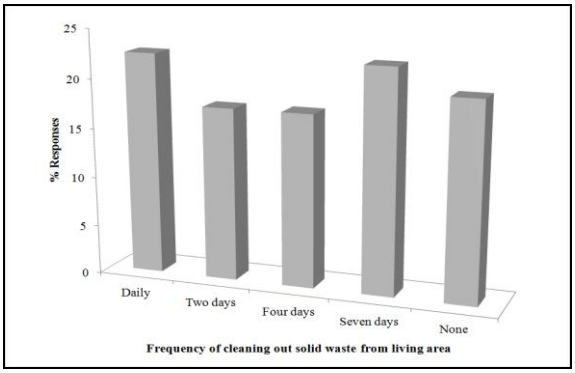

Fig. 6. Frequency of cleaning out solid waste from living area in Bahawalpur

The residents' practices on handling solid waste in their living space are illustrated in Figure 6. From Figure 6, 22% respondents clean and collect their solid waste on daily basis; 18% each collect their solid waste after the interval of two and four of days respectively; while 22% clean and collect their solid waste after seven days and the rest (20%) of the residents responded that they just throw out their solid waste in the street and then they never clean it. These results indicate the level of awareness of the residents on effective ways to handle solid waste and indicating how the authorities carry out their solid waste management mandate (Shafqat et al., 2014). Furthermore, there were no waste bins placed in study area for solid waste collection. TMA and BWMC need to place the waste bins and waste containers nearer the link roads and crossings of streets for primary collection of solid waste.

3.2.2 Disposal of solid waste

Figure 7 show that 84% respondents thrown their waste material in streets openly. Whereas the use of waste bins (6%), land fill (6%) and burning (4%) are utilized very rarely from residents. TMA Bahawalpur city used landfills for final disposal of waste material which is a most common method in developing countries (Taylor and Allen, 2006).

Fig. 8. Solid waste in front of houses in Bahawalpur

Fig. 9. Solid waste heap in a plot study area of Bahawalpur

However, because of poor collection most of the solid waste is dumped in the streets as illustrated by Figures 8 and 9.

These results indicate that there is dire need to bring change in the attitudes of the residents regarding the threats associated with open throwing of waste material. Previous studies found that people living habits, household income, family size, level of educational attainment, religious and cultural beliefs, and social and public attitudes highly influence the generation and disposal of solid waste (Bandara et al., 2007; Longe et al., 2009; Samuel, 2015).

3.2.3 Solid waste management payment

A solid waste management system requires financing. As with other urban municipal services residents are required to pay for solid waste management. The majority of the respondents (86%) have never paid any payment to the waste collectors or sweepers, while the remaining 14% said that they paid solid waste management payments to privately hired sweepers and collectors monthly between 100-200 PKR. It is found in a study conducted in Kampala (Uganda), that about 48% households were agree to pay for better solid waste management system with a monthly charges of UGX 100 (USD 2.91) (Ojok et al., 2013). These results show that the authorities are not recovering any costs from the residents due to the residents' inability to pay or unwillingness to pay or a combination of both. Due to high cost of handling and managing of waste material, the municipal budget is not adequate to disposed of the entire generated solid waste in most of developing countries (Halla and Majani, 1999; Awomeso et al., 2010; Guerrero et al., 2013).

When the respondents were asked to rate the performance and efficiency of solid waste management system, the results are shown in Figure 10. It was found that 44% of the respondents of study area were of the opinion that the solid waste management system was poor; 22% and 23% each responded that the system was average and very poor respectively and 11% of the respondents were satisfied with the solid waste management system.

3.3 Impacts of solid waste management practices

3.3.1 Impacts on environment

Impacts on the environment such as land degradation were observed during the field survey by field observation and communication with local residents. Figure 11 illustrates the effect of dumping solid waste indiscriminately. From the field observations it can be attributed to open dumping of solid waste and subsequent impacts on the surrounding environment aesthetically as well as the flora and fauna and hence depleting the open spaces in study area immensely.

