Baseline Study on Municipal Waste Burning Practices in Itogon, Benguet

Research Report

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I. Introduction

Solid waste management is one of the most pressing environment issues in the Philippines and in the whole world. The Department of Environment and Natural Resources reports that the country produces over 21 million metric tons of garbage every year. It estimates that in 2020, waste produced was 214,265,676 metric tons.[2]

Although Republic Act 9003 (The Ecological Solid Waste Management Act) was passed in 2000, there remains many gaps in its implementation. The law mandates Local Government Units (LGUs) to prepare a 10-year solid waste management plan. LGUs with approved plans as of 2020 constitute only 58.6 percent of all LGUS. Segregation of waste at source, a key component of the law, remains a major challenge.[3] Materials recovery facilities (MRFs) that are intended to enhance waste segregation and waste diversion are sadly inadequate. As of 2020 there were only 11,558 MRFs servicing 14,483 barangays or 34.5% of all barangays in the country. Only 399 LGUs (of 1634 LGUs) have access to sanitary landfills while 261 open dumpsites are still in use[4]. Disposal in sanitary landfills increased slightly by 2023 to 478 LGUs or 29.25% of the total LGUs.[5]

The burning of solid is prohibited by RA 9003 as well as RA 8749 or the Clean Air Act. The practice however persists though the extent of the problem has remained undocumented. Apart from the inconvenience that backyard burning brings to the neighborhood, the practice may cause health and environmental problems. Toxic chemicals released during the burning process include nitrogen oxides, sulfur dioxide, volatile organic chemicals (VOCs) polycyclic organic matter (POMS) and heavy metals[6] depending upon the materials in the feed stock. Burning plastic in particular, would release other toxins including benzo(a)pyrene (BAP) and polyaromatic hydrocarbons (PAHs) which are known carcinogenic substances.[7] Burning of municipal waste also releases dioxins and furan, chemicals that are listed among the “dirty dozen” whose production is strictly covered by the Stockholm Convention on Persistent Organic Pollutants

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[1] *Names of research team members are in Annex 1.*

[2] https://www.denr.gov.ph/images/DENR_News_Alerts/DENR_News_Alerts_10_January_2021_Sunday.pdf

[3] https://www.pna.gov.ph/articles/1175460

[4] https://www.denr.gov.ph/images/DENR_News_Alerts/DENR_News_Alerts_10_January_2021_Sunday.pdf

[5] https://www.philstar.com/nation/2023/05/16/2266547/only-478-1634-lgus-have-access-landfills

[6] https://dnr.wisconsin.gov/topic/OpenBurning/Impacts.html#:~:text=Burning%20trash%20can%20cause%20long,toxic%20chemicals%2C%20such%20as%20dioxin.

[7] https://dnr.wisconsin.gov/topic/OpenBurning/Impacts.html#:~:text=Burning%20trash%20can%20cause%20long,toxic%20chemicals%2C%20such%20as%20dioxin.

(POPs) because of their long-term serious effect on the environment and human health.[8]

In light of the potential harm of this largely unmonitored and undocumented practice, this study focuses on determining the extent of the practice of burning municipal waste with the view of influencing government programs and policies on solid waste management. The research site is the Municipality of Itogon where the practice of burning solid waste is known to happen.[9]

II. Profile of Itogon

1) Demographic Information

Itogon is one of the thirteen municipalities of the Province of Benguet. It is situated in the southeastern section of the province, bordered on the west by Tuba, on the northwest by Baguio City, La Trinidad and Tublay, on the north/northeast by Bokod, on the east by Nueva Viscaya and on the South by the Province of Pangasinan. It has a land area of 49,800 hectares (498,000,000 square meters), divided into nine barangays. The largest of these barangays are Dalupirip, Tinongdan and Ampucao. The densest barangays in terms of population, however, are Tuding, Virac and Ucab. These, along with Gumatdang are the smallest barangays in terms of land area.

Figure 1: Map of Benguet

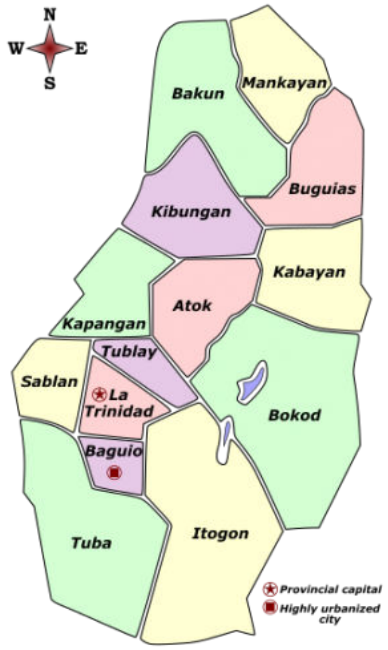
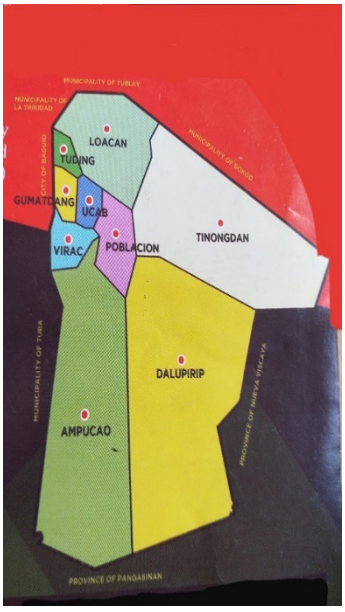


Figure 2: Map of Itogon



[8] https://stopopenburning.unitar.org/guidance-and-examples/philippines/ban-garbage-initiative/

[9] Based on informal interviews with officials and residents of the area by the Adventist Development and Relief Agency team.

The 2020 Population Census shows a total of 61,498 persons living in the municipality, distributed across 14,601 households. Average household size is 4.21.

