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SUSTAINABLE APPROACH OF SOLID WASTE MANAGEMENT OF SMALL URBAN AREA: CASE FOR HABIBGANJ MUNICIPALITY IN BANGLADESH

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ABSTRACT

Existing solid waste management system of *Habibganj* municipality (pourashava) of Bangladesh was studied. A total of 234 households were surveyed. Solid waste generation rate was found to be 0.36 kg/cap/day. Household waste disposal was one of the main problems across the city. Among the different options of waste disposal, 21.4% and 23.9% respondents generally threw their wastes into nearby ponds and drains, respectively. About 14.5% of the sampled households discarded their wastes in their respective compound and only 12% households used bins supplied by the municipality. About 10.7% households disposed their garbage on the roadside. Lack of awareness, lack of dustbins, and improper maintenance of drainage system and lack of drainage facilities were the main reasons of the current inadequacy of the management system as reported by 183 (78%) respondents. The result indicate that for a 200 MT capacity composting plant, safe distance will be about 800 m from the disposal site in terms of odorous impact, while 500 m for health impact. In this study, a sustainable management system of solid waste disposal is suggested for the *Habibganj* municipal area.

Key words: Habiganj pourashava, solid waste, sustainable development, biogas, drainage problems, health impact

INTRODUCTION

Solid wastes comprise all the wastes arising from human and animal activities. According to WHO (World Health Organization), solid waste can be defined as useless, unwanted or discarded materials arising from domestic, trade, commercial, industrial and agricultural as well as from public services. Existing solid waste management system (SWMS) of a small urban area of Bangladesh namely *Habibgang Town* has been presented in this paper. Socioeconomic and environmental problems that are related to SWMS of *Habibgang Town* have also been described in this study. The objective of the paper was to give a general idea about solid waste generation from a small urban area, its associated problems and management system. Future plan for sustainable development of the city has also been suggested in this paper.

Habiganj Town, a district town and a first class pourashava, is located in the Southwest region of Sylhet Division of Bangladesh. The River Khowai flows beside the *Town*. The population of the *Town* is about 100 thousands and the area is about 9.05 square kilometer (BBS, 2001).

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MATERIALS AND METHODS

Data collection

The entire nine wards of the *Habibganj Town* were selected in order to generalize the findings for the whole urban area. The ward-wise distribution of households was taken into account that was 234 out of 6731 in number. The Habiganj Pourashava Authority was provided the household-list. It was maintained that the sampling error would remain within a certain limit with confidence level of 95% (Blalock, 1993). The family chief of every 20th household in each ward was interviewed based on a questionnaire. The ward-wise distribution of households as recorded previously by Alam and Chowdhury (2004) is given in Table 1.

Randomness of the sample was maintained during selection of the respondents. In each unit, proportionate representation of social class was ensured during selection of the households. The selected samples were classified as poor, middle and rich classes constituting 147, 75 and 12 households, respectively.

Table 1. Distribution of households according to wards (Alam and Chawduary, 2004)

Ward No.	No. of households
1	17
2	34
3	24
4	24
5	29
6	29
7	29
8	24
9	24
Total	234

Data collection

All data were collected through face-to-face interview. After collection of the data at first visit, several meetings were held with the team members and an interim test checklist of information was prepared. This list was pre-tested in non-sampled area through a pilot survey before finalization. The final checklist contained both pre-coded (for using SPSS software (Statistical Program for Social Sciences), yes was given, code 1; no was given code 2)

Data collectors were provided an extensive training on various aspects of data collection in the field. In addition, experienced and highly qualified supervisors were engaged in the field to minimize the loss and distortion of data. In some cases, the information gathered from the respondents needed a revision as some data couldn't be obtained from direct questions e.g. in some cases income data needed to be obtained from expenditures and savings data.