Residents' perceptions on impacts of the solid waste management practices on the environment were that; 90% of the respondents argued that the current solid waste management practices were affecting their surrounding environment and 10% of the respondents showed no concern about its impacts on the environment. A recent study conducted in Ahmedpur East City (Bahawalpur) reported that almost 95% of solid waste is inappropriately thrown open in the fields and streets and creating severe problems (Mohsin et al., 2016). It was also observed that generally, the plots or houses near the landfills or dumping site could not attract tenants or property dealers due to unhygienic and unpleasant conditions surrounding them. Residents (58% of the respondents) were also of the opinion that solid waste management practices affect the land values in terms of rents or selling prices.

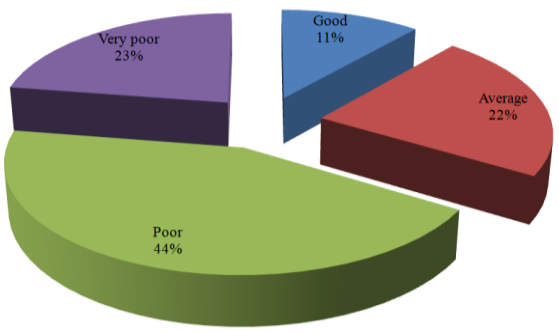

Fig. 10. Rating of solid waste management system in Bahawalpur

Fig. 11. Land degradation due to dumping of solid waste in study area of Bahawalpur

Table 2. Summary of chi square result for frequency of dumping methods, environmental and health problems

Cross tabulation	χ^2	Sig.
Dumping Methods vs. Environmental Problems	14.404	.002
Dumping Methods vs. Health Problems	7.736	.025

χ^2= chi square value; Sig. = P-value significant at 5%; N=80

On the other hand, 42% of the respondents did not think that solid waste management practices had a negative impact on land values. Similar results were reported in previous studies those highlighted the negativities and adverse impacts of poor solid waste dumping on surrounding land values (Ready, 2005; Wokekoro and Uruesheyi, 2014).

In order to measure the association of the dumping methods and associated environmental problems, the chi-square was applied. Table 2 shows the results of dumping method versus environmental problems. The chi-square value of 14.404 shows a high positive relationship between these two attributes. The calculated p-value of .002 is also highly significant at a 5% confidence interval. These results certify that dumping methods are affecting the quality of environment and creating severe environmental problems as causing harms to bird and animal communities and leads to the land degradation. Hence, they have significant relationship.

3.3.2 Impacts on public health

It is found that the main risks to health are indirect and awakened from the breeding of disease vectors, as most of solid waste is thrown into the streets and stagnant there for many days. This solid waste creates breeding ground for insects, flies and mosquitoes. A previous study conducted in Bahawalpur City indicated that almost 71% of households thrown their garbage in open fields and streets which is a great threat to local environment in terms of heath and pollution. Moreover, it is found that there is key connection between the inappropriate solid waste disposal and occurrence of vector borne diseases (Khan et al., 2014). The greatest health risk in this area comes from the heaps of solid waste which are the source of many diseases particularly diarrheal diseases caused by bacteria, viruses or parasites.

Among these, Malaria and typhoid fever were frequently reported in that area (Fig. 12). Many residents of the study area were suffering from malaria due to mosquitoes which fostering in the dirty heaps and holes of stagnant water of solid waste.

In spite, they were suffering allergies and skin diseases also. Surprisingly, about, 20% respondents were not infected by any of these diseases perhaps due to attainment of better medical facilities and improved standard of living. Generally, the insects and rodent vectors are in the refuse and spread diseases such as cholera and dengue fever (Alam and Ahmade, 2013).

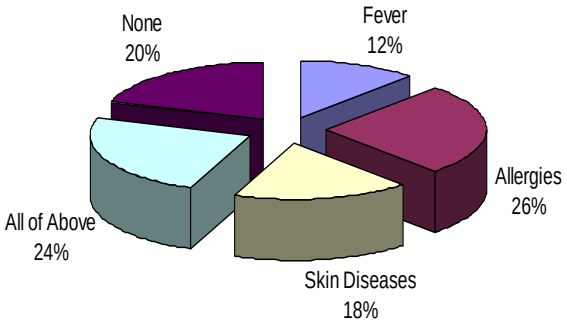

Fig. 12. Diseases caused by solid waste in study area of Bahawalpur

Previously, few studies also point out the problems related to environmental and health risks caused by open dumping of solid waste. As it is concluded in a study conducted in five major slums of Bahawalpur City that, lack of proper solid waste

disposal creating many environmental and health issues for slum dwellers (Noor et al., 2014). Another study also analysed that children and adults are mostly affected by the bad conditions of solid waste and other environmental problems and thus they perpetually registered their complaints in TMA (Arshad et al., 2013). Additionally, many of them were also suffering from different types of skin allergies. Mostly children and aged residents were suffering from these diseases (i.e. Malaria, typhoid fever) as they are more susceptible to environmental pollution than adults.