Table 1: Land Area and Population Density[10]

Barangay	Population	Land Areas in Hectares	Density (persons per Land Area)
Urban			
Ampucao	10,924.00	11,332.00	0.96
Loacan	8,378.00	4,581.00	1.83
Poblacion	4,221.00	1,803.60	2.34
Tuding	10,211.00	501.10	20.38
Ucab	8,751.00	663.30	13.19
Virac	10,796.00	752.10	14.35
Subtotal	***53,281.00***	***19,633.10***	***2.71***
Rural			
Dalupirip	2,862.00	17,118.80	0.17
Gumatdang	1,709.00	531.40	4.22
Tinongdan	3,646.00	12,515.70	0.29
Subtotal	***8,217.00***	***30,165.90***	***0.27***
Total	***61,498.00***	***49,799.00***	***1.23***

Table 2: Population and Number of Households Per Barangay

Barangay	Population	Number of Households	Average HH Size
Urban			
Ampucao	10,924.00	2,569.00	4.25
Loacan	8,378.00	1,884.00	4.45
Poblacion	4,221.00	912.00	4.63
Tuding	10,211.00	2,349.00	4.35
Ucab	8,751.00	2,081.00	4.21
Virac	10,796.00	3,126.00	3.45
Subtotal	***53,281.00***	***12,921.00***	***4.12***
Rural			
Dalupirip	2,862.00	526.00	5.44
Gumatdang	1,709.00	369.00	4.63
Tinongdan	3,646.00	785.00	4.64
Subtotal	***8,217.00***	***1,680.00***	***4.89***
Total	***61,498.00***	***14,601.00***	***4.21***

[10] Source: Philippine Statistical Authority 2020 as cited in the Itogon Ecological Profile, 2020, https://itogon.gov.ph/itogon-profile/.

The Census also reveals that residents are mostly young. About 2/3 are of working age, a little less than 1/3 are young dependents and about 4% are 65 years old and above. The total dependency ratio remaining constant at 50% for the past decade.

Table 3: Population by Age Group and Dependency Ratio[11]

Age Category	2007	2010	2015	2020
0-14 years	14,860	16,483	17,557	18,059
15-64 years	31,933	37,362	39,885	41,004
65 years and above	1,768	2,048	2,378	2,446
Total Population	48,561	55,893	59,820	61,509
DEPENDENCY RATIOS				
Child dependency ratio	46.53	44.12	44.02	44.04
Old age dependency ratio	5.54	5.48	5.96	5.97
Total dependency ratio	52.07	49.60	49.98	50.01

2) Economic Resources and Activities

With a land area of 49,800 hectares (498,000,000 square meters), Itogon is by far, the largest municipality of Benguet Province. It's alienable and disposable area, however, is only 3.78% (1,883.21 hectares). A large part of the area (86.03%) is classified as timber or forest land while the remaining section (10.19%) is mineral land covered by Patent Mining Claims and Mineral Product Sharing Agreement.

Table 4: Land Classification in the Municipality[12]

Land Classification	Land Area	Percent of Total Area
Alienable and Disposable (A&D)	1,883.21	3.78
Timberland/Forestland	42,844.48	86.03
Mineral	5,072.31	10.19
Total	**49,800.00**	**100.00**

The mineral resources found in the area are gold, silver and copper. Mineral land is predominantly located in Barangay Ampucao although the other barangays, except Dalupirip and Tinongdan, also have portions classified as

[11] Source: Municipal Planning and Development Office as cited in the Itogon Ecological Profile, 2020, https://itogon.gov.ph/itogon-profile/.

[12] Source: Land Management Bureau, Department of Environment and Natural Resources, Municipal Planning and Development Office as cited in the Itogon Ecological Profile, 2020, https://itogon.gov.ph/itogon-profile/.

mineral land. Forestland is found in all barangays but the largest portions are in Dalupirip and Tinongdan. Barangay Loacan has the largest share of A&D land.

Itogon is also rich in water resources. Two river systems traverse through the municipality. The Agno River supplies the water for the Binga Dam at Barangay Tinongdan. The Ambalanga River, on the other hand, crosses Gumatdang, Virac and Poblacion, then empties into the Agno River. Smaller rivers and creeks are found in all barangays.

Table 5: Land Classification by Barangay

BARANGAYS	A&D	%	Forestland	%	Mineral	%	Total
AMPUCAO	201.71	10.71	6,828.24	15.94	4,302.05	84.81	11,332
DALUPIRIP	380.03	20.18	16,738.97	39.07		0.00	17,119
GUMATDANG	64.64	3.43	398.77	0.93	67.59	1.33	531
LOACAN	890.64	47.29	3,533.68	8.25	156.68	3.09	4,581
POBLACION	63.25	3.36	1,729.62	4.04	11.13	0.22	1,804
TINONGDAN	212.51	11.28	12,303.49	28.72		0.00	12,516
TUDING	30.51	1.62	302.43	0.71	168.06	3.31	501
UCAB	0.87	0.05	355.49	0.83	306.64	6.05	663
VIRAC	39.05	2.07	653.78	1.53	60.16	1.19	753
TOTAL	**1,883.21**		**42,844.47**		**5072.31**		**48,800**

Itogon is classified as a First-Class Municipality. That is, one that has obtained an average annual income of 15 million pesos or more.[13] The local economy takes advantage of the resources in the area.

Rice production is practiced in four barangays: Dalupirip, Tinongdan, Poblacion and Loacan. Vegetable and livestock production, on the other hand are found in all 9 barangays. While fishery production is reported in Ampucao, Dalupirip, Gumatdang, Poblacion, Tinongdan and Tuding.

