



Assessment of solid waste generation and disposal in urban areas of Pakistan: A case study of District Dir Lower

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Abstract

Solid waste management (SWM) is the main issue in the Pakistan because before the disposal the solid waste (SW) is not segregate properly. The study has been conducted to show the (SWM) in the study area Dir Lower. Mostly (SW) is produce in the cities and also lack of proper management system such handling, storage, transportation and disposal. District Dir lower lies in mountainous region in Khyber Pakhtunkhwa Pakistan. Currently there is no proper landfill area for (SW) disposal. Respectively the (SW) were thrown in stream and bank of the river which consider the best landfill site for the (SW). The study was also conducted in Dir Lower to investigate the present status, quantity, sources, generation rate, collection and disposal of household solid waste (HSW). For this purpose, a total 300 questionnaires were randomly distributed in the cities area of Dir Lower such as Timergara, Chakdara, Samar Bagh, Khall, Munda and Kombar. The (SW) collection authority Tehsil Municipal Administration (TMA) also reported that we have no proper mechanism and technologies for (HSW) management. Currently the (HSW) is dumping in open dump sites and causes many environmental problems and health risks in the study area. Therefore, it is important for the government to play its role by providing capital, proper technology, etc. and to collect the (HSW) at daily basis, for sustainable (SWM) to reduce the burden of over activities on environment and health risk.

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Introduction

The urban environment is deteriorating daily due to the mismanagement of household solid waste in South Asian countries such as Afghanistan, Pakistan, India and Bangladesh (Ghaforzai *et al.*, 2021). This is especially serious in developing countries that need the necessary infrastructure for proper waste collection and disposal activities (Jadoon *et al.*, 2014). Solid waste contains a large number of recyclable and degradable waste such as municipal, agricultural, and hospital waste (Gowda *et al.*, 1995). Throughout the world industrial development and urbanization is the main sources of solid waste. Urban areas generating a large amount of waste and are expected to reach 1.25 million metric tons/day, up from 3.5 million in 2020. And a total of 375\$ will be used for waste management by 2025 (World Bank, 2012).

Due to the rapid increase in economic growth, population, and urbanization can raise the consumption of different resources. Subsequently, a large amount of solid waste going to the environment (Singh *et al.*, 2014). It has become a very challenging issue to sustain the standard pattern of life. Moreover, the day-to-day urban environment is depreciating because of the mismanagement of household solid waste (HSW) (Ali *et al.*, 2012). Management of solid waste is the main issue in developing countries in near future (Saeed *et al.*, 2009). Different plans are used in a developed country for MSW, to produce electricity. For this purpose, technology is most commonly using such as pyrolysis, gasification, and incineration. This method of disposal of solid waste generates hydrogen and methane and is mostly used to get energy from solid waste (Ryu, 2010). In developing who have a poor waste management system and peoples are directly linked to their food and other waste collectors are exposes to infectious diseases (Ali *et al.*, 2017).

Every day each person generated 0.74 kg of solid waste throughout the world. Globally annual waste production ratio was reached 2.01 billion tonnes and 33% of solid waste is not properly managed. Mismanagement of solid waste leads to different

problems such as disturb the water quality, air quality, disease transmission. Commonly solid waste reduce with the help of four activities that are handling, collection of waste, transportation, and disposal (Eisted *et al.*, 2009). During the construction different types of construction waste produced. It is estimated that more the 10 billion of constructed waste are generated from which European Union involve 800 million tons and the United State generates 700 million every year (Ajayi *et al.*, 2016). Greenhouse gases are emitted from the landfill area which leads to global warming. From landfill sites, the major greenhouse gas is methane (Tian *et al.*, 2013). Municipal solid waste (MSW) received 118 million metric tons of solid waste and there were 657 landfill sites in china (NBSC, 2017). Waste collection and disposal is the main problem, particularly in Srilanka. Due to the development in the city area the waste generations are increasing day by day. The struggle is going to control the problem of disposal in the city area (Wijetunga, 2012).