Table 2 shows the results of dumping method versus health problems. The chi-square value of 7.736 with confidence interval of .025 demonstrates a strong association between open dumping of solid waste and health related problems. Solid waste is usually dumped openly in vacant plots/ open spaces or in thrown in streets (Fig 8 and 9).

4. Conclusion

Safe and secure disposal of solid waste is now becoming a global issue for most of developing countries. A similar situation prevails in Bahawalpur City. The study explored the solid waste management practices and their impacts on the local environment and public health in Model Town C of Bahawalpur City (Pakistan). Most of the solid waste was generated at household level and consisted mostly of organic waste, plastics and polythene bags. The management of solid waste in study area was not satisfactory because most of the generated solid waste thrown out in the nearby vacant plots or in streets openly. Although, the collection and disposal of solid waste was the main responsibility of TMA and subsequently BWMC but only 40% of the solid waste was collected in the town. The residents were also not satisfied with the solid waste management system currently in place. It was concluded that the current solid waste management system impacts adversely on the environment and creates opportunities for health risks for the community. The average and chi-square results also verified that there is strong relation found between poor dumping methods and environmental and health problems with high significance values.

5. Suggestions

It was suggested that: There is need to Initiate Public-Private Partnership (PPP) in solid waste management to improve the provision of the service to the community. Managerial authorities need to adopt international standards for the sustainable disposal of solid waste and garbage especially three R (reduce, reuse and recycle) should be follow. Legislative bodies should pass and implement strictly effective legislation and regulations towards safe disposal of sewage, solid and hazardous waste.

The Environmental Protection Agency (EPA) and allied departments should ensure higher treatment coverage, underlining efficient collection and disposal of solid waste from households, commercial and industrial units. TMA, BWMC and municipal authority needs to place waste bins and street containers on nearby dwellings for the ease access to collect solid waste from residents. Responsible authorities must allocate more financial resources towards solid waste management.

Better utilization of aiding and funding sources and encouraging internal investment towards water, sanitation and solid waste management should be done. Residents need to increase environmental awareness. Usage of modern machinery and equipments for safe and convenient disposal of solid waste should practice.

Acknowledgements: The authors are thankful to the residents of the study area and other supporting sources like TMA, BWMC. Without their support in the field current study would be not possible.

Competing Interests: The authors declare that there is no potential conflict of interest.

References

Abedullah. 2006. Sources and consequences of environmental pollution and institutions role in Pakistan. J. App. Sci. 6: 3134-3139.

Abel, A. 2007. An analysis of solid waste generation in a traditional African city: the example of Ogbomoso, Nigeria. Environ. Urb. 19: 527-537.

Aglanu, L.M. and D.O. Appiah. 2014. The Korle Lagoon in Distress: The stress of urban solid waste on water bodies in Accra, Ghana. Int. J. Inn. App. Stud. 7(2): 717-728.

Akaateba, M.A. and I. Yakubu, 2013. Householders' satisfaction towards solid waste collection services of Zoomlion Ghana Ltd in Wa, Ghana. Euro. Sci. J. 9: 198-213.

Alam, P. and K. Ahmade. 2013. Impact of solid waste on health and the environment. Int. J. Sustain. Dev. Green Eco. 2:165-168.

Alhassan, M. and J. Mohammed. 2013. Households' demand for better solid waste disposal services: Case study of four communities in the New Juaben Municipality, Ghana. J. Sustain. Dev. 6:16-25.

Aljaradin, M., K.M. Persson and E. Sood. 2015. The role of informal sector in waste management, A case study; Tafila-Jordan. Resour. Environ. 5:9-14.

Al-Khatib, I.A. and H.A. Arafat. 2010. A review of residential solid waste management in the Occupied Palestinian Territory: A window for improvement? Waste Manage. Res. 28: 481-488.

