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Assessment of Status and Practices of Solid Waste Management in Chamba Town, Himachal Pradesh, India

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ABSTRACT

Municipal solid waste management has become a matter of dispute in today's society and requires utmost attention to be resolved.The current mechanism of waste management in the Chambatown is not efficient and has been under growing stress. The main purpose of the current research is to know the status of waste generation, characterization, disposal among other important determinants of waste management. Demographic data were used to find the patterns of waste generation of the public at large in the Chamba town. Further, the understanding, awareness, attitude towards the grim situation of waste management in the town was also explored among the public. The mean environmental score of the respondents was found to be 4.39 with a σ=1.9. The respondent willingness to pay for participating in market-based policy for improved waste management in their town was investigated. It was reported, an overwhelming proportion of respondents were in favor of paying a pre-determined amount on monthly basis to the concerned urban local body for better management of waste. The strategic town of Chamba holds many avenues of economic expansion which seemingly will pull the strings of the existing waste management system. The present study suggests that various management techniques such as bio-composting, gasification, waste-to wealth, waste-to-energy should be studied and explored in their context of feasibility in Himalayan ecosystem so that an Integrated Solid Waste Management (ISWM) strategy would better serve the need of the town. Various such management strategies should be explored for economic feasibility before being adopted for any practical results.

Keywords : Municipal solid waste, Environmental score, Willingness to pay, Waste management.

INTRODUCTION

The growing hysteria around the waste management around the globe is indicative of how uncontrollable the problem has become. More profound is the damage caused by the hazardous constituents of the Municipal Solid Waste (MSW) to the local environment (Bharti *et al.*,2014). In developing cities, unprofessional management of MSW is injurious to human health and triggering ecological, natural and economical losses (Kumar and Nandini 2013). The solid waste problem is often neglected or overlooked especially in developing countries like ours because it is thought to be resource exhaustive and non-productive. Scarcity of land for the management of tonnes

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of MSW being generated daily has further aggravated the seriousness of the waste problem (Afroz and Masud 2011). The cost for providing efficient MSW management services in under developed countries are too high (Hazra *et al.* 2013). This may be due to lack of proper infrastructure and high population growth. A more prevalent thought among the masses is that the general public is not responsible for the menace but the administrative authorities and local experts are to be held responsible for managing MSW.Sustainable and eco-friendly management techniques are required in order to judiciously manage our waste resources. The most important step in entire SWM chain is to collect the waste in segregated manner which further enhances its management options. In majority of countries, the responsibility to collect, transport and dispose off MSW lies with the respective Urban Local Bodies (ULB). But a reality check tells a different story that more often than not these ULB's fails to perform the very first and most important step of collecting segregated waste. Although a significant amount of money is spent by ULB's in developing nations for MSWM, the services provided are still not efficient (Henry et al. 2006). For maintaining public health and hygiene, an effective MSW management policy is timely required. However, lack of reliable data on volume and characteristics of MSW put together with poor planning, outdated infrastructure and out of place management practices are most significant drawbacks in designing an effective MSW management system.

Status of solid waste management in India

India, the world's second highest populated country after China with population of 1.21 billion (Census of India 2011) already containing 17.5% of the world's population, is a land of physical, climatic, geographic, ecological, social, cultural and linguistic diversity. High rate of population growth, declining opportunities in the rural areas and shift from stagnant and low paying agriculture sector to more paying urban occupations, largely contribute to urbanization. It is interesting to note that currently 1 out of every 3 person is living in urban area and it is projected that as much as 50% of India's population will live in cites in next 10 years (Khurshid and Sethuraman 2011). No doubt, India has achieved multifaceted socio-economic progress during last 70 years of its independence. However, in spite of heavy expenditure by Civic bodies, Management of MSW continues to remain one of the most neglected areas of urban development in India (Vij 2012). Though solid waste management is one of the basic essential services to be provided by municipal authorities in India, the present scenario provides rather a clumsy picture in terms of service delivery as evidenced by absence of adequate overall waste management mechanism (Lata and Dolma 2019). Present level of service in many urban areas is so low that there is a threat to the public health in particular and environmental quality in general (Supreme Court Committee Report 1999).