During the first visit to *Habibganj* pourashava, the researchers met the Chairman, Chief Executive Officer and the Supervisor of the conservancy unit of the *Habibganj p*ourashava. The informative gathered was shared with people from different social categories and occupations such as teachers, reporters, doctors, businessmen, housewives, students, day laborers, rickshaw pullers, field workers of EPI (Expanded Program of Immunization).

Physical and chemical characteristics of the samples were determined by method described by Peavy et al (1985) and Techobanoglous et al (1993). The moisture content of solid wastes is expressed in wet-weight method; the moisture in samples is expressed as a percentage of wet weights of materials. Solid waste was kept in a box for 48 hrs for collecting lechates for determination of BOD, COD and nitrates.

RESULTS

Characteristics of solid waste

In this study, a relatively small quantity of samples was analyzed due to resource constraints. Only 5 kg solid waste was analyzed in each sample. According to the study, the mixed waste dumped at low-lying land and water bodies, located at Moilar Chakka in Mohonpur, was characterized with high organic content (about 76% by weight), high moisture content (39 to 57% by weight), ash content (7 to 13% by weight), low volatile matter (7-10% by weight) and fixed carbon content (2-5% by weight).

The physical composition of waste components varied widely with the location and season of the year. The major components of municipal solid wastes included food wastes, paper, plastic, clothes, glass, metal, construction material and similar objects. Table 2 shows the composition of municipal waste in residential and commercial areas where the major portion of solid waste of the city was organic food and vegetable waste.

Table 2: Physical composition of mixed municipal wastes of Habibganj

Physical composition	Percentage by weight (in winter)	Percentage by weight (in summer)
Food waste	52.20	48.00
Fine dust	9.50	9.70
Plastics	10.30	10.30
Stone, bricks and earthward	14.30	14.30
Rags	3.40	1.10
Paper	5.50	6.80
Leather	1.70	2.50
Metals	1.20	1.80
Others	1.90	1.50

The results of the analysis of mixed waste show high moisture content, high ash and high BOD and COD values that may cause serious problems in the disposal site. High organic nitrogen content represents the fertilizer value of the waste and potential for conversion of the waste into good compost but may lead to groundwater pollution through leachates. Table 3 shows that the leachates were acidic with moderately high BOD and COD (132.60 and 154.7 mg/L, respectively) and were also rich in organic nitrogen.

Table 3: Chemical composition of solid waste (maximum and minimum values of 123 samples)

Constituents	Residential	Commercial	Clinical	Disposal site
pH	4.8-4.2	-	-	4.0-6.0
Moisture content (%)	51.28-47.93	42.8-36.7	49.13-43.67	58.9-52.67
Organic nitrogen (mg/L)	39-35.2	-	45.10-37.56	41.34-34.78
COD (mg/L)	193-180.3	94.2-90.45	381.2-348.5	157.45-151.23
BOD (mg/L)	111.8-99.98	91.78-88.45	309-294	135.3-129.4

*To obtain moisture content the solid waste material was dried in an oven at 77 °C for 24 h

Existing solid waste management system

Solid wastes accumulating in Habiganj pourashava was found to be derived from various sources. These include (i) domestic waste from households, (ii) refuse from commercial offices and business holdings, (iii) refuse from community holdings such as schools, colleges, mosques, temples, churches, clubs, community centers, auditoriums, and community organizations, (iv) trash swept from all kinds of streets including highways, arterial and sub arterial roads, (v) residue from all types of sanitary facilities in the form of human excreta, toilet papers and the like, (vi) waste from hospitals, and (vii) dry animal excreta (cows, chicken etc). It was found from the survey work that the generation rate of solid waste was about 0.36 kg/capita/day.

At present, uncontrolled dumping of collected garbage in low-lying land and water bodies, located at Moilar Chakka in Mohonpur, is going on. Pourashva is dumped solid waste, which leads to environmental pollution. It was found from survey that crude method was followed in pourashava. Crude dumping method is used to dispose the solid waste in Habiganj. Habiganj pourashava has been using this method in order to minimize the cost of waste disposal. A question related with environmental condition and problem associated with the existing situation were asked during survey work (table 4). The present situation of City pourashava office was collected. Area of dumping area is 3.16 acre. 74 sweepers exist for the city. Survey was carried out for health issues based duration of diseases, type of diseases etc.