There are two types of mining in the area: mining operations of large-scale mining companies and small-scale mining. Mining activities are concentrated in Ampucao, Gumatdang, Loacan, Poblacion, Tuding, Ucab and Virac. Residents of Barangays Dalupirip and Tinongdan on the other hand practice gold panning along the stretch of Agno River.

Investors have also taken advantage of the abundance of spring water to establish swimming pool resorts. As of 2020, twelve such establishments were operational.

Because of its proximity to Baguio City, the municipality has not identified a commercial district area. Wholesale and retail trade however still thrive in the

[13] https://www.officialgazette.gov.ph/1987/07/25/executive-order-no-249-s-1987/#:~:text=(A)%20FIRST%20CLASS%20%E2%80%93%20THE,LESS%20THAN%20THIRTY%20MILLION%20PESOS.

municipality. A Public Market is located in the Philex Mines area in Ampucao while satellite markets (talipapa) are found in Tuding, Ucab and Virac. Small family-operated retail stores or sari-sari stores are found in all barangays.

Labor force participation based on 2015 data is pegged at 93.98%. This is slightly higher for males (95.82%) than females (88.88%). The types of employment that residents engage in are in Table 7.

Table 6: Labor Force Participation as of 2015[14]

Sex	Population 15 Years and Over	Employed	%	Unemployed	%
Male	14,008.00	13,422.00	95.82	586.00	4.18
Female	5,053.00	4,491.00	88.88	562.00	11.12
Both Sexes	19,061.00	17,913.00	93.98	1,148.00	6.02

Table 7: Types of Gainful Employment[15]

Major Occupational Group	Male	Female	Total
Managers	486	1,110	1,596
Professionals	427	1,042	1,469
Technicians and associate professionals	361	364	725
Clerical support workers	191	391	582
Service and sales workers	893	1,012	1,905
Skilled agricultural, forestry and fishery workers	1,377	462	1,839
Craft and related trades workers	1,092	168	1,260
Plant and machine operators and assemblers	12,183	311	12,494
Elementary occupations	2,519	1,826	4,345
Armed forces occupation	23	3	26
Not reported	7	4	11
Total	19,559	6,693	26,252

3) Solid waste characterization and management

Results of a Waste Analysis and Characterization Study conducted in 2018 indicate that the municipality generates 13,050.10 kilograms of solid waste per day or 4,763.29 tons per year. Over half of this is biodegradable waste. Residual waste for disposal makes up 13.99% of generated waste. Majority of the waste originate from the residences (98.27%) while the remaining percentage come from institutions, commercial establishments, industries and tourist areas.

[14] Source: Community-Based Monitoring System Census 2015 as cited in the Itogon Ecological Profile, 2020, https://itogon.gov.ph/itogon-profile/.

[15] Source: Philippine Statistical Authority 2015 as cited in the Itogon Ecological Profile, 2020, https://itogon.gov.ph/itogon-profile/.

Table 8: Composition of Waste by Classification[16]

	2015 (Base Year)				2023 (Projected Data)		
TYPES OF WASTE	**Kg/day**	**Percent**	**Kg/Year**	**Tons/year**	**Kg/day**	**Kg/Year**	**Tons/year**
Biodegradable	6,809.33	52.18	2,485,405.45	2,485.41	7,574.46	2,764,677.90	2,764.68
Recyclable	2,474.66	18.96	903,250.90	903.25	2,752.73	1,004,746.45	1,004.75
Total Residual	3,146.88	24.11	1,148,611.20	1,148.61	3,500.48	1,277,675.20	1,277.68
Residual with potential	*1,320.56*	*10.12*	*482,004.40*	*482.00*	*1,468.94*	*536,163.10*	*536.16*
Residual for disposal	*1,826.32*	*13.99*	*666,606.80*	*666.61*	*2,031.54*	*741,512.10*	*741.51*
Special	619.23	4.75	226,018.95	226.02	688.81	251,415.65	251.42
Total	**13,050.10**	**100.00**	**4,763,286.50**	**4,763.29**	**14,516.47**	**5,298,511.55**	**5,298.51**

Table 9: Composition of Waste by Source [17]

Waste Sources	Percent	kg/day	kg/year	tons/year
Residential	98.27	12,824.02	4,680,767.30	4,680.77
Commercial	1.07	139.59	50,950.35	50.95
Institutions	0.54	70.00	25,550.00	25.55
Industries	0.11	14.08	5,139.20	5.14
Tourist spots	0.02	2.42	883.30	0.88
Total	**100.00**	**13,050.11**	**4,763,290.15**	**4,763.29**

In 2015, solid waste management became the responsibility of the Municipal Environment and Natural Resources Office under the direct supervision of the Mayor's Office and the Municipal Solid Waste Management Board. The 10 Year Solid Waste Management Plan of the Municipality indicates that solid waste is deposited by households in specified collection points and picked up by designated personnel who report to the MENRO. Itogon makes us of 1 dump truck, 2 mini dump trucks, 2 loaders and 1 bulldozer for this purpose.

Itogon also has 2 municipal MRFs (1 with a septic vault), 11 barangay-based MRFs, 14 school-based MRFs as well as 7 vermicomposting facilities. The municipality, however, does not have a controlled open dumpsite nor does it have an engineered sanitary landfill. The 10 Year Solid Waste Management Plan indicates that collected waste are stored temporarily at the RCA at Besil Gumatdang while awaiting the approval and construction of a proposed ESLs. The Plan also identified the following challenges:

- Presence of roadside dumping along the Municipal and Barangay roads
- Dumping of waste in water bodies (rivers and creeks)
- Lack of permanent waste disposal site
- Limited available sites for Materials Recovery Facility
- No approved site for final disposal facility as per NSWMC Resolution No. 64, s.2013
- Geographical limitations since a large part of the Municipality is within a Protected Area

[16] Source: Revised Ten Year Ecological Solid Waste Management (ESWM) Plan (2019-2028), Municipality of Itogon the years 2019-2028

[17] Source: Revised Ten Year Ecological Solid Waste Management (ESWM) Plan (2019-2028), Municipality of Itogon the years 2019-2028

- Lack of commitment and dedication of constituents on proper segregation of wastes
- Proximity to Baguio City makes Itogon a target for illegal dumping of waste from nearby areas
- In-migration of residents, tourism, proposed educational and commercial establishments in the municipality would mean additional waste to be generated and managed
- Very high susceptibility to geological hazards
- Social acceptability of solid waste final disposal facility

It is this research's task to validate/ update the information provided in the Solid Waste Management Plan as part of the overall objective of determining the extent of open burning of municipal solid waste.