Generally, MSW in India consists of high percentage of biodegradables (40-60%), inert (30-60%), paper (3-6%) with other components such as plastics, metals making up not more than 1% (Rana *et al.* 2015, Rawat *et al.* 2013). The waste collection efficiencies metropolitan and tier-I cities vary between 70% to 90% and is less than 50% in tier-II and tier-III cities of which 90% is dumped in open (DoUD 2016). Several environmental concerns, such as emission of greenhouse gases, VOCs' and pollution through leachate seepage, are few among many caused by direct landfilling of MSW (El-Fadel *et al.* 1997).Several studies have been carried out in an Indian perspective on generation, collection and disposal techniques (Rana *et al.* 2015, Rana *et al.* 2017), MSW generation forecasting with population as variable (Das and Bhattacharyya 2014) and on characterization of MSW (Rawat *et al.* 2013). Various factors such as family size, education and awareness are generally linked to the quantity and composition of MSW generated especially in developing countries (Monavari *et al.* 2012).

Status of solid waste management in Himachal Pradesh

Geographically, the state covers an area of 55,673 km^2 area and hosts some picturesque valleys of the Himalayas'. Tourism and horticulture can be regarded as the mainstays of the state economy and livelihood activities. With only 54 urban agglomerations, Himachal Pradesh is one of the least urbanized state of India which only generates a 370 TPD of MSW as per

the state data, far less than any metropolitan cities. Whereas, a report by TERI on 'Urban waste management in Himachal Pradesh' estimated the MSW generation to be 304.3 TPD in 2011. Current annual MSW increase rate of 1-1.33% annually (Pappu *et. al.* 2007) and estimates for the urban population projections in the year 2021 shows that MSW generation will rise to 416 TPD (TERI 2015). The findings from previous study conducted by NEERI reports the waste characterization pattern as Biodegradable > Paper > Plastic > Textile >Inert >Glass >Rubber > Metal (DoUD 2015). Many waste disposal facilities in the state are not suitable for dumping purposes owing to their vicinity to the freshwater sources. Furthermore, the issue is more aggravated by the lack of land available for utilization as disposal site. Also, the hilly terrain of state poses certain distinctive difficulties of its own for the management of MSW due to scattered population, during the rough weather conditions and when huge number of tourists throng the state in season time briefly increasing the floating population of the area (DoUD 2015). Therefore, pristine as well as fragile environment of hills are easily susceptible to degradation and deterioration due to tactless handling of MSW.

General description of the study area

The present study focuses on the socio-economic factors influencing the MSW management in Chamba town of the Himachal Pradesh (Fig.1). The town with 11 wards has an area of 4.33 km^2 and an elevation of 996 amsl with little variations, lies at $32^0$10'N to $33^0$13'N and $75^0$45'E to $77^0$33'E on the banks of river Ravi in the north-west of the state. The total population of town is 19933 with an impressive sex ratio of 999 and total number of households are 4556 (Census of India 2011). As per the data collected from the respective municipality before conducting the survey the Chamba town generates almost 5 TPD of MSW. As per the data made available by Urban Development Department (Govt of Himachal Pradesh), the town now has 100% door-to-door collection and source segregation as well. Although these such claims have long been made by the ULBs' in the state but a ground check represents a stark contrast. The study primarily assesses the awareness level, perception regarding the SWM, current management scenario and most importantly the people's Willingness to Pay (WTP) for improved waste management services in the town. It has been well established from the previous studies that individual, social and financial factors are the real determinants of success of any waste management program.