Table 4: Major problems of the locality

Problems	Percentage
Lack of drainage	15.8
Lack of dustbin	79.6
Waste disposal	18.4
Insufficient health care facilities	10.8
Lack of proper communication	3.2
Lack of water supply	9.0
Lack of drainage system	63.4
Lack of street light	5.4
Lack of sanitation facilities	4.2
Water logging	2.1
Social problems such as drug problems	8.9
Lack of employment opportunity	3.2
Satisfactory collection system	40
Mixed dumping system and total collection	60
Drainage system within the boundary	63
Lack of pourashava facilities	82
Diseases in last year	36.2
Fever	42.7

Safe distance from dumping place

Formaldehyde odor is a common emission from the solid waste disposal site. Other odorous substances are hydrogen sulphide and ammonia. As formaldehyde has the lowest value of TLV (Threshold level value, eight hour average) and odor threshold (DOE, 2006), safe distances in terms of health impact and odor impact have been computed. Considering formaldehyde emission of 0.2 g/sec-m^2 (DOE, 206) for 100-MT solid waste occupying an open area of 0.1 km^2; safe distance has been computed and shown in Table 5. It has been calculated based on future urban plan of *Habibganj* Pourashova (200 MT).

Table 5: Safe distances from solid waste dumping site or composting plant

Capacity	Impact distance in meter					
	Summer		Winter		Monsoon	
	Odor impact	Health impact	Odor impact	Health impact	Odor impact	Health impact
100 ton	0.4	0.25	0.35	0.25	0.3	0.25
500 ton	2.2	1.40	1.92	1.40	1.60	1.40
200 MT	800	500	700	500	600	500

DISCUSSION

Problems and drawbacks in Habiganj Pourashava

The existing system of solid waste management in Habibganj has several problems and drawbacks. Some of the major problems and drawbacks, which need urgent attention, are mentioned below:

Unplanned urbanization

Unplanned urbanization of Habiganj Pourashava is one of the complex problems. Many areas here have developed with very narrow lanes and roads. So there is no accessibility for the waste collectors. Dwellers of these congested areas dispose off their waste into local drains, low-lying lands and ponds.

Incomplete and inefficient collection practice

With the present number of conservancy facilities, most of the waste remains uncollected. About 60% (140 out of 234) respondents reported that the existing collection system is unsatisfactory. A huge number of clinical wastes from various private hospitals also remain uncollected. According to experts' opinion that 40% of the solid waste and hospital waste remained uncollected due to lack of facilities of HP (Hopiganj Pourashava) (lack of cleaners, lack of trucks, vans etc). These hospitals dispose their waste in roadside drains, local drains or in water body (e.g. old Khoai River). Obviously, accumulation of large amount of uncollected wastes produces strong offensive smell and pollutes air. It also acts as a breeding ground for mosquitoes, flies, and other insects. Moreover, it helps producing and spreading pathogenic microorganism. The leachates from these degrading wastes can pollute the ground and surface water. The present method of collection and disposal is very inefficient. Moreover, the present numbers of sweepers, dustbins, and collection vehicles are insufficient for the present need. It is clear from the survey work that it was impossible for 74 sweepers to keep the town clean. The present design of communal bin is not satisfactory (table 5), as it is open and allows entry of rainwater producing leachate; birds and other rodents spread the refuse, and the scavengers can easily scatter the wastes. At present Habiganj Pourashava does not follow any criteria for selection of site and they are disposing the waste in low-lying areas in an unsanitary manner, using crude dumping method. A part of 3.16-acre land of HP, which is located at Moilar Chakka in Mohonpur, is used for dumping place.