In South Asia, Pakistan is considering a fast urbanizing country (Ali *et al.*, 2019). In the world Pakistan is the sixth-largest country based on population and, hence Karachi is the biggest and most populous country of Pakistan (PBS, 2018). This is estimated that the population of Pakistan will cross 363 million in 2050. The population of Pakistan is rapidly increasing and different problems are associated with the increasing population. The main problem is poor SWM which leads to environmental pollution in Pakistan. Environmental pollution produces different types of health-related issues due to the malpractice of municipal solid waste (Arshad *et al.*, 2018). At present, about 30 percent of municipalities in Pakistan ate managed by government services (Economic Survey Pakistan 2014-15). In Pakistan, there is no proper management of solid waste such as handling, collection, transportation, and disposal. It is stated by the Ministry of Environment Pakistan, that the solid waste generation capacities are more than 54,850 tons per day and less than 50% of the collection rate in the city area (Ejaz and Janjoua, 2012).

There is no engineering landfill in any city and no other waste to energy plant is working successfully (Safar *et al.*, 2016). Per capita, per annum, solid municipal waste generated in Pakistan is 2.4% which is 0.283 kg to 0.612 kg per capita daily (EPD, 2019).

Landfill is the final stage of solid waste management (Weitz *et al.*, 1999). According to researchers waste pickers are those who search the waste for their food and useable substances. In Karachi waste are collected with the direct of peoples who have no proper protective equipment and have more health risk. Karachi is the largest city in Pakistan which produces 9000 tons of solid waste per day (Iqbal, 2019), Such cities include Lahore, the provincial capital of the country's political and economic center. But the city still lacks adequate waste management facilities, making the disposal of its 6,000 tons of waste a day a serious epidemic and environmental concern (Kamran *et al.*, 2015). In Lahore, the waste management Company produces 500 to 700 tons/day of composting waste and other fuel-derived waste (Nasrullah *et al.*, 2014).

Due to the population explosion main issue is solid waste management because the Northern area having no area for the disposal of solid waste. Timergara, Khall, Samer Bagh, Komber, Munda, and Chakdara are the cities area of Dir Lower and there is the main problem is the land landfill site. The present study measured the level of solid waste generation and its composition as well as to measure the ratio of recycling level in the study area. In these areas, the solid waste disposal point is near the river and most the peoples have thrown the solid waste in the water channel or river, which produce a different health-related issue for all living organism.

Materials and methods

The Study Area

Fig. 1. show the selected cities in the study area. Lower Dir District is a district in the Malakand Division of Khyber Pakhtunkhwa province in Pakistan. Timergara city is the district headquarter and largest city, while the other large cities are

Chakdara, Munda, Samar Bagh, Khall, and Kumbar. Dir has a total area of about 1583 square kilometers (157800 hectares). The total cultivated area is 59755 hectares, forest covers a total of 5812 hectares, 1114 hectares are covered by a river and 10808 hectares are covered by herbs and shrubs. 5812 hectares and others used for other purposes. According to the census of 2017, the total population of the urban area was 40373 and the rural population was 1395544. The District borders with Swat District on its East, Afghanistan on its West, Upper Dir and Chitral on its North & north-west respectively, and Malakand and Bajaur Agency on its South.

Criteria for sample collection

District Dir lower is the mountainous region of Pakistan. The main city area of district Dir lower is Timergara, Khall, Chakdara, Samer Bagh, Munda, and Kumbar. Near the city, there were no proper places for the disposal of solid waste, and most effective the water body and agricultural land in the study area.

Methods of data Collection

In the present study, the data collected both from the secondary record through content analysis and primary data through various qualitative and quantitative methods.

Quantitative Data Collection

The quantitative data collected using the following techniques.

Household survey

In the present study, we selected the urban area of the study area for data collection The study area was divided into six strata because each was consider cities area of Dir Lower such as Timergara, Khall, Chakdara, Munda, Samer Bagh, and Kumbar. From each stratum 50 respondents were interview and a questionnaire survey was conducted using questions. Detailed information present in the questionnaire to collect information from the local people. The questionnaire was randomly distributed in the selected study area and it contains both open and close-ended questions to collect information about solid waste management in the Northern area of Pakistan.

Focus Group Discussion

Besides the interview schedule for collecting the quantitative data, the researcher used FGDs. The researcher developed an FGD guide to discuss and collect the data. The FGD consist of various themes including the collection, transportation, and proper disposal in the study area. The factors which affect the level of solid waste management and related problem. In FGD the perception of the people identified solid waste management and the coping strategies of the local community. Personal interviews are properly also planned. Different NGOs are also approached to get relevant information and their interventions.