MATERIALS AND METHODS

Firstly, the research objectives were clearly identified and understood in order to finalize the research methodology. The current solid waste management scenario and the public perceptions were investigated through an empirical study conducted in Chamba

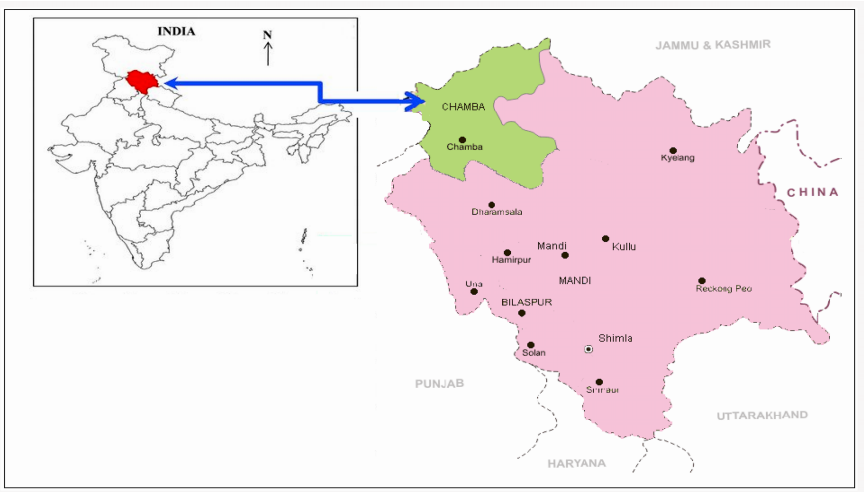

Fig.1. Location of the study area.

town. It was chosen as a study area because the current waste management scenario is in shambles and seems to be in distress. The door-to-door collection service and source segregation were not present in majority of the town at the time of survey. The municipality had earlier launched door-to-door waste collection, but it failed to get desired results due to the less participation of locals. The questionnaire survey was conducted in the month of October in the year of 2018. Key challenges recognized for improper waste management are: (i) Collection, (ii) On-source segregation, (iii) Informal recycling sector, (iv) Inadequate infrastructure for treatment.

After conduction the preliminary survey, the structured questionnaire was prepared and surveys were conducted to generate the primary data to check the status of solid waste management. The total sample size was 717 which was about the 30% of the total number of households in Chamba town. The sampled households were chosen randomly in all the 11 wards of the town. Respondents were asked for consent to conduct the survey in order to reject any response bias during the survey. It was observed that different wards of the town were having different problems and some were better than others in terms of waste management. Also, the socio-economic structure of the wards seems to vary from each other. A brief outlook of the town reveals that the area of old town located around the Chaugans' is very thickly populated with a web of narrow lanes. Localities adjoining Chamba-Bharmaur and Chamba-Pathankot state highways on the former river terraces are experiencing fast development. According to a report by Town and Country Planning Department, Chamba Planning Area is expected to expand at rapid pace due to growing commercial activity, rural-urban migration and better amenities.

The structured questionnaire was prepared after a thorough review of the literature. The questionnaire was further divided into the following 4 sections to investigate several issues:

Socio-economic section,
Solid waste management scenario,
Awareness, attitude, health and perception with w.r.t solid waste management,
Willingness to pay (WTP).

Several issues were explored and investigated through the questionnaire survey. In the first section, information on demographic data concerning age, gender, family size, education and occupation of the family head was gathered. The following section includes the prevailing waste management status, environmental behavior of citizens was examined. This helped us gain insights into the people's behavior and practices of collecting and disposing of their household waste.

The third section includes the common man's questions as well as a few scientific questions to investigate their knowledge and awareness regarding the matter of waste management. The launch of Swachh Bharat Abhiyaan has surely affected people's mindset that cleanliness is important and necessary and not a subsidiary thing. It primarily includes questions to evaluate the level of awareness and attitude of respondents. Questions based on awareness or attitude were clubbed together to get a respective index. Another important perspective was established by investigating the ill-effects of poor waste management on the health of citizens by calculating a health index.