Solid waste generation and disposal system

It was clear from the analysis that daily generation of solid was in the study area was 0.36 kg/capita/ day. This rate is less than that of Sylhet city (0.46 kg/cap/day), Chittagong city (0.66 kg/cap/day) of Bangladesh (Asia Arb, 2000). But it was very important to mark that significant portions of Habiganj Pourashava's dwellers reside in slums and squatter settlements. Besides, there are many newly included areas in Pourashava which are very congested and where dwellers do not have any form of solid waste collection services. These people dispose their wastes into low-lying lands, roadside drains or local drains or channels. At present, Habiganj Pourashava authority collects solid waste from households and hospitals and disposes it without discriminating between the two categories. Clinical wastes carry pathogens, sharp and toxic substances endangering the lives of the dwellers (generation rate is 0.45 kg to 0.80 kg per bed per day based on the report from ward boy and nurses) (Alam and Chowdhaury, 2004).

It was evident from the analysis of data of table 3 that whenever these highly polluted leachates got entrapped in ponds with the surface wash, a high degree of pollution of the ground and surface water became imminent with subsequent health hazard. Leachates from solid waste with high pollution potential from community bins, storage points, and landfills later mixed with surface wash would be stored in the lagoons. It is evident the lagoon containing leachates mixed (Khan, 2005) with surface wash would pollute the environment and also increase the risk of ground water contamination. The household waste disposal was one of the main problems across the city. Among the different options of waste disposal, generally 50 respondents (21.4%) admitted that they threw their waste into nearby ponds, 56 respondents (23.9%) dumped the waste into nearby drains. The figure was higher than that for Khulna town (Khan, 2005). From the present study, it was found that about 14.5% of the sampled household discarded their waste in the residential compound, while 12% used bins supplied by the pourashava. About 10.7% households threw their garbage on the roadside. There was no house-to-house waste collection system in Habiganj. Therefore, disposal of household waste has become a breeding ground of diseases.

About 63% households were found to have their own drainage system. Only 39% of these drainage systems were directly connected to the pourashava's drainage system. However, according to the majority of the respondents (63.4%) the existing drainage facilities maintained by the pourashava were not satisfactory and sufficient. In addition, it was observed that solid waste was indiscriminately dumped on roadsides and in open drains leading to serious health risks and degradation of living environment. Dumping of domestic waste in the home and roadside arenas was found to become a potential source of pollution in the localities. In other words, garbage pollution was serious environmental concerns at Habiganj. From the study, it was found that the traditional concepts and technologies for waste collection are becoming insufficient and ineffective causing major portion of the generated wastes to remain uncollected and disposed of locally. At the same time capability of Habiganj Pourashava's solid waste management and its hygienic disposal is miserably lagging behind. This situation makes the environment of the city quite gloomy and dismal for future. The present system of waste management in Habiganj pourashava is environmentally ineffective and poses a hazard to public health and the operators. The solid waste dumps of Habiganj pourashava are unregulated and unsanitary, resulting in adverse impacts like degradation of water quality (Alam and Chowdhaury, 2004), attraction of disease-carrying insects and rodents and overall degradation of the environment (Alam and Chowdhaury, 2004).

Environmental consequences

Environment is the sum of all social, biological, physical, and chemical factors, which constitutes the surrounding of human beings (Ahmed and Rahman, 2000). In this section, different types of problems such as social and health related problems that are creating a threat for Habiganj town for sustainable development are presented.

Facilities

Existing surface drains were found structurally unsound. The numbers of dustbin (28 out of 60) in the locality were found inactive. As a result, many people used to throw their solid wastes and other garbage into the street or street side drains. Most importantly, the Habiganj pourashava garbage collectors were hardly found during the time of data collection. Lack of awareness, lack of dustbin, improper maintenance of drainage and lack of drainage facilities are the main reasons for insufficient drainage facilities that were reported by 183 (78%) respondents (Alam and Chowdhaury, 2004; Sobahan, 2005).