Al-Khatib, I.A., M. Monou, A. Salam, A. Zahra, H.Q. Shaheen and D. Kassinos. 2010. Solid waste characterization, quantification and management practices in developing countries. A case study: Nablus District – Palestine. J. Environ. Manage. 91:1131-1138.

Altaf, M.A. and J.R. Deshazo. 1996. Household Demand for Improved Solid Waste Management: A Case Study of Gujranwala, Pakistan. World Develop. 24:857-868.

Anjum, R. 2013. Willingness to pay for solid waste management services: A case study of Islamabad. CEECC Working Paper No. 3. Pakistan Institute of Development Economics (PIDE), Islamabad, Pakistan.

Arshad, S., A. Shafqat, A.A. Khan and Q. Safdar. 2013. Youth environmental complaints in Bahawalpur City, Pakistan: An informational intervention for local environmental governance. Human Geographies: J. Stud. Res. Human Geog. 7: 71-80.

Asian Development Bank (ADB), Institute for Global Environmental Strategies (IGES), United Nations Environment Programme (UNEP), 2006. Promoting Reduce, Reuse, and Recycle in South Asia. Synthesis Report of 3R South Asia Expert Workshop Kathmandu, Nepal, 30 August -1 September 2006.

Awomeso, J.A., A.M. Taiwo, A.M. Gbadebo and A.O. Arimoro. 2010. Waste disposal and pollution management in urban areas: A workable remedy for the environment in developing countries. Am. J. Environ. Sci. 6: 26-32.

Bandara, N.J.G., J.P.A. Hettiaratchi, S.C. Wirasinghe and S. Pilapiiya. 2007. Relation of waste generation and composition to socio-economic factors: A case study. Environ. Mon. Assess. 135: 31-39.

Boadi, K.O. and M. Kuitunen. 2002. Urban waste pollution in the Korle Lagoon, Accra, Ghana. Environmentalist. 22(4): 301-309.

Bolyard, S.C., and D.R. Reinhart. 2016. Application of landfill treatment approaches for stabilization of municipal solid waste. Waste Manage. 55: 22-30.

Botkin, D.B. and E.A. Keller. 2011. Environmental Science: Earth as Living Planet (8th Ed.). John Wiley & Sons, Inc.

Brennan, E.M. 1999. Population, Urbanization, Environment, and Security: A Summary of the Issues. Environmental Change & Security Project Report. 5: 4-14.

BWMC. 2015. Company Profile. Bahawalpur Waste Management Company (BWMC), Retrieved from http://www.bwmc.com.pk/cu.html on October 31, 2015.

Chithra, K., P.P. Anilkumar and M.A. Naseer. 2016. Municipal solid waste management, a major impacted sector of urban environment due to residential land use activities- Study of Kozhikode City. Procedia Environ. Sci. 35: 110-118.

Coad, A. 2011. Collection of Municipal Solid Waste: Key issues for Decision-makers in Developing Countries. United Nations Human Settlements Programme (UN-HABITATE), Nairobi, Kenya.

Dunfa, K.D. and T.V. Krishna. 2013. Environmental impact assessment: A study on status of solid waste in Addis Ababa, Ethopia. Asian J. Res. in Soc. Sci. Hum. 3: 137-147.

EPD (Environment Protection Department). 2015. Solid Waste. Environment Protection Department, Government of the Punjab, Lahore. Retrieved from http://epd.punjab.gov.pk/solid_waste on 8 Nov. 2015.

Ezebilo, E.E. and D.E. Animasaun. 2011. Households' perceptions of private sector municipal solid waste management services: A binary choice analysis. Int. J. Environ. Sci. Tech. 8: 677-686.

Festus, M.O. and O.B. Ogoegbunam. 2012. Imperatives of environmental education and awareness creation to solid waste management in Nigeria. Acad. Res. Int. 3: 253-258.

Fudala-Ksiazek, S., M. Pierpaoli, E. Kulbat and A. Luczkiewicz. 2016. A modern solid waste management strategy – the generation of new by-products. Waste Manage. 49: 516-529.

Gillespie, T. 2016. Accumulation by urban dispossession: Struggle over urban space in Accra, Ghana. Trans. Inst. Br. Geogr. 41(1): 66-77.

Govt. of Punjab. 2014. Punjab Development Statistics 2014. Bureau of Statistics, Government of the Punjab, Lahore.