The final tier of the questionnaire survey was to gather information on citizen's willingness to participate in market-based policies for better waste management in their town. Several market-based instruments have been created and implemented for solid waste management around the world. These policy tools are regarded as more effective than command and control instruments. Willingness to Pay (WTP) of respondents was estimated based on the contingent valuation method (Mitchell and Carson 2013). Respondents were first presented with a scenario proposing environmental improvements and were then asked to declare the amount they are willing to pay for availing the improved services or willing to accept to give up the benefits of improved services. Specifically, the proposed scenario provides four benefits such as door-to-door collection, improvement in cleanliness, conservation of the natural environment, increased social harmony. WTP question was in an open-ended format due to its advantages in comparison to dichotomous format questions.

RESULTS AND DISCUSSION

The study contains the use of both basic descriptive

Table 1. Demographic characteristics of the respondents.

Variables	Frequency	Percentage (%)
Gender	N=717	
Male	434	60.5
Female	283	39.5
Age	N=717	
18 – 25	103	14.36
26 – 35	171	23.84
36 – 50	255	35.60
>50	188	26.20
Family Size	N=717	
1 – 3	45	6.30
4 – 6	478	66.66
7 – 9	185	25.80
> =10	9	1.25
Education	N=717	
Illiterate	61	8.50
10^{th}	156	21.75
12^{th}	193	26.91
Graduate	279	38.91
Higher	28	3.90
Occupation	N=717	
Government	267	37.23
Agriculture	54	7.53
Business	229	31.93
Any other	178	24.82

and inferential statistics to analyze the data. The software package used were Microsoft Excel and SPSS (version 25) to get the desired results from the data obtained during the questionnaire survey.

Demographic data analysis

Demographic factors are important as they influence as well as govern the social behavior of the citizens in any given area. In the present study the questionnaire contains five of these demographic factors viz., age, sex, education, family size and occupation. The mean age of respondents questioned during the survey was 41.38 (SD = 13.87) and the mean household size was found to be 5.47 (SD = 1.71). A simple frequency analysis and basic descriptive statistic has been applied to analyze these factors as shown in Table 1.

Present waste management practices

Investigating current waste management practices followed by the respondents in the town is particularly important because it gives insights into people's environmental behavior and level of existing infrastructure. Firstly, we investigated the quantity and the type of waste produced.

It was found that the mean amount of waste generated per household per day was 0.98 kg (SD = 0.33). The minimum amount of waste generated by household was 0.10 kg/day and maximum was 2.5 kg/day. Further, the Pearson correlation value r=0.664 between size of a family and amount of waste generated by them was also found significant at $p<0.01$ level of significance (Table 2).

Waste characterization, which is very essential step to know the changing trends of waste generation, helps in selecting the appropriate waste treatment techniques required. As per the survey findings kitchen waste makes up the highest proportion of waste produced at household level by mass in kg. It was found that, although the plastic waste from packaged products, wrappers,were very common but due to its light weight it consisted in low proportion by mass (3%) despite of the fact that it occupies large volumes, usually 40-50% (Fig. 2). This finding is important because plastic waste is the most hazardous component of MSW and easily the most littered one too. Collecting the waste in segregated manner would easily make it cheaper to treat such waste through small decentralized waste processing plants.

Table 2. Result of correlation between family size and amount of waste generated by them. **. Correlation is significant at the 0.01 level (1-tailed).