Health issues

About 36.2% of the household members were found to be attacked by several diseases during the last six months of this study. The prevalence of fever and cold seemed to be high among the study population. Majority of the household members (42.7%) suffered from fever followed by 10.5% cold and 7% eye diseases. While the remaining 40% suffered from other disease including diarrhea, jaundice and anemia.

It was learnt that none of the members of the family of the 95% households died during the last six months. About 42% of the household members were found suffering for 1-5 days, while 25% were found suffering between 1-10 days. It is clear from the survey that a disease caused by inadequate water supply and sanitation was responsible for death of few of the respondent's parents. Actually unhygienic condition and lack of knowledge about sanitation lead the present situation to reach a danger level (Alam and Chowdhaury, 2004; Sobahan, 2005).

Health impact

On-site health hazard

From the present study, it was found that about 14.5% of the sampled household discarded their waste in the residential compound. About 10.7% households threw their garbage on the roadside. There was no house-to-house waste collection system in Habiganj. Therefore, disposal of household waste has become a breeding ground of diseases.

The most serious health threat is expected from pathogens. *Aspergillus* fumigates causes aspergillosis (reported from District Hospital, Habiganj). This fungi is well known product of silage composting and grows well on decaying vegetable matter at temperature above 45^0C. The corrosive and flammable nature of unprocessed solid wastes (broken glass, metal edges, chips, battery etc.) pose risk to workers. According to Director of District Hospital of Habiganj, long-term exposure of workers to low levels of organic chemicals such as dioxins, PCBs etc poses threat to nervous and reproductive system (Alam and Chowdhuary, 2004).

Odor hazard

Another area of concern is release of odorous gases emanating from solid waste disposal sites. Offensive odors may be generated during active stage of composting. The intensity of odor increases if composting conditions are not controlled and/or unprocessed or processed feedstock has been stored for a long time. A rough estimate of maximum distances of health and odor impact has been computed by Peavy *et al.*,(1985) using Gaussian Distribution Model for area sources with wind speed of 3 km/sec at a temperature range of 24-35 ºC. The maximum mixing height has been assumed to be 1500 m and minimum-mixing height as 450 m. Formaldehyde odor is a common emission from the solid waste disposal site. Other odorous substances are hydrogen sulphide and ammonia. Considering formaldehyde emission of 0.2 g/sec-m^2 for 100-MT solid waste occupying an open area of 0.1 km^2; safe distance from solid waste dumping place has been computed. Result indicate that for a 200 MT capacity composting plant, safe distance will be about 800 m from the disposal site in terms of odorous impact while 500 m for health impact. The calculation of safe distance from solid waste dumping site was shown for 200MT below:

For health impact TLV is 0.93mg/m^3, for odor impact it is 0.50 mg/m^3.

We know the concentration $C = Q /(\pi \times u \times \sigma_y \times \sigma_z)$:

$Q= (0.2gm/sec\text{-}m^2) \times (0.05\times1000\times1000\ m^2)$

Wind speed u =3000m/sec

$\sigma_y = 1.058x^{0.55}$ for C type wind speed

$\sigma_z = 0.73x^{0.55}$ for C type wind speed

For health impact, safe distance x is 800m. (relationship between dispersion coefficient of y and z axis were 0.69, (Rao and Rao, 1998).

Remedial options

Estimation of required landfill area

Based on generation rate of solid waste, it is essential for calculation of landfill area for solid waste. At present, it was calculated that the average present daily solid waste generation is 98.2 ton for the city. Moreover, as land cost is very high, so alternative use of solid waste will be attractive.