Criteria for Focus Group Discussion

In the current approach, only those members participating in FGD who have been residing in the study area. Various categories of members including in the FGD i.e. teachers, political leaders, religious leaders, traditional leaders, farmers, joint TMA committee members, and members from local Government and district administration. Among the other stakeholder other members participating from the Forest department, wildlife department, fishery department, Irrigation, Agriculture, and some NGO.

Interview in the study area

The researcher conducted key informative interviews with the various stakeholders including community elders, government servants, local people, and youth. The researcher focused on questions about solid waste management conditions in the commercial area. Further, they interviewed about the landfill area of the solid waste and various changes in the environment. Perception of the people measured about the solid waste which affect the physical, chemical, and biological environment and also effect on the crops production as well as the population of fishes.

Field Observation

Besides the above quantitative and qualitative approach a detailed and continuous field observation takes place. The researcher spend time in the commercial area and observed their solid waste management condition in the study area.

The researcher observed the nature of solid waste such as recyclable and non-recyclable. This secondary data used for the analysis of the solid waste condition of the local people in the study area. During the field observation snapshot were taken which is shown in Fig. 2. and Fig. 3.

Statistical analysis

Solid waste and social surveys data were analyzed through Origin Pro 2019, MS Excel and SPSS which statistical analysis was conducted.

Results

Household waste generation in major cities

Fig. 2. Show the household waste composition and storage methods in the city area of Dir Lower. Different types of waste were generated such as organic, plastic, and paper. Respectively the organic waste generation was more as compared to other waste. Organic or kitchen, paper, plastic, and other were 46, 14, 28, and 16% of waste generation capacity of solid waste in Timergara. Respectively, waste generation in Chakdara was organic or kitchen, paper, plastic, and other were 41, 20, 26, and 12%. In the city area of Munda the solid waste generation percentage was 38, 24, 30, and 8%. In Samar Bagh organic or kitchen, paper, plastic, and other waste was in 70, 20, 30, and 10%. Correspondingly, Organic or kitchen, paper, and other waste generation capacity in Khall were 36, 26, 30, and 6% and Kombar the percentage was 52, 16, 28, and 4% of the solid waste generation capacity during the household survey.

Waste storage methods in the study area

Fig. 2. shows various different methods for waste storage such as closed containers, open containers, plastic bags, and piles in the yard were used for the storage of solid waste in the city area of Dir lower. For waste storage, were 16, 20, 28, and 36% used in the Timergara. Respectively, in Chakdara 26, 20, 8, and 46% used for waste storage. In the city area of Samar Bagh, the waste storages were 18,30,16 and 36% while in Khall the percentage of storage were 24, 34, 12, and 30. In the city of Kombar closed container, open container plastic bags, and piles yard which was used for solid waste storage was 16, 24, 10, and 50%.

Waste disposal methods

The different methods were used for the disposal of household solid waste in the city area of district Dir lower shown in Fig. 3. In the city area of Timergara different methods were used such as burn, bury, dump on road/street, communal container, recycle, reuse and compost were in 12, 4, 16, 28, 6, 14, and 24%. Respectively, in the Chakdara disposal of the household waste method were used such as burn, bury, dump on the road/street, communal containers, recycle, reuse and compost were in 14, 2, 30, 14, 8, 4, and 26. In the cities area of Munda and Samar Bagh, different methods were used for disposal of household waste in a different proportion such as 14, 2, 30, 14, 8, 4, 26 and 12, 6, 22, 20, 12, 8, 4, 24. Respectively, in the city area of Khall waste disposal in the household was with different percentage burn, bury, dump on road/street, communal container, recycle, reuse and compost were in the 8, 12, 18, 26, 8, 4, and 24%. Commonly, the most used method for a household in the city area of Kombar was to burn, bury, dump on road/street, communal container, recycle, reuse and compost 10, 6, 14, 28, 14, 6, and 22%.

Waste disposal in Chakdara city

People in the Dir lower were used different methods to get rid of household waste. In Dir lower Chakdara is consider a city area and different types of waste are generated such as food waste, yard trimming, paper cardboard, plastic, metal, and glass. The respondents used different methods to get rid of solid waste such as burn, bury, dump on the street, communal containers, recycle, reuse, and composting. In Chakdara burning of household waste to get rid of waste disposal such as yard timing, paper cardboard and plastic were burned on 6, 20, and 14%. Respectively food waste, paper Cardboard, plastic, metal, and glass buried in 4, 4, 6, 2, and 6% in Chakdara and food waste 20%, yard trimming, paper cardboard, plastic, metal, and glass were 24, 26,30,16, and 18% of the solid waste dump on road/street is the city of Dir Lower. Communal container received food waste, yard trimming, paper cardboard, plastic, metal, and glass were 24, 30, 24, 20,12, and 34% and yard trimming, paper cardboard, plastic, metal, and

glass were 2, 6, 4, 46, and 4% recycled in the city area of the chakdara. Food waste yard trimming, paper cardboard, plastic, metal, and glass were 14, 6, 10, 4 12, and 14% were reuse and Food waste yard timing, paper cardboard, plastic, metal, and glass were 40, 26, 14, 22, 12, and 24 were composting in the city area of the Chakdara.