III. Methodology/ Data Collection Process

Methods of Data Collection

This study used multiple methods for data collection. These are:

1) Review of documents:

   Documents from different Municipal Offices and the barangays were reviewed to obtain a picture of the general condition of the research site. The information served as guide for more specific data collection. The most important reference materials are the Municipal Profile, the Municipal 10- year Solid Waste Management Plan including the data from the Waste Analysis and Classification Survey (WACS). Municipal legislation pertinent to solid waste management and other related materials were reviewed. A list of these documents and their sources are found in Annex 2.1.

2) Review of literature
   The review of literature focused on scientific studies on open burning of municipal solid waste. On line scientific journals are the main source materials. Annex 2.2 presents the scope of topics that were covered by the literature review.

3) Direct observation/transect walk

   A walk through the project site enabled the researchers to identify critical locations for waste disposal and burning. Direct observations also enabled the team to validate responses regarding waste management. Expected outputs of this observation process are in Annex A.3.

4) Key informant interviews

   Information from officials of public offices, private institutions and individuals directly responsible for the management of solid waste in the area provided the necessary background information for the current study. Their responses helped sharpen data collection on the ground. Furthermore, involvement these key stakeholders may help facilitate their engagement in the implementation of the recommendations that will be generated through the research.

5) Household survey

   Solid waste generation and management ultimately boils down to the individual households. In fact, about 98% of waste generated in the Municipality come from households. Thus, household knowledge of proper solid waste management, their actual practices, their opinions, attitudes and recommendations are critical information for the current research. The survey instrument is found in Annex A.5

6) Survey among commercial establishments

   In addition to the households, business establishments, usually Small, Medium and Micro Enterprises (SMMEs) contribute to the waste generated in the municipality. Data presented in the 10-year Solid Waste Management Plan of Itogon indicate that these commercial establishment contribute about 1.07% of the total solid waste. These businesses (especially the small retail stores – or sari-sari (variety stores) are also often a major source of common household goods and are therefore key to the reduction of domestic waste. Information from them is therefore necessary. The survey instrument is found in Annex A.6

7) Community-level and Municipal-level validation meetings

   After the data have been processed and analyzed, the team went back to each of the 9 communities to present the highlights of the results for validation, additional inputs and recommendations. A municipal level presentation of the results for validation and inputs was also conducting involving key officials of the Municipality.

Data Sources and Data Collection Tools

The sources of data for each research method and the corresponding data collection tool/guide are summarized in the table below:

Table 11: Summary of Data Sources

Research Method	Sources	Tools/Guide
Review of documents	Pertinent government agencies	Annex A.1
Review of Literature	Online scientific/ research journals	Annex A.2
Direct observation/transect walk	Physical characteristics of 9 barangays	Annex A.3
Key informant interviews	Key informants	Annex A.4
HH survey	Sample households	Annex A.5
Survey of commercial establishments	Sample commercial establishments	Annex A.6

Sample Size for the Surveys

Sample sizes for households and business establishments are 375 and 92, respectively. These sample sizes were determined using the following values

(see Table 12). The actual number included in the survey are 377 household and 94 business establishments.

Table 12: Values used to Determine Sample Size

Parameters	Sample Households	Sample Commercial Establishments
N – Population Size	15209[18]	1984
Z – Critical value at 95% level of confidence	1.96	1.96
e – margin of error	0.05	0.05
p – sample proportion	0.5[19]	0.25[20]
n – calculated sample size	375	92

Sampling Procedure

The initial plan was to choose respondent cases using a simple random sampling procedure. This was revised because of the absence of a general list of all households at the municipal level. The recently-completed Community Based Monitoring System (CBMS), a survey of all households, has not been turned over to the municipality for use. Attempts to put together the sampling frame by collecting household lists from the barangays was futile since some of the barangays did not have complete household lists. In some cases, the list of households is kept by the Barangay Health Worker (BHW) or Barangay Nutrition Scholars (BNS) in charge of specific sitios.

Table 13: Availability of HH list per Barangay

	HH Size	Number of Sitios	Registry of Barangay Inhabitants
AMPUCAO	2970	93	Available in electronic form
DALUPIRIP	561	21	Hard copy available in BHW/BNS notebooks at the barangay hall; some notebooks kept by BHW/BNS
GUMATDANG	466	20	Available in electronic form
LOACAN	1955	41	Available in electronic form (2 files- Upper and Lower Loacan)
POBLACION	947	22	Available in electronic form
TINONGDAN	820	37	Hard copy available in BHW/BNS notebooks at the barangay hall; some notebooks kept by BHW/BNS
TUDING	2521	23	Hard copy available in BHW/BNS notebooks at the barangay hall; some notebooks kept by BHW/BNS
UCAB	2206	22	Available in electronic form

[18] Updated total number of households in the Municipality
[19] Assumes maximum variation
[20] Assumes smaller variation

VIRAC	2763	34	Currently being encoded; hard copy available in BHW/BNS notebooks at the barangay hall; some notebooks kept by BHW/BNS
	15209	313	

In addition, researchers found that in all barangays, sitios and settlement patterns are widely dispersed, rendering simple random sampling (even at barangay level) impractical and inefficient. We thus opted to use a multi-stage cluster sampling in which a proportionate random sample of sitios were chosen then a proportionate random sample of households were chosen per sample sitio,

A complete list of business establishments was available at the Municipal Permits and Licensing Office. For efficient data collection, sample business establishments were randomly selected from among the businesses in the sample sitios.