Solid waste generation rate=100 tons/day

Volume required /day=100 tons/day x 2000 lb/ton/ (800 lb/yd3) = 250 yd3/day

Area required/year=(250 yd3/day)(365day/ year)(227 ft3/yd3)/(15ft)(43560 ft2/acre) = 31.7 acre =128.068X103 sq. m

Generally 60 percent solid wastes are considered as rapidly decomposed part of municipal solid waste (MSW)(Municipal Solid Waste). Table 6 from Alam and Chowdhury (2004) shows the rapidly and slowly decomposed parts of solid waste for determining the chemical composition and amount of gas that can be derived from each part. From Table 6, chemical formula without sulphur (small amount of sulpher may present in solid waste, but finding out composition) and neglecting ash content can be determined using molar composition of carbon, hydrogen, oxygen and nitrogen and considering normalized mole ratio of nitrogen equal to one.

Table 6: Distribution of the rapidly and slowly decomposed organic components

Component	Wet weight (lb)	Dry weight (lb)	Composition in lb C	H	O	N	S	Ash
Rapidly decomposable Organic Constituents								
Food waste	9.0	2.7	1.3	0.17	1.02	0.07	0.01	0.14
Paper	34.0	32.0	13.92	1.92	14.08	0.10	0.06	1.92
Card Board	6.0	5.7	2.51	0.34	2.54	0.02	0.01	0.29
Yard wastes	11.1	4.4	2.10	0.26	1.67	0.15	0.01	0.20
Total	60.1	44.8	19.83	2.69	13.31	0.34	0.09	2.55
Slowly decomposable Organic Constituents								
Rubber	2.0	1.8	0.39	0.12	0.056	0.08	0	0.05
Textile	0.5	0.5	0.99	0.05	0	0.01	0	0.05
Yard wastes	7.4	3.0	1.43	0.18	1.14	0.01	0.01	0.13
Wood	2.0	1.6	0.79	0.10	0.69	0	0	0.02
Total	11.9	6.9	3.24	0.45	2.39	0.19	0.01	0.25

Rapidly decomposable part's composition is $C_{68}H_{110}O_{50}N$.

Slowly decomposable part's composition is $C_{18}H_{27}O_{8}N$.

The total amount of gas production can be estimated using the above compositions considering the specific weights of methane (CH_4) and carbon dioxide (CO_2) are 0.0448 and 0.1235 lb/ft^3 respectively.

CH_4 in rapidly decomposable part = (560 x 44.4)/(1741 x 0.0448) = 318.8 ft^3 = 9.034m^3

CO_2 in rapidly decomposable part = (1452 x 44.8)/(1741 x 0.1235) = 302.5 ft^3 = 8.57 m^3

CH_4 in slowly decomposable part = (176 x 6.9)/(427 x 0.0448) = 63.48 ft^3 = 1.8 m^3

CO_2 in slowly decomposable part = (176 x 6.9)/(427 x 0.1235) = 23.03 ft^3 = 0.65 m^3

Rapidly decomposable = (318.8 + 302.5) = 621.3 ft^3 = 17.56 m^3

Slowly decomposable = (63.48 + 23.03) = 86.51 ft^3 = 2.45m^3

Biogas plant

A biogas plant having an inlet chamber, a digester and gasholder can be suggested for reducing the pressure of using natural gas. Garbage is partially digested in the inlet chamber. An asbestos pipe discharges the contents of the inlet chamber to the bottom of the digester. The digester is constructed with brick masonry and plastered with cement mortar. This type of plant will reduce the pressure of fuel and also increase the environmental stability of the zone. Application of gasification technique such as installation of cyclone gasifier will reduce the power shortage of the zone. Fig. 1 shows the flow diagram of power generation of solid waste. This was developed with consulting solid waste experts Professor Amin and considered the local condition, technical ability and affordability. Moreover, in Bangladesh, CSKS ORPHANAGE ZINJIRA DHAKA project is running successfully (Nag, 2000; BCAS , 1997; Asia Arb, 2000).

Sustainable remedies for solid waste as energy generation

For handling solid waste along with hospital wastes, open dumping and incinerator are used. But care should be taken for operation of incineration. Air pollution is a matter of concern in this case Ambasht and Ambasht (1999). Table 7 shows the pollutants generated by incineration (DOE, 2006).