Waste disposal in Timergara city

Timergara is the capital of district Dir lower and different were used by the local community to get rid of household waste which is shown in Fig. 4. In Timergara yard trimming, paper cardboard, and plastic disposal percentage were 10, 20 and 12% were burn in the study area. Only 6% of paper cardboard were buried to get rid of household waste and some of the peoples dump the solid waste on road/street for their disposals such as food waste, yard trimming, paper cardboard, plastic, metal, and glass were 30, 26, 10, 10, 14, and 20%. Communal containers were used for food waste, yard trimming, paper cardboard, plastic, metal, and glass were 30, 38, 16, 12, 6, and 26% in the study area. In paper cardboard, plastic, metal, and glass were 48, 26, 64, and 18% of the solid waste were recycle in the city area of Timergara. In the study area yard trimming, plastic, metal, and glass were 6, 28, 6, and 26% recycled. The food waste, yard trimming, paper cardboard, plastic, metal, and glass were 30, 26, 26, 12, 10, and 10 of the solid were composting in the study area.

Waste disposal in Kombar city

Fig. 4. shows people in the Dir lower (Kombar) were used different methods to get rid of household waste. In Kombar the city of Dir lower to burn the solid waste such as yard trimming, paper cardboard, and plastic were 6, 14, and 8% to get rid of household waste. Respectively, yard trimming, paper cardboard, plastic, metal, and glass were 10, 6, 4, and 10% were buried in the study area. Commonly, were 20, 22, 18, 26, 8, and 24% were dump on road/street and food waste, yard trimming, paper cardboard, plastic, metal, and glass were 30, 26, 16, 14, 12, and 28% were disposal of solid waste in the communal container in Kombar area.

The recycled solid waste was yard trimming, paper cardboard, plastic, metal, and glass were 6, 22, 12, 54, and 14%. Food waste, yard trimming, paper cardboard, plastic, metal, and glass were 20, 12, 14, 8, 16, and 10% were reused in the study area of Dir lower. Respectively, the composting material was food waste, yard trimming, paper cardboard, plastic, metal, and glass were 50, 18, 16, 28, 10, and 14% in Kombar Bazar.

Waste disposal in Munda city

Fig. 5. shows the people of Dir lower (Munda) were used different methods to get rid of household waste. In the study area the solid waste such as yard timing, paper cardboard, and plastic was 14, 30, and 4% of the household waste burned and food waste, yard trimming, paper cardboard, plastic, and glass were 4, 2, 6, and 8% were buried. Food waste, yard timing, paper cardboard, plastic, metal, and glass were 26, 18, 8, 26, 10, and 18% waste disposable in a dump on road/street. Respectively, communal containers were used to dispose of the food waste, yard trimming, paper cardboard, plastic, metal, and glass were 20, 18, 10, 20, 8, and 24% in the study area. Commonly, recycling solid waste was paper cardboard, plastic, metal, and glass were in the 20, 16, 70, and 10%. In the study area food waste, yard trimming, paper cardboard, plastic, metal, and glass were 8, 6, 8, 10, 12, and 14% reuse which were produced in daily routine. Most of the solid waste such as food waste, yard trimming, paper cardboard, plastic, metal, and glass were 42, 54, 18, 24, 4, and 26% were composting in the study area.