Respondent Selection

For any given sample household, the respondent is the male or female household head – whoever is most involved in the management of household solid waste. In cases when neither male nor female household heads were available, any other adult household member was chosen to be the survey respondent. For business establishments, respondents were the business owner or its manager.

Data Analysis Plan

Qualitative and quantitative data analysis were used. Data from the document review, literature review, direct observation/transect walk and key informant interviews were qualitatively analyzed. Data from the survey were subjected to both qualitative and quantitative analyses.

Descriptive and inferential were used. Percentages, measures of average and measures of dispersion are the primary descriptive tools. Where necessary, bivariate tables with corresponding measure of relationship shall be applied. These would allow for comparison across selected independent variables such as location of the household. Inferential tests shall be used to determine the likelihood that sample data reflects population characteristics. Tests of comparison between proportions in the sample and the population as well as calculations of confidence interval shall be applied using a .05 level of significance.

IV. Limitations of the Study

A number of factors limit the results of the study. As earlier mentioned, simple random sampling was not feasible due to the absence of a complete sampling frame and the very dispersed housing pattern. None-the-less, the alternative process we utilized maintained scientific objectivity and the absence of selection bias.

Much as we want to use data from an updated WACS, the Municipal plan to conduct the WACS was called off and the research grant did not provide for the

conduct of WACs independently. This means a detailed look into the specific types of waste that is generated especially the types of waste that are disposed of through burning was not feasible. To compensate, the research relied on the general information provided in the previous WACS, direct observation, and first-hand knowledge (based on previous work on solid waste management)[21] of the typical types of wastes generated by households.

Establishing a causal or a correlational link between open burning of waste and human and environmental health is limited by the fact that laboratory testing was not included among the research methods. Testing of air, water and soil quality for contaminants from the burning would certainly have established the extent of contamination and potential health impacts. Toxicological testing of residents, especially those directly exposed to open waste burning would clearly establish the link to human health.

The study would also benefit from locating the different burn sites vis-à-vis residential areas, schools, farms and critical water sources to determine the potential risks for air, water and soil contamination.

V. Survey Results

1) Respondent Profile

Household survey respondents are either the mother (48.7%) or the father (47.2%). Respondents other than the household heads include the HH head's son or daughter (10.1%) or other relatives (4.8%) while 1.9% are single-single member households. Business establishment respondents are generally the owner or co-owner (81.9%), the designated manager (13.8%) or the caretaker/storekeeper (4.3%). There are slightly more male household respondents (57.0%) while business establishment respondents are predominantly female (72.3%).

Average age of household respondents is 47.94 years; youngest is 15 years old while the oldest is 88 years old. Business establishment respondents on the other hand have an average age of 45.11 years; 16 being the youngest and 81, oldest. In terms of education, respondents from the sample households have generally reached high school level (41.9%). A sizeable number reached college or vocational education levels (37.1%). In contrast there are more business establishment respondents who reached college or vocational education levels (47.9%) while 39.4% reached high school levels.

2) Waste Generation in Households and Businesses

Some characteristics of businesses and households that impact on waste generation and management are presented below.

Majority of the business establishments included in the sample are retail store (72.34%) – that is, the typical sari-sari stores that populate most barangays. A

[21] For instance, an interview with the General Services Criss Biscarra of Baguio City General Services Office revealed that about 80% of residual waste in the city is plastic. Zero Waste Baguio Inc. was lead consultant in the conduct of the WACS at the University of the Philippines Baguio in 2017 and 2020 and in the conduct of the Waste Analysis and Brand Audit in Barangay Tawang, La Trinidad, Benguet in 2022.

few (12.8%)[22] are establishments that render services to their clients while 6.7% are establishments that serve food and beverages.

Households in Itogon are not very large with mean household size of 4.47 members. Single member households are relatively numerous (6.1%) while households with more than 10 members constitute less than 1% of the sample households.

Households with infants and toddlers aged less than 1 year make up 9.04% of households. These are the potential generators of diaper waste. Those with women of child-bearing age (age 12 to 49 years) or potential users of sanitary napkins, constitute 70.74%. While those with members who are undergoing prolonged medication (more than 6 months) make up 35.28%. Not all the reported diseases, however, may require household treatment that generates medical waste. The most commonly reported illness is hypertension, reported in 45 cases. This is followed by heart disease (28 cases), rheumatism/arthritis (24 cases) and disability due to old age (23 cases). Diabetes, kidney disease and stroke patients were reported in 12, 8 and 4 cases, respectively.

Households involved in farming make up a little less than one fourth (23.47% of respondents). More than half of these (52.27%) use chemical inputs, potentially generating hazardous waste. Over a third of households (38.73%), on the other hand are involved in small scale mining – another potential source of hazardous waste.

In terms of purchasing behavior, we find that Itogon residents buy their household needs in Baguio City. Itogon does not have its own public market although the small-scale retail stores supply much of the households' basic needs. The phenomenon of online shopping has also taken root in the municipality. More than two-thirds (67.37%) of the households shop online. More than half (55.12%) do so at least once a month while 11.02% are frequent online shoppers (i.e. shopping more than once a month).

Although the municipal ordinance to ban the use of single use plastic has not been fully enforced, we find that majority of households (80.05%) and majority of businesses (85.11%) always bring their own bags when they go to market. Only 2.30% of households and 9.57% of businesses never bring bags with them. While this practice helps reduce the use of disposable plastic that end up as waste, so much more needs to done to control the proliferation of plastic waste.