Guerrero, L.A., G. Maas and W. Hogland. 2013. Solid waste management challenges for cities in developing countries. Waste Manage. 33: 220-232.

Halla, F. and B. Majani. 1999. Innovative ways for solid waste management in Dar-Es-Salaam: Toward stakeholder partnerships. Habitat Int. 23: 351-361.

Hamer, G. 2003. Solid waste treatment and disposal: Effects on public health and environmental safety. Biotechnol. Adv. 22(1–2): 71-79.

Han, Z., H. Ma, G. Shi, L. He, L. Wei and Q. Shi. 2016. A review of groundwater contamination near municipal solid waste landfill sites in China. Sci. Total Environ. 569–570: 1255-1264.

Haryono, 2015. The Identification of city solid waste management based on the active participation of families and trash pickers. Acad. Res. Int. 6: 177-184.

Jadoon, A., S.A. Batool and M.N. Chaudhry. 2014. Assessment of factors affecting household solid waste generation and its composition in Gulberg Town, Lahore, Pakistan. J. Mater. Cycles Waste Manage. 16: 73-81.

Jaunich, M.K., J.W. Levis, J.F. DeCarolis, E.V. Gaston, M.A. Barlaz, S.L. Bartelt-Hunt, E.G. Jones, L. Hauser and R. Jaikumar. 2016. Characterization of municipal solid waste collection operations. Resour. Conserv. Recy. 114: 92-102.

Khan, A.A., M. Fatima and K. Khan. 2014. Spatial Analysis of Environmental Health Risks: A Case of Bahawalpur District, Pakistan. Pakistan J. Comm. Soc. Sci. 8: 238-257.

Kjeldsen, P., M.A. Barlaz, A.P. Rooker, A. Baun, A. Ledin and T.H. Christensen. 2002. Present and Long-Term Composition of MSW Landfill Leachate: A Review. Crit. Rev. Environ. Sci. Technol. 32(4): 297-336.

Kolekar, K.A., T. Hazra and S.N. Chakrabarty. 2016. A review on prediction of municipal solid waste generation models. Proc. Environ. Sci. 35: 238-244.

Laner, D., M. Crest, H. Scharff, J.W.F. Morris and M.A. Barlaz. 2012. A review of approaches for the long-term management of municipal solid waste landfills. Waste Manage. 32(3): 498-512.

Lee, C.K.M., C.L. Yeung, Z.R. Xiong and S.H. Chung. 2016. A mathematical model for municipal solid waste management – A case study in Hong Kong. Waste Manage. 58: 430-441.

Longe, E.O., O.O. Longe and E.F. Ukpebor. 2009. People's perception on household solid waste management in Ojo Local Government Area in Nigeria. Iranian J. Environ. Health Sci. Eng. 6: 201-208.

Mahar, A., R.N. Malik, A. Qadir, T. Ahmed, Z. Khan and M.A. Khan. 2007. Review and Analysis of Current Solid Waste Management Situation in Urban Areas of Pakistan. In: Proceedings of the International Conference on Sustainable Solid Waste Management, 5–7 September 2007, Chennai, India, p.34–41.

Marshall, R.E. and K. Farahbakhsh. 2013. Systems approaches to integrated solid waste management in developing countries. Waste Manage. 33(4): 988-1003.

Masood, M., C.Y. Barlow and D.C. Wilson. 2014. An assessment of the current municipal solid waste management system in Lahore, Pakistan. Waste Manage. Res. 32: 834-847.

Memon, M.A. 2010. Integrated solid waste management based on the 3R approach. J. Mater. Cycles Waste Manage. 12(1): 30-40.

Mohsin, M., M.M. Anwar and M.J. Iqbal. 2016. Practice and conditions of solid waste management in Ahmedpur East, Bahawalpur, Pakistan: A way forward. Sindh Univ. Res. J. 48: 95-100.

Muhammad, M.N. and H.I. Manu. 2013. Gender roles in informal solid waste management in cities of Northern Nigeria: A case study of Kaduna Metropolis. Acad. Res. Int. 4: 142-153.

Mukherjee, S., S. Mukhopadhyay, M.A. Hashim and B. Sen Gupta. 2015. Contemporary Environmental Issues of Landfill Leachate: Assessment and Remedies. Crit. Rev. Environ. Sci. Technol. 45(5): 472-590.