Waste disposal in Samar Bagh city

Fig. 5. shows people in the Dir lower (Samar Bagh) were used different methods to get rid of household waste. In the study area paper cardboard, plastic was 16, and 14% of waste burned to get rid of solid waste. Commonly, yard trimming, paper cardboard, plastic, and glass were 10, 14, 4, and 4% were bury to dispose of the solid waste and food waste, yard timing, paper cardboard, plastic, metal, and glass were 24, 16, 10, 16, 6, and 20% of the solid waste disposed of in the dump on road/street. Respectively, food waste, yard

trimming, paper cardboard, plastic, metal, and glass were 22, 22, 18, 20, 14, and 30% were used communal containers for the disposal of solid waste in the study area. Yard trimming, paper cardboard, plastic, metal, and glass were 8, 20, 10, 60, and 6% of the solid waste were recycled. Commonly, in the study area food waste, yard trimming, paper cardboard, plastic, and metal were 16, 4, 6, 12, 10, 10, and 8% of the solid waste reuse in the Samar Bagh. Food waste, yard trimming, paper cardboard, plastic, metal, and glass were 40, 20, 16, 24, 12, and 32% of the people composting their solid waste in the study area.

Waste disposal in Khall city

Fig. 6. shows people in the Dir lower (Khall) were used different methods to get rid of household waste. In the study area yard trimming, paper/cardboard, and plastic were 10, 16, and 12% of waste burned to get rid of solid waste. Commonly, food waste, yard trimming, paper/ cardboard, plastic, and glass were 4, 2, 6, and 4% were bury to dispose of the solid waste and food waste, yard trimming, paper/cardboard, plastic, metal, and glass were 16, 26, 18, 20, 14, and 20% of the solid waste disposed of in the dump on road/street. Respectively, food waste, yard timing, paper/cardboard, plastic, metal, and glass were 28, 18, 26, 18, 10, and 30% were used communal containers for the disposal of solid waste in the study area. Paper/cardboard, plastic, metal, and glass were 4, 10, 50, and 4% of the solid waste were recycled. Commonly, in the study area food waste, yard trimming, paper cardboard, plastic, and metal were 20, 14, 12, 12, 10, and 10% of the solid waste reuse in the Samar Bagh. Food waste, yard trimming, paper cardboard, plastic, metal, and glass were 32, 30, 20, 26, 16, and 36% of the people compost their solid waste in the study area.

Perception of the peoples about SWM in Chakdara

The perception of the respondent District Dir lower (Chakdara) about solid waste was shown in Table 1. Different questions were asked by the respondent in the study area about solid waste management. About 64% of people were agreeing that the solid waste collection mechanism provides by the government.

Only 30% of peoples were agreed about the adequate solid waste collection facilities and 24% of the people were satisfied with the existing collection of solid waste. Respectively 32% of the respondents were satisfied with the existing transportation in the study area. Currently, 14% of peoples were paying for solid waste collection improvement, and consequently, 42% of the respondents were agreed willing to pay and dispose of solid waste. Only 16% of people were segregate solid waste before the disposal and 10% of respondents were agreed that the local municipality segregates waste before the disposal.

Table 1. Perception of the peoples about solid waste management in Chakdara.

Perception of the peoples about solid waste management	Yes	No
The waste mechanism provided by Govt. or private sector	64	36
Provide adequate solid waste collection facilities.	30	70
Are you satisfied with an existing collection of your solid waste?	24	76
Are you satisfied with the existing transportation of your solid waste?	32	68
Are you currently paying for your waste collection improvement?	14	86
Are you willing to pay for your solid waste collection improvement?	48	52
Are you willing to pay for your solid waste disposal?	42	58
Do you individually segregate your solid waste before disposal?	16	84
Does the local municipality segregate waste before disposal?	10	90

Perception of the peoples about SWM in Timergara

The perception of the respondent in District Dir lower (Timergara) about solid waste was shown in Table 2. Different questions were asked by the respondent in the study area about solid waste management. About 54% of people were agreeing that the solid waste collection mechanism provides by the government. Only 24% of peoples were agreed about the adequate solid waste collection facilities and 22% of the people were satisfied with the existing collection of solid waste. Respectively 38% of the respondents were satisfied with the existing transportation in the study area. Currently, 20% of peoples were paying for solid waste collection improvement, and consequently, 68% of the respondents were agreed willing to pay and dispose of solid waste. Respectively, 60% of the

respondent were willing to pay for your solid waste disposal. Individually only 18% of the respondents were segregate solid waste before the disposal and 14% of respondents were agreed that the local municipality segregates waste before the disposal.

Table 2. Perception of the peoples about solid waste management in Timergara.