	Correlations					
	Family size			Waste generated		
	Pearson correlation	Sig. (1-tailed)	N	Pearson correlation	Sig. (1-tailed)	N
Family size	1		717	.664**	.000	717
Waste generated	.664**	.000	717	1		717

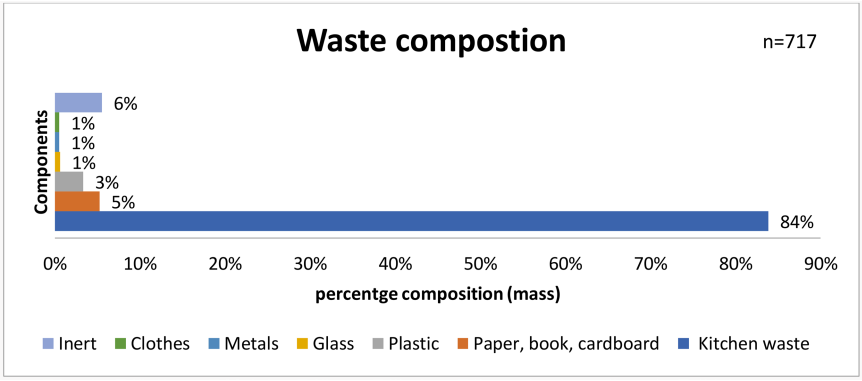

Fig. 2. Waste types and their composition as recorded during the survey.

Also, segregation of waste would allow for better and more effective ways to utilize bio-degradable waste as raw material for various bio-waste processing plants. Metals, glass and cloths each makes up 1% of the waste composition in a typical household MSW. Significantly low proportions of metals reveal that a bulk part is being recycled by the informal recyclers.

Respondents were also asked about how they usually collect their household waste; the most popular method for collection was dustbin (81.59%) followed by cartoon (cardboard and plastic) collection. Use of plastic bags (3.48%) for collection of household waste was found to be very undesirable because these bags easily gettear apart and results in littering. Moreover, plastic bags consume more time while collecting by the *safai-karmcharis* compared to standardized dustbin thereby lowering efficiency of collection (Zurbrugg 2003). Those who dump their household waste in their backyard (2.09%) practices open burning of the waste in the open to get rid of it. Waste collection responses are shown below as recorded during the survey in Fig. 3.

Waste disposal mechanism, as per the survey findings, is in total disarray at many localities of the town. Out of total, 41% of the respondents stated that they dispose of their household waste in public bins installed in their residence whereas, 19% of the respondents were found disposing their waste in open spaces. Khad, nallah, watershed, sewage line (31%) were next most popular way of disposing waste in

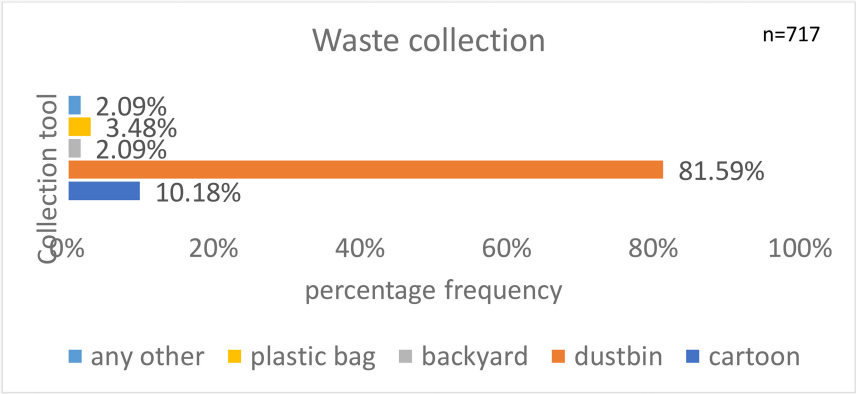

Fig. 3. Waste collection practices followed by the households.