Table 7: Concentration of air pollutants generated due to incineration

Type of pollutants	Concentration (µg/m^3)
Particles	16-3428
NO_2	18-78
SO_2	14-267
HCl	250-453
HF	4-8
CO	12-547

It is evident from Table 6 that net emission of pollutants from solid waste by existing incineration process creates environmental problems. If the incineration displaces oil fired boiler or gas boiler systems, then energy recovery is possible (it means that instead of using incinerator, you can use gas boiler system or fired boiler system). For particulate matter, emission is 13 g per ton (Table 6). Heat recovery emits 0.11g/kWh of the energy (Peavy and Row, 1995;Palin, 1997). Credit per ton of waste is 0.11 x 2000 g = 211 g considering heat recovery of 2000 kWh per ton of waste ((Palin, 1997). According to the survey work, 130 kg of solid waste per year per person is produced in *Habibganj* City. As energy generation is a solution of solid waste, proper handling and operation will provide a sustainable solution for the city (Palin, 1997).

In order to achieve ecological sustainability, the set up of relation and interaction between sustainability and societal values is critical (Sanvicens and Baldwin, 1997). This is to encourage people to use biotechnology such as use of biogas and composting waste as fertilizers. This will reduce environmental pollution; waste volume, environmental degradation and protect endangered species (BCAS , 1997). The proposed layout of solid waste management system has been developed keeping ecosystem management principles in mind described by Shukla and Srivastava (1992) and shown in Fig. 2. It was developed by focusing on the existing facilities of pourashava in consultation with experts. To minimize the crisis of land area for disposal of solid waste in the future; an effective option would be to reduce the volume of solid waste prior to disposal by composting of the organic wastes. In this calculation, 25% of the collected inorganic waste has been considered to bear some market values, being reclaimed and recycled by informal sectors. The remaining 75% is assumed to be transported and dumped in disposal sites. During composting, 85% of the organic waste may be converted into composting and the remaining 15% is required to be land filled. In the present study, land requirements with and without composting has been compared assuming a collection efficiency of 50%. From the estimated waste generation, the

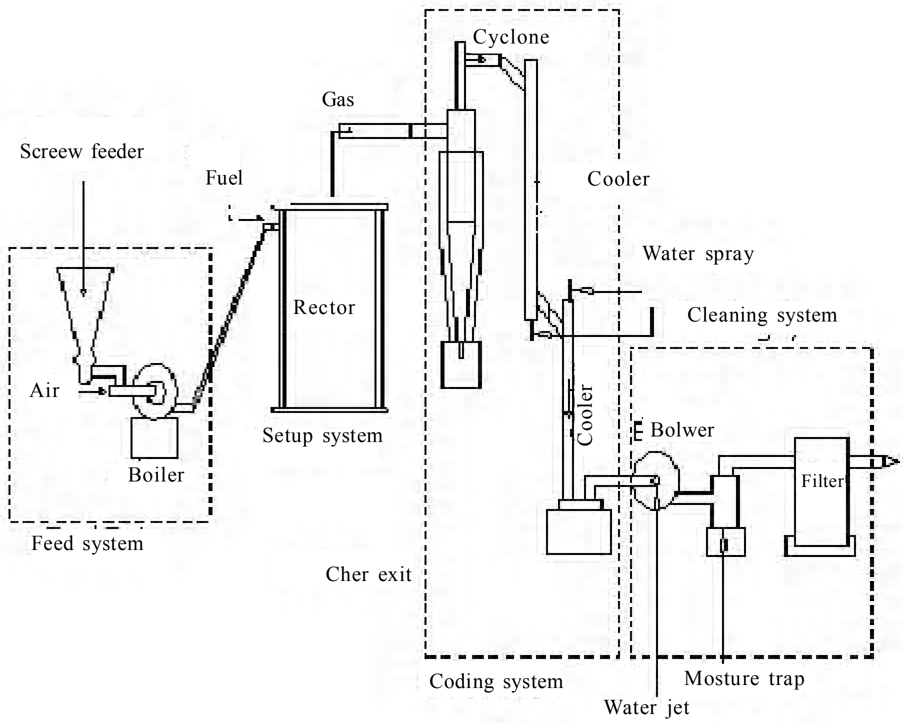

Fig 1: Flow diagram of generation of power from solid waste

required area has been calculated assuming a compacted solid waste density of 1.1 ton/m^3 and a depth of 4.57m.