Perception of the peoples about solid waste management	Yes	No
The waste mechanism provided by Govt. or private sector	54	46
Provide adequate solid waste collection facilities.	24	76
Are you satisfied with an existing collection of your solid waste?	22	78
Are you satisfied with the existing transportation of your solid waste?	38	62
Are you currently paying for your waste collection improvement?	20	80
Are you willing to pay for your solid waste collection improvement?	68	32
Are you willing to pay for your solid waste disposal?	60	40
Do you individually segregate your solid waste before disposal?	18	82
Does the local municipality segregate waste before disposal?	14	86

Perception of the peoples about SWM in Samar Bagh

Table 3. shown the perception of the respondents about the solid waste in the district Dir lower (Samar Bagh). Different questions were asked by the respondent in the study area about solid waste management. Commonly, 44% of people were agreeing that the solid waste collection mechanism provides by the government.

Respectively, 50% of peoples were agreed about the adequate solid waste collection facilities and 46% of the people were satisfied with the existing collection of solid waste. Respectively 42% of the respondents were satisfied with the existing transportation in the study area. Currently, 8% of peoples were paying for solid waste collection improvement, and consequently, 52% of the respondents were agreed willing to pay and dispose of solid waste. Commonly 58% of the respondent were willing to pay for solid waste collection improvement. Only 8% of people were individually segregate solid waste before the disposal and 14% of respondents were agreed that the local municipality segregates waste before the disposal.

Table 3. Perception of the peoples about solid waste management Samar Bagh.

Perception of the peoples about solid waste management	Yes	No
The waste mechanism provided by Govt. or private sector	44	76
Provide adequate solid waste collection facilities.	52	48
Are you satisfied with an existing collection of your solid waste?	46	54
Are you satisfied with the existing transportation of your solid waste?	42	58
Are you currently paying for your waste collection improvement?	8	92
Are you willing to pay for your solid waste collection improvement?	52	48
Are you willing to pay for your solid waste disposal?	58	42
Do you individually segregate your solid waste before disposal?	8	92
Does the local municipality segregate waste before disposal?	14	86

Perception of the peoples about SWM in Munda

The perception of the respondent about solid waste was shown in Table 4. Different questions were asked by the respondent in the study area about solid waste management. About 60% of people were agreeing that the solid waste collection mechanism provides by the government. Only 18% of peoples were agreed about the adequate solid waste collection facilities and 34% of the people were satisfied with the existing collection of solid waste.

Table 4. Perception of the peoples about solid waste management in Munda.

Perception of the peoples about solid waste management	Yes	No
The waste mechanism provided by Govt. or private sector	60	40
Provide adequate solid waste collection facilities.	18	82
Are you satisfied with an existing collection of your solid waste?	34	66
Are you satisfied with the existing transportation of your solid waste?	24	76
Are you currently paying for your waste collection improvement?	8	92
Are you willing to pay for your solid waste collection improvement?	24	76
Are you willing to pay for your solid waste disposal?	52	48
Do you individually segregate your solid waste before disposal?	10	90
Does the local municipality segregate waste before disposal?	20	80

Respectively 24% of the respondents were satisfied with the existing transportation in the study area. Currently, 8% of peoples were paying for solid waste collection improvement, and consequently, 24% of the respondents were paying for your waste collection improvement and 52% were willing to pay for your solid waste disposal.

Currently, in the study area, 10% of the respondent were segregate the solid waste before disposal. In the study area, 80% were not agreed that the municipality segregates the solid waste before the solid waste.

Perception of the peoples about SWM in Kombar

The area of Kombar district Dir lower was respondent about solid waste was shown in Table 5. Different questions were asked by the respondent in the study area about solid waste management. About 72% of people were agreeing that the solid waste collection mechanism provides by the government. Only 38% of peoples were agreed about the adequate solid waste collection facilities and 34% of the people were satisfied with the existing collection of solid waste. Respectively 18% of the respondents were satisfied with the existing transportation in the study area. Currently, 18% of peoples were paying for solid waste collection improvement, and consequently, 18% of the respondents were agreed willing to pay and dispose of solid waste and 86% of the respondent were willing to pay for your solid waste disposal. Currently, 14% of people were segregate solid waste before disposal and 8% of respondents were agreed that the local municipality segregates waste before the disposal of solid waste in the study area.

Perception of the peoples about SWM in Khall

The perception of the respondent about solid waste was shown in Table 6. Different questions were asked by the respondent in the study area about solid waste management. About 48% of people were agreeing that the solid waste collection mechanism provides by the government. Only 64% of peoples were agreed about the adequate solid waste collection facilities and 16% of the people were satisfied with the existing collection of solid waste. Respectively 58% of the respondents were satisfied with the existing transportation in the study area.