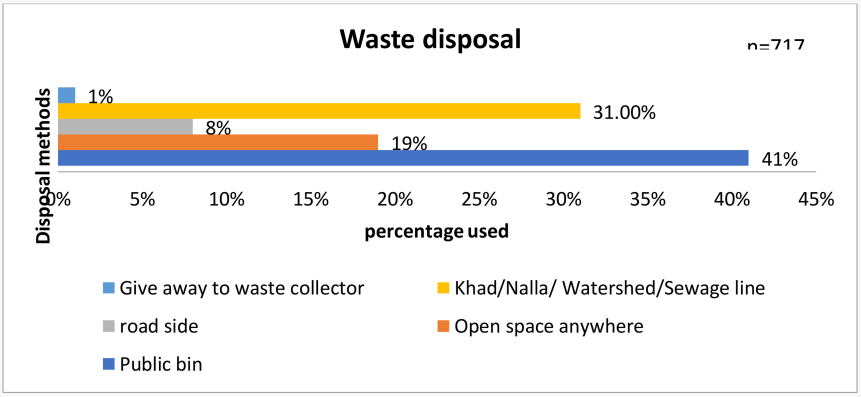

Fig. 4. Waste disposal practices followed by the households.

the town followed by open space dumping (Fig. 4). Only a handful (1%) of respondents were giving away the waste to the waste collector for door-to-door collection. Road-side disposal along the narrow lanes was also found to be prevalent among some locales in certain pockets the town (8%). Stray cows, dogs, flies and mosquitos were a regular sight where waste is dumped in the indiscriminate manner. Improperly disposed waste create ruckus and act as a breeding ground for insects, pest and other infectious diseases. Furthermore, waste disposal around residential area spreads bad odour and release toxic gases into the surroundings.

Awareness and attitude

In the third section, several questions related to awareness, attitude, health, perception and future scenario on solid waste were put up. Studies have shown that the lack of environmental concern and awareness among the general public is one of the major factors linked with the carelessness towards waste management (Ejaz and Janjua 2012). Therefore, we tried to assess the environmental concern and awareness of the respondents by calculating an environmental score of the respondents. The environmental score was based on four indexes awareness, attitude, health and perception regarding the solid waste impacts on nearby environment. Each of the four indexes contained questions to evaluate respondent's knowledge about the same. Respondent's performance was evaluated for each index by assigning him/her a score out of maximum. Thus, the score of each of the 4 indexes was added up to get an environmental score for each respondent out of maximum 9.

Awareness index consists of questions related to adverse impacts of solid waste mismanagement on natural resources such as air, water and land. Awareness index shows that 49.23% of respondents thought that environmental pollution due to solid waste is grave and require urgent action. Besides, 16.21% thought the problems were not so grave while more than a third of the respondents (34.55%) were not at all aware of the impacts of solid waste menace.

The attitudinal index shows that nearly half (45.42%) of the respondents were positive in their approach and were inclined to make contributions for better waste management. While 31.75% were non-affirmative in their approach towards waste management. Although a chunk of 27.47% of respondents stated that they are not sure of their attitude and that it would depend upon the government policies. Incentive-based policies may hold the key to lure this sort of respondents into following better waste management policies.

Health index which tried to investigate the respondent's awareness regarding ill-effects of poor waste management on hygiene and disease. An overwhelming proportion of respondents 85% thought

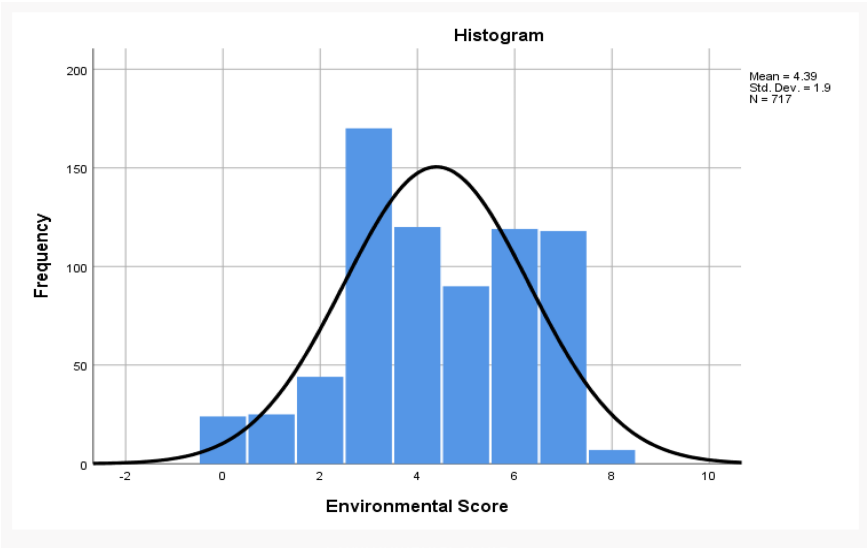

Fig. 5. Environmental scores and their frequency.