We also find that the practice of reusing empty containers to be fairly common. Among Households 54.38% say they sometimes reuse empty containers and 37.14% say they always reuse containers. Among business, 42.70% say they sometimes reuse containers while 46.07% say they always reuse containers.

3) Solid Waste Management Practices

a) Waste segregation

[22] Sample business establishments that provide services include construction companies, tailoring and t-shirt printing, printing press, internet shop, laundry shops, property rental/boarding houses, gasoline refilling stations, gold trading, modeling agency and buying and selling of scrap materials.

Majority of households (83.29%) maintain multiple garbage receptacles in their homes. This would help ensure segregation of garbage at source. Half of these households (52.87%) however, maintain only two garbage containers while 43.63% maintain 3 containers. Only 3.5% maintain 3 or more containers. Furthermore, 15.12% of the sample keep only 1 container and another 1.59% do not have any garbage receptacles at home. These latter households claim they throw waste directly into a pit or burn them.

The practice of segregating waste and putting these in separate containers is high. Three fourths (75.37%) of respondents claim they always segregate waste; 9.43% do segregate waste sometimes and 15.09% do not segregate waste at all. Surprisingly, a third (35.09%) of those with only 1 garbage receptable at home still manage to segregate waste. On the other hand, 6.27% of those who say they maintain 2 or 3 garbage containers at home do not segregate waste.

The most common segregation practice is to categorize household waste into 2. This is done by 59.75% of households. There is however some variation in the types of waste that are segregated. Many (75.79%) separate residuals and recyclable materials. Others distinguish among biodegradable materials (for compost or animal feed) and recyclable materials. A third of households (33.02%) segregate waste into three categories. 90.48% of these correctly distinguish among biodegradable waste (for compost or animal feed), recyclable materials and residual materials. Segregating into 4 categories is rare. Done only by 1.57% of households and only 1 respondent correctly identifies the 4 categories – biodegradable waste, recyclable materials, residuals and special (toxic and hazardous) waste.

In half of the cases (51.06%), business establishments manage waste separate from their household waste. Most of these businesses maintain 2 (44.09% of businesses) or 3 (37.63% of businesses) garbage containers. 15.05% keep only 1 garbage receptacle in the business establishment. About 81.72% of the cases report that they always segregate waste from their business.

Waste is typically segregated into 2 by 70% of businesses. These usually separate recyclable materials from residuals. Sometimes recyclables are separated from the biodegradable materials. Only three respondents reported that they separate toxic and hazardous waste from other types of waste.

b) Dealing with biodegradable waste

As indicated in the previous section, biodegradable waste is often used as compost or as animal feed. 72.68% of households do compost biodegradable waste and 87.80% feed food scraps to animals. About two thirds (62.33%) practice both ways of waste management and only 7 households (2.12%) practice neither. When asked what they do with biodegradable waste, we were told that they throw this in open space or the river.

Majority of those who compost biodegradable waste prepare a compost pile (71.43%) or dig a compost pit (25.64%). Others throw the biodegradable materials directly into their gardens. Only 1 household practices vermicomposting and another uses molasses as inoculant.

Among the business establishments, 34 do not generate food scrap while 39 do not generate biodegradable waste. Majority of those that generate food scraps

give these as feed to animals (79,33%). Those with biodegradable waste generally (78.18%) compost these materials. Only 4 business establishment practice neither of these 2 biodegradable management methods. Similar to households, business establishments generally use a compost pile (69.77%) or a compost pit (25.58%).

c) Managing recyclable materials

The survey looked into three ways of managing recyclable waste: a) giving/selling these to waste collectors, b) giving/ selling these to junkshops and c) bringing these to the barangay Materials Recovery Facility (MRF).

Giving/selling recyclable materials to waste collectors is the most common way of managing this type of waste (78.51%). This method is convenient because the waste collectors are ambulant and can pick-up the materials at the household level. Those that sell/give recyclable materials to the junk shops are far less (49.07%). Although there are 4 junkshops in the municipality, they can still be quite difficult to reach. Bringing recyclable materials to the designated MRFs is the least common way of managing recyclable materials. Only 18.30% regularly bring materials to the MRF while 1.59% sometimes do so. Forty-three households (11.41%) Neither give recyclable materials to waste collectors nor bring these to junkshops nor bring these to the MRF.

When asked why households do not bring materials to the MRF, respondents generally say they think there is no MRF in the area or don't know where it is located (66.23%) or they think it is too far (58.28%) or think it is non-functional (1.66%). In addition, respondents say there is no one in the household to bring materials to the MRF (10.60%) or household members do not have the time to do so (5.30%). The fact that materials given at the MRF are given for free was mentioned in one instance.

Four of the business establishments in the sample claim they do not generate recyclable materials. Those that do generally give/sell these materials to the waste collectors (86.67%). A little over half (56.18%) of them bring the recyclables to the junk shops. Only 17.78% bring the materials to the MRF. As in the case of the household, awareness of the MRF and distance are the primary reasons for non-utilization of MRFs. About 8 businesses do not practice any of the three ways of recyclable management.

d) Management of residual waste

The Municipal Environment and Natural Resources Office (MENRO) is primarily responsible for the collection and disposal of the municipal residual waste. A barangay collection schedule has been established (see Table 14). Each barangay identifies the areas where residents can leave waste for pick up by the municipal waste collectors. Pick-up points are usually along the main road, often at waiting sheds. Barangays are also responsible for designating volunteers or "Bantay Basura" who oversee the proper and orderly disposal and pick-up of solid waste. Among these volunteers' responsibilities is ensuring that biodegradable materials are not mixed with residual waste.