Table 5. Perception of the peoples about solid waste management Kombar.

Perception of the peoples about solid waste management	Yes	No
The waste mechanism provided by Govt. or private sector	72	28
Provide adequate solid waste collection facilities.	34	66
Are you satisfied with an existing collection of your solid waste?	38	62
Are you satisfied with the existing transportation of your solid waste?	18	82
Are you currently paying for your waste collection improvement?	18	82
Are you willing to pay for your solid waste collection improvement?	18	82
Are you willing to pay for your solid waste disposal?	68	32
Do you individually segregate your solid waste before disposal?	14	86
Does the local municipality segregate waste before disposal?	8	92

Table 6. Perception of the peoples about solid waste management Khall.

Perception of the peoples about solid waste management	Yes	No
The waste mechanism provided by Govt. or private sector	48	52
Provide adequate solid waste collection facilities.	64	36
Are you satisfied with an existing collection of your solid waste?	16	84
Are you satisfied with the existing transportation of your solid waste?	58	42
Are you currently paying for your waste collection improvement?	10	90
Are you willing to pay for your solid waste collection improvement?	78	22
Are you willing to pay for your solid waste disposal?	74	26
Do you individually segregate your solid waste before disposal?	94	6
Does the local municipality segregate waste before disposal?	16	84

Currently, 10% of peoples were paying for solid waste collection improvement, and consequently, 78% of the respondents were agreed willing to pay and dispose of solid waste and 74% of the respondent were willing to pay for your solid waste disposal in the study area (District Dir lower Khall). Only 94% of people were segregate solid waste before the disposal and 16% of respondents were agreed that the local municipality segregates waste before the disposal.

Discussion

Solid waste management is a main challenge for local government officials because SWM related problem is increasing day by day (Asrara *et al.*, 2016). Solid waste management is the main issue in developing countries such as Sari Lanka, India, and Pakistan. In Pakistan, there is no proper management of solid waste and peoples are direct through the waste which affects water, land, and air and roughly 20 million tons of physical waste is generated annually in Pakistan, with the annual growth rate of about 2.4% (Racheal, 2019).

Respectively in the study (Dir lower), the six regions consider the city area i-e Timergara, Chakdara, Munda, Samar Bagh, Khall, and Kombar, and these cities different types of solid waste were generated. The population of Dir lower were increasing day by day which increase the level of solid waste. Pakistan is rapidly urbanizing country in South Asia (Ali *et al.*, 2019). Dir lower is the mountainous region of Khyber Pakhtun Khwa and there is no proper landfill for the disposal of solid waste. Due to the lack of reduction, reuse, and recycling the waste material entered into a water body, agricultural land, and different types of greenhouse gases which affect the quality of the environment. Commonly, many communities in developing countries are still performing landfilling and open dumping was used to dispose of complete waste without prejudice (Wang *et al.*, 2009). The TMA finally dispose of the solid waste near or in the water channel which affects the water quality in district Dir lower. In the water channel, the solid waste was incinerated in all of the selected areas which also polluted the air quality. Due to less attention of government and miss behavior of peoples increase the solid waste in the study area. The urban environment is deteriorating daily due to the mismanagement of household solid waste. This is especially serious in developing countries that need the necessary infrastructure for proper waste collection and disposal activities (Jadoon *et al.*, 2014). Timergara is the capital of Dir lower and most of the solid waste was generated. According to the survey, most of the solid waste was organic/kitchen wastes were generated in the study area. In Timergara,

Chakdara, Munda, Samar Bagh, Khall, and Kombar the organic waste generation capacity were 46, 41, 38, 70, 36, and 52% because the organic/kitchen waste was used daily beside the kitchen waste the plastic waste generation capacity was high in amount. After the plastic paper waste was generated in the study area. According to the survey, different methods were used to store household waste. Most of the solid waste was used to pile to store solid waste in the study area. Karachi is the largest city of the country, which generates more than 9000 tons of physical waste daily (Iqbal, 2019). In Timergara, Chakdara, Munda, Samar Bagh, Khall, and Kombar were used pile in 46, 40, 36, 30, 30, and 50% to store the solid waste because the number of a dustbin, closed container, and open container were less in number and most of the peoples were not used to easily access to store the household waste. Despite of this, up to 31% to 49% waste lies haphazard in open areas, roads and streets in Pakistan, while various municipal authorities have the waste efficiency between 51 to 69% (Government of Pakistan, 2005). Respectively in the study area, a different method was used i-e burning, bury, dump on roads/streets, communal containers, recycling, reuse, and composting for the disposal of household garbage. In the study area there were no proper facilities for waste handling, storage, transportation and disposal.