improper waste management affects health and causes diseases such as dengue, malaria, diarrhoea, typhoid. While 6% of the respondents had no idea about this. This may be due to the lack of awareness about the ill-effects of poorly dumped waste among these respondents.

We also tried to find out respondents' perceptions regarding the impacts of solid waste management or mismanagement on our community and society overall. The perception of respondents is important to investigate as this gives us an insight into their core desires regarding the issue of solid waste. This core desire than can possibly be mobilized to participate in the social and community program for waste management in the town. Huge proportion (67.95%) of the respondents agreed that proper waste management brings social harmony and a positive character to the society. The perception differs from the attitude because many times people want a menace to be solved but see themselves as non-resourceful in solving it, thus not realizing their own power. Getting a clue about their perception is important to further train them and thus converting them to active component. On the other hand, people with positive attitude see themselves as resourceful and thus ready to participate in any program more easily.

During analysis it was found that the mean of environmental score for all the respondents is 4.39 with a standard deviation of 1.9. The minimum score was 0 and the maximum score was 8. Furthermore, over whelmingly 45.60% of respondents scored more than the mean environmental score of 4.39 (Fig. 5).

The relation between education and environmental score of the respondents have been found in the current study. The finding of this is important since the individuals who are positively inclined towards a proposed environmental policy are more likely to comply with it. The mean Environmental Score for Graduation and Post-Graduation level of education is higher than the total mean of 4.39. Further it is observed that respondents with no education score extremely low on the scale which is an indicator

Table 3. Environmental score of respondents with different education level.

Dependent Variable:	Descriptive statistics Environmental Score		
Education	N	Std. Deviation	N
No. Education	1.41	.783	61
Matric	2.72	.785	156
Senior Secondary	4.29	1.461	193
Graduation	5.78	1.068	279
Post-Graduation	7.04	.508	28
Total	4.39	1.900	717

of their poor level of knowledge about the matter of environmental concerns (Table 3).The inference drawn from these results establishes that the overall environmental behavior of a respondents are also function of the education level of the respondent.

Another important index was Future Severeness Index which was measured on a 4-point Likert scale. It measured the respondent's perception of how much the problem of solid waste is going to grow or decline in near future (5-10 years). 48.81% of respondents thinks that the problem is going to be 'very severe', 37.09% stated that this is going to be 'severe', 5.30% said 'not so severe' while 8.78% said 'not at all severe'. Most of the respondents think the problem is surely going to increase in near future but the degree of severity can vary given the effort put be government authorities, stakeholders and local people. Another way the rise of population and consumption rate are also going to push the waste generation and if no concrete efforts are put to tackle this menace than surely the solid waste problem is going to increase.

Willingness to pay

The final objective of the study was to investigate the willingness of citizens to pay for some market-based policy for improved waste management in the town. More often than not people were willing to spend an amount to ensure their waste is managed properly. Various studies conducted in the developing nations such as Nigeria (Ezebilo *et al.* 2013), India (Mahima and (Muhammed *et al.* 2014) Thomas 2013) and Malaysia reveals that a majority of the households were willing to pay some amount for improvement of MSWM in their locality. A majority of respondents 85.4% (N=610) were willing to pay amount for the proposed scenario of waste management and almost all the respondents were ready to declare the amount they were willing to pay for the proposed scenario. 58.82% (N=420) were ready to pay a monthly sum of Rs 50 for the door-to-door collection of solid waste, 22.69% (N=162) were ready to pay Rs 100 for the same. Besides there were a few (N=28) who were ready to pay Rs 150 or more.The high percentage of respondents were willing to pay was also correlated to the fact that there was huge demand from respondent's side for the door-to-door collection service. However, effectiveness of door-to-door collection only proves to be high when collection frequency is typically not more than once a week.