The present study was attempted to collect more specific information on health and environmental situations of the small urban area of Habiganj Pourashava. The survey work revealed that the generation rate of solid waste was about 0.36 kg/cap/day. Among the different options of waste disposal, 21.4% respondents generally threw their wastes into nearby ponds and 23.9% respondents generally dumped their waste into nearby drains. Lack of awareness, lack of dustbin, improper maintenance of drainage and lack of drainage facilities are the mean reasons for insufficient drainage facilities reported by 78% of respondents. For proper management of solid waste, a gas boiler system has been proposed that will be suitable for small urban area such as Habiganj because gas fields are also situated in the vicinity of the city. Moreover, construction of a biogas plant will be the best solution for handling the waste.

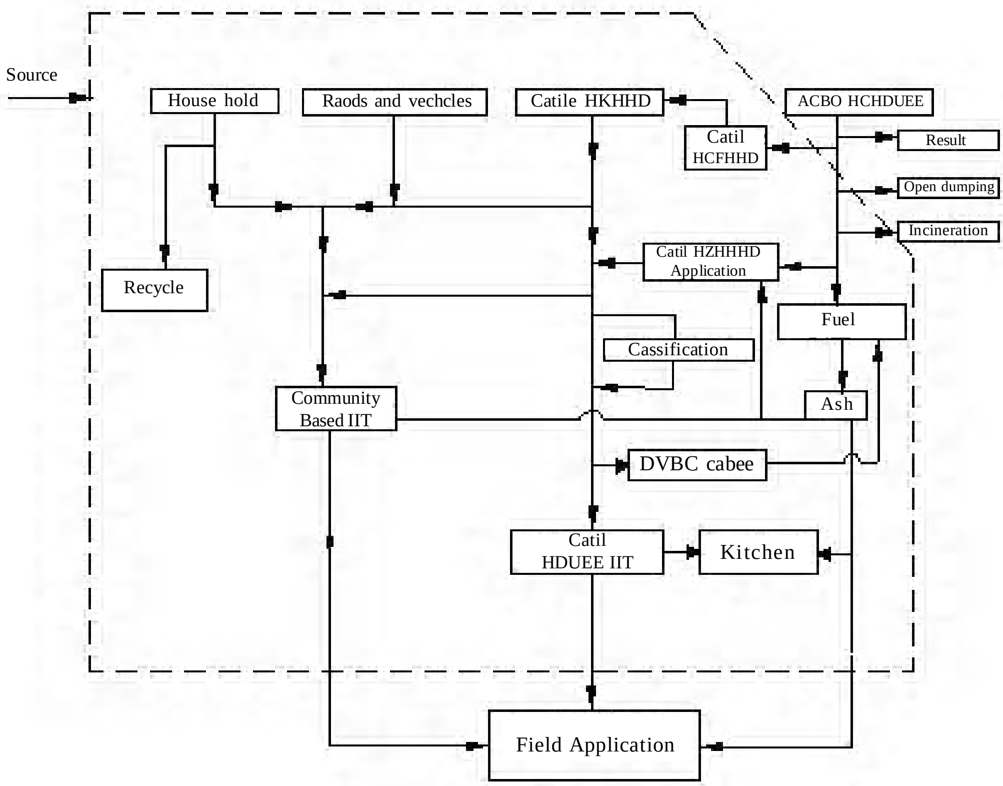

Fig 2: Proposed layout of solid waste collection and disposal practice

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