Most of the respondents were used composting methods for the disposal of garbage. Commonly in the city area, there was no proper place for the disposal of solid waste. The solid waste is disposed of in the water channel. During the rainy season, the water washes the solid waste and enters a water body. The channel open dumping site, located in Hyderabad Sindh, the industrial and commercial city of Pakistan with a population of over 03 million, one of the major deposits of both domestic and industrial. These waste products are dumped in this dumping site untreated, posing environmental risks to life in the area directly or indirectly. Leachate is formed from the infiltration and passage of water through solid waste which results in a combination of physical, chemical and microbial processes that transfers pollutants from waste materials to the water (Peter *et al.*, 2002).

Most of the solid waste entered the river Punchkora and Sawat. The waste of Chakdara entered to river Sawat and the area of Timergara, Khall, Kombar, Samar Bagh, and Munda were entered into the river Punchkora. The composting rate is high in the study area i.e 28, 24, 26, 18, 24, and 22%. On an average basis, Pakistan MSW is characterized by a higher proportion of organic waste about 56% on wet weight basis (Farooq and kumar, 2013). Commonly different types of waste were generated i-e food waste, yard timing, paper/cardboard, plastic, metal, and glass. These heavy metals are discharging approximately 10,000-12,000 tons every year. Only, 30% of total discharged material is reprocessed and reused in storage condition (Giusti *et al.*, 2009).

To get rid of the solid waste i-e burning, bury, dumping on-road/streets, communal containers, recycling, reuse, and composition were commonly used to dispose of household waste in the study area. Metal and high-density plastic were recycling in the study area (Dir lower) In Chakdara 46% of metal was recycling because it's considered a valuable substance in the study area. Recyclable materials such as metal and plastic are segregated by home-owners and/or waste pickers and sold for revenue (Khan *et al.*, 2018). Paper cardboard was burning 20%, food waste was 40% on composting and 14% of food waste was reuse, which was used for the fodder of animals in Chakdara. Most household waste in Pakistan forms biodegradable wastes (Arshad *et al.*, 2018).

In Timergara the recycling was 64%, plastic was 28% reuse and yard timing was 38% dispose of the communal containers to get rid of the household waste. In Kombar, Munda, Samar Bagh, and Khall cities metal were 54, 70, 60, and 50% recycled. The high-density plastic was also recycling in the study area and some percentage of the solid waste was also burning. About 8% of plastic was burning in Kombar, in Munda 30% of the paper waste was burnt and Khall 16% of paper waste also burnt. Sometimes the respondent gets energy from the solid waste and in some places the solid waste burn to get rid of waste. whereas, MSW incineration contributed about 37% and other shared remaining 3% of MSW in 2016 according to same study.

The situation specifies the importance of MSW landfilling in China (Ali *et al.*, 2018). Finally, in the study area there is no proper landfill and processing system before the solid waste management. However, in developing countries a large number of communities are still practicing landfilling and open dumping for total waste disposal without any preprocessing (WANG *et al.*, 2009). Throughout the whole cities large open container were used for the collection of solid waste and the number of dustbin were less in number. In the study area the peoples were not used the container and dustbin in proper way which lead mismanagement and create different type of problem in the study area.

Conclusion

(HSW) produced at Dir Lower mainly founded the decomposable organic portion, mostly kitchen waste (>80%) though other constituents comprised yard trimming, paper, plastic and others. Approximately >70% of the people disposed the SW openly in streets or banks of water sources without any segregation. SW was not disposed appropriately, for example degradable waste was not decomposed biologically, paper was not collected for reprocessing, while plastic was burnt openly. Waste collection facility by TMA was not organized and day-to-day SW collection was only 15% from the households. Thus, causing rapid environmental and human health risks like water resources contamination, blockage of streams and sewers and spread different types of diseases. Furthermore, an amplified awareness programs in the study area is mandatory to stop scattering, burning and unlawful dumping of SW openly. Similarly also obligatory a daily base collection and proper organized mechanism with improved distribution of economic and technical resources as well as implementation of laws to manage SW and ban unlawful practices.

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