In the present study, only a fraction of respondents 14.6% (N=107) were not willing to pay any amount for proposed waste management scenario. Such refusals of payment are common in environmental valuation studies (e.g. Adams *et al*.. Refusals may be attributed to protest responses, zero valuation of the environmental good or budget constraint (Genius *et al.* 2008,Meyerhoff and Liebe 2006,Tziakis *et al.* 2009). Several reasons were stated by the people for not willing to pay for waste management services. A majority (64.36%) of the respondents stated that although they can afford but are not willing to pay for it as they feel this must be the sole responsibility of the municipal council to provide these services. Several others (11.21%) were the ones who simply couldn't afford such services at all. Only a handful (4.74%) of the respondents were completely satisfied with existing services and had no reason to pay more for it.

Institutional trust was also examined as the respondents were also questioned about their preferred authority for providing waste management services in their area. More than a half (52.72%) of the respondents stated that the municipality can better manage their waste in contrast to NGO's or private contractors for which 11.85% and 28.91% opted for respectively. While a few of the respondents (6.52%) had no idea

Table 4. Respondents answers for not willing to pay as recorded during the survey.

Variables	Category	Frequency (%)
Reason for not willing to pay for the improved solid waste management	√ Cannot afford the service	11.21
	√ Can afford but don't want to pay for it	64.36
	√ Satisfied with the existing service	4.74
	√ Any other	18.69

about this and said they didn't bother about the issue. Institutional trust is an important factor for determining the success of any waste management program. Key policy factors for managing the waste problem are making a better plan, arranging infrastructure and institutional capacity.

CONCLUSION

MSWM is of utmost importance now than ever. Efficient solid waste management consists of 5R's (Refuse, Reduce, Reuse, Repair and Recycle) and can help fight global threats like biodiversity loss, pollution and climate change. One cannot deny the need for economic growth but the importance to make it sustainable is only possible by mainstreaming professional waste management by making profitable and respectable. The survey observations reveal that the Chamba town lacks adequate waste management resources and infrastructure. The town doesn't even have a designated dumping site for final disposal of MSW and it was observed that currently waste is dumped on a random vacant plot of land along side river Ravi. The former dumping site near Kuran was banned by NGT in 2015 and since then no new site has been designated for the disposal of MSW. Therefore, it is recommended that there is an urgent requirement for the up-gradation of collection techniques and infrastructure for waste disposal in Chamba town. Furthermore, there is a need to implement and explore waste segregation at source along with waste minimization options and recycling. Survey findings reveal that most of the respondents are willing to pay an amount for the improvement of MSWM in the locality. From the survey, it is known that the households are eager for improved waste management services in their locality and the required funds for MSWM can be generated through a uniform fee structure. It is strongly recommended that the more awareness campaigns should be carried out in the town addressing as well as involving the general public to enhance their knowledge and to achieve the desired level of participation from all walks of life. Further, incorporation of informal recycling sector and those associated with this sector should also be made stakeholders in any waste management plan. Recycling holds the key to any management plan and bridge has be to developed to link this with formal waste management sector. No waste management technology can suit the need of an any area without studying the waste generation patterns over a period of time. This study tries to achieve this dimension and scope for further such studies in the Himalayan region are continuously required to design a sound waste management system. Conclusively, various management techniques such as bio-composting, gasification, waste -to -wealth, waste-to-energy should be studied and explored in their context of feasibility in Himalayan ecosystem.This will help develop ISWM system to be effective for the treatment of MSW in the most environmentally sustainable way.

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