Najam, S., R. Nawaz, S. Ahmad, N. Ehsan, M.M. Khan and M.H. Nawaz. 2015. Heavy metals contamination of soils and vegetables irrigated with municipal wastewater: A case study of Faisalabad, Pakistan. J. Environ. Agric. Sci. 4: 6-10.

Noor, S., M. Fatima and S. Sehrish, 2014. Unsustainable environment and prevalence of diseases in urban slums: A case of Bahawalpur, Pakistan. Int. Res. J. Environ. Sci. 3: 74-82.

Ogunyanwo, O.O. and A.A. Soyingbe. 2014. Determinants of solid waste collection and disposal: Differentials of high and low density areas of Sango – Ota Metropolis. Int. J. Dev. Res. 4: 2005-2009.

Ojelade, I.A. and B.G. Aregbesola. 2014. Environmental sustainable development: Focusing on solid waste reduction in Nyanya and Environ of Abuja, Nigeria. Adv. Soc. Sci. Res. J. 1: 126-131.

Ojok, J., M.K. Koech, M. Tole and J. Okot-Okumu. 2013. Households' willingness to pay for improved municipal solid waste management services in Kampala, Uganda. Sci. J. Environ. Eng. Res. 2013:sjeer-143.

Oteng-Ababio, M. 2012. The role of the informal sector in solid waste management in the GAMA, Ghana: Challenges and opportunities. Tijdschrift voor economische en sociale geografie. 103(4): 412-425.

Ozcan, H., S. Guvenc, L. Guvenc and G. Demir. 2016. Municipal solid waste characterization according to different income levels: A case study. Sustainability. 8(10): 1044.

Pires, A., G. Martinho and N.-B. Chang. 2011. Solid waste management in European countries: A review of systems analysis techniques. J. Environ. Manage. 92(4): 1033-1050.

Ready, R.C. 2005. Do Landfills Always Depress Nearby Property Values? Rural Development Paper No. 27, The Northeast Regional Center for Rural Development, The Pennsylvania State University, PA, USA. Retrieved from http://aese.psu.edu/nercrd/publications/rdp/rdp27.pdf on October 31, 2015.

Saeid, N., A. Roudbari and K. Yaghmaeian. 2014. Design and implementation of integrated solid wastes management pattern in industrial zones, case study of Shahroud, Iranian J. Environ. Health Sci. Eng. 12: 1-7.

Samuel, O.O. 2015. Socio-economic correlates of household solid waste generation: Evidence from Lagos Metropolis, Nigeria. Manage. Res. Prac. 7: 44-54.

Shafqat, A., S. Noor and M. Fatima. 2014. Practices and challenges of municipal solid waste management in Bahawalpur City, Pakistan. J. Sustain. Sci. Manage. 9: 90-98.

Sharholy, M., K. Ahmad, G. Mahmood and R.C. Trivedi. 2008. Municipal solid waste management in Indian cities: A review. Waste Manage. 28(2): 459-467.

Taylor, R.G. and A. Allen. 2006. Waste disposal and landfill: Information needs. In: Schmoll, O., Howard, G., Chilton, J., Chorus, I. (Eds.), Protecting Groundwater for Health: Managing the Quality of Drinking-water Sources. IWA, London.

The Urban Unit. 2011. Bahawalpur City Profile. The Urban Unit, P&D Department, Govt. of Punjab, Lahore, Pakistan. Retrieved from http://www.urbanunit.gov.pk/PublicationDocs/Punjab%20city%20profiles/Bahawalpur%20City%20Profile.pdf on January 07, 2014.

Visvanathan, C. and U. Glawe. 2006. Domestic Solid Waste Management in South Asian Countries – A Comparative Analysis. In: 3 R South Asia Expert Workshop, 30 August - 1 September 2006, Kathmandu, Nepal, p. 1-14.

Wokekoro, E. and L. Uruesheyi. 2014. The Impact of open waste dumps on rental values of residential properties in Port Harcourt, Nigeria. Int. J. Sci. Res. 3: 226-230.

Zhang, D.Q., S.K. Tan and R.M. Gersberg. 2010. Municipal solid waste management in China: Status, problems and challenges. J. Environ. Manage. 91(8): 1623-1633.

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 Environment (SCOPE) Urban Solid Waste Management Review Session, Durban, South Africa, November,p.1-13.