Solid waste collected from the barangays are brought to the Temporary Residual Containment Area (TRCA). At the time of the research, the TRCA that was operational is located at Antamok, Lower Loacan. This was eventually closed

down because of poor road conditions leading to Antamok. Collected waste was then brought to the municipal MRF at Ayosip, Poblacion[23] where these are sorted (to separate recyclable materials) and stored. Since the municipality only has two 4-cubic meter dump trucks, solid waste is allowed to accumulate at the TRCA for more efficient transport to the Engineered Sanitary Landfill (ESL) in Capas, Tarlac. At the time of the research the dump trucks make 2 trips to Tarlac in one week.

Table 14: Schedule of Solid Waste per Barangay

BARANGAYS	SCHEDULE OF WASTE COLLECTION
Ampucao Proper	Fridays
Ampucao Dalicno	Thursday (pm)
Dalupirip	Friday
Gumatdang	Tuesday
Loacan	Thursday (am)
Poblacion	Monday
Tinongdan	Thursday (am)
Tuding	Wednesday
Ucab	Tuesday
Virac	Monday

Compliance to the waste collection schedule is far from perfect. A little more than half of households (54.64%) always follow the waste collection schedule while close to three-fourth (71.28%) of business establishments do likewise.

The most common reason for non-compliance for both households and business establishment, is the low awareness of the waste collection in the area. Some respondents think there is no waste collection in the barangay or that waste collection in the barangay has ceased (47.73% of households and 76.92% o businesses). Respondents from both groups also reported lack of knowledge of the designated time or the designated area of collection. Officials explained that in some barangays, collection schedules were only established in December, 2021, during the height of the Covid pandemic. Thus, information about waste collection may have not been effectively disseminated. In some cases, waste collection has been severely affected by weather conditions. Typhoon Egay in July 2023, for instance, wiped out the bridge linking Lower Loacan to the Poblacion and other barangays. Hence, garbage collection in the area was suspended. It was resumed when the weather improved and vehicles could traverse the river. A third factor is the timely release for funds for fuel for the trucks. Garbage collection was temporarily suspended to prevent overflow at the TRCA.

Other reasons for non-compliance to waste collection is the distance of the collection area. 17.42% of households and 7.69% of businesses say the collection point is too far. Others say they do not have the time or personnel to bring out the garbage. In addition, a few households claim they are not motivated

[23] By this time the municipal MRF at Besil, Gumatdang has been closed by order of the Environment Management Bureau.

to bring garbage to the collection area because sometimes the garbage is not collected anyway.

How then do households and businesses deal with residual waste? The most common alternative means of disposing residuals is through burning. Over 80 percent of households and businesses that do not bring residuals to the collection area burn their residual waste (84.78% of households and 88.46% of businesses). Some cases also bury their waste or dump them in pits (39.13% of households; 23.08 of businesses) or throw these in open spaces, including the river (20.29% of households and 7.69% of businesses). A few cases bring their residuals outside the barangay or even outside the municipality. Others bring the residual to the barangay MRF. A few who live near the Philex Mines say they bring to residuals to the company's landfill.

We also find that burning is practiced even by the residents who bring residuals to the collection area. More than half of businesses (55.32%) and three fourths (74.54%) of households admit to open burning. Those who openly burn waste do so quite frequently. Most of them do so at least once a week (60.14% of households; 59.62% of businesses) or at least once a month (29.54% of households; 25.0% of businesses). Still others burn residuals more than once per week (6.05% of households; 9.62% of businesses).

Estimated volumes of waste burned each time are high for both households and businesses. 75.44% of households say they burn more than 1 kg of waste while 80.39% of businesses burn approximately the same amount. In addition, 15.30% of households and 9.80% of business burn about ½ to 1 kilogram of waste each time.

The locations of the burn sites are typically farther than 5 meters away from the household (48.21%) or from the business location (63.46%). There are households and businesses that burn within a 2-meter radius from their location (12.14% of households and 7.69% of businesses). Households/businesses usually utilize individual burn areas. There are no common burning areas used by most members of the community.

Although distance from the household/business is used here as a rough measure of the risk from burning, it is admittedly an inadequate measure of risk since wind factor has to be considered in the spread of smoke and ashfall. Percolation and surface run-off of toxic substances released during burning would also have to be considered. Exposure to the toxic substances may also be higher for the person responsible for burning the waste and also higher in denser communities. During the community validation, participants say

Table 15: Summary of Information on Open Burning Practices in Itogon

Variables	Categories	Households	Businesses
Cases who admit to open burning	Among those who do not bring waste to the collection area.	84.78%	88.46%
	Among total number of cases	74.54%	55.32%
Frequency of waste burning	At least once a week Still others burn residuals	60.14%	59.62%
	More than once per week	6.05%	9.62%
	At least once a month	29.54%	25.0%
Estimated volumes of waste burned each time	More than 1 kg of waste	75.44%	80.39%
	½ to 1 kilogram of waste	15.30%	9.80%
Location of burn sites	Farther than 5 meters away from the household/business location	48.21%	63.46%
	Within a 2-meter radius	12.14%	7.69%

4) Knowledge on Solid Waste Management /Open Burning of Waste

How informed are the residents of the risks of improper solid waste management?

First, in terms of participation in orientations on solid waste management, we find that less than half of households (42.97%)and businesses (47.31%) have attended any orientation of waste management. Highest percentages of household orientation are found in Tinongdan (65.38%) and Gumatdang (63.64%). For businesses, the highest percentages of participation on waste management orientation are reported in Poblacion (70%) and Tinongdan (60%). Highest attendance of households in more than 1 orientation session is reported in Poblacion (19.23%), Virac (12.50%) and Tinongdan (11.54%).

In most cases, the orientation was conducted by barangay officials/staff (79.63% of households and 59.09% of businesses) and municipal officials/staff (18.52% of households and 38.64% of businesses). Private entities also played some role in the orientation of the households (19.14%) and businesses (9.09%).

Familiarity with the Ecological Solid Waste Management Act of 2000 (RA 9003) is generally low (27.47% among households and 24.73% among businesses). It is definitely higher, however, among those who have attended orientation on waste management (40.74% among households and 40,91% among businesses). Awareness of the Municipal Ordinance on solid waste management, however is much higher (63.13% of households; 64.52% of businesses) especially among those who have attended any orientation (88.89% of households and 88.64% of businesses).

In spite of the low participation in orientation activities, knowledge of prohibited acts under RA 9003 or Mun. Ord. No. appears high. Only 6.9% of households

and 3.19% of businesses could not name any prohibited act. The rest are able to identify one or more such acts. Regulations on proper waste segregation and the prohibition of waste burning are the most widely known. As many as 76.92% of households know that segregation of waste is mandatory and 71.88% know that waste burning is not allowed. For businesses, the figures are also high at 79.79% and 78.72%, respectively. Prohibition of dumping in rivers and waterways and other open spaces is also widely known.

Table 16: Summary of Respondents' Knowledge on Open Burning

Variables	Categories	Households	Businesses
Know that open burning of waste is prohibited by law		71.88%	78.72%
Is burning a safe way of disposing of waste	Not safe	55.17%	68.09%
	Depends[24]	26.79%	26.79%
	Safe	18.04%	8.51%
Knowledge of problems caused by open burning of waste	Burning of waste affects health	63.46%	52.40%
	Burning of waste affects the environment	40.38%	40.63%.

When asked if the respondents think burning is a safe way of disposing garbage, only 55.17% of households and 68.09% of businesses think that it is not safe to burn waste. 26.79% of households and 22.34% of businesses think that burning may be unsafe depending on circumstances. They usually refer to the type of waste that is burned. Only 18.04% of households and 8.51% of businesses categorically say that burning is a safe method of waste disposal.

The most frequently cited problems caused by waste burning are health-related. 63.46% of households say burning is bad for the health. 52.40% say burning of waste affects health in general. A few cited more specific health issues such as headache/migraine, respiratory diseases, asthma, heart diseases and cancer. The second set of issues pertaining to waste burning is environmental as cited by 40.38% household respondents. 17.79% mentioned environmental impacts in general while others cited specific effects like air pollution, the release of carbon monoxide, the impact on the ozone layer, global warming and climate change and landslides. A few respondents said burning waste is harmful without citing any specific harm. A few say it is harmful to vulnerable groups like children and those with pre-existing health conditions. A few said burning waste is bad because of the odor or because it can be a potential cause of fire. Health-related risks make up 50% of responses among business establishments. Environment-related risks on the other hand constitute 40.63%.

The survey also looked into the community's awareness of risks posed by special types of waste or those that are classified as toxic or hazardous wastes. The responses of households and businesses are as follows:

[24] Materials that respondents think are not safe to burn include rubber especially tires and plastics.

Table 17: Types of Special Wastes Identified by Respondents

Types of Special Wastes	Households	Types of Special Wastes	Businesses
NONE	18.30	NONE	18.09
MEDICAL WASTE	12.47	MEDICAL WASTE	21.28
ELECTRONIC WASTE	6.10	ELECTRONIC WASTE	7.45
LIGHT BULB	20.95	LIGHT BULB	29.79
BATTERIES	45.09	BATTERIES	52.13
AGRICULTURAL CHEMICAL CONTAINERS `	14.06	AGRICULTURAL CHEMICAL CONTAINERS `	7.45
MINING CHEMICAL CONTAINERS	6.10	MINING CHEMICAL CONTAINERS	3.19
CONTAINERS OF CLEANING AGENTS	9.28	CONTAINERS OF CLEANING AGENTS	11.70

Note that about 18% of households and 18% of business are unaware of special types of waste that are potentially harmful if not managed properly. Batteries, light bulbs and medical wastes are the most commonly mentioned types of special waste. Containers of agricultural chemical inputs was also identified by 14.06% household respondents. Identifying waste agricultural chemical inputs among household that are engaged in farming/gardening is low at 15.91%.

In addition to these special wastes, respondents identified a host of other wastes that may cause harm if improperly managed. The most common of which are: plastics including cellophanes (61.70%), used diapers and sanitary napkins (27.66%), rubber including tires (23.40%), glass/ bottles (19.15%) and broken glass/plastic (12.77%).

A significant number of respondents are unaware of the proper ways of managing waste from chemical agricultural inputs. A third admit they do not know how to manage such wastes (34.22% of households; 38.04% of businesses). About one third think these should be buried (32.10% of households and 30.43% of businesses). Giving these to recyclers is the next most commonly identified way of disposing of this type of special waste. We further note that 6.37% of households and 3.26% of businesses think burning is an appropriate way of managing containers of agricultural chemicals.

Knowledge on the safe way of managing waste from small scale mining is also low. About 40% of households and 42.86% of businesses admit they do not know the appropriate way of managing solid waste from mining. Households think these be buried (26.33%) or brought to the designated waste collection area (17.82%). Burning is the third most frequently recommended means of managing such waste (9.57%). For businesses, the top two means of is disposal are bringing the mining waste to the collection area (13.19%) and burning (10.99%).

Among households engaged in small scale mining, burying waste generated in the industry seems to be the most appropriate means of disposal (28.97%). Some also believe it is appropriate to leave these in the open field or throw them into the river or other waterways (17.93%) while 16.55% think mining-related waste should be brought to the designated waste collection area or to the MRF.

Close to a third (31.03%) admitted not knowing the appropriate way to manage the waste while those who think burning is appropriate make up 14.48% of households involved in small scale mining.

The three most common ways of disposing of electrical wastes identified by the respondents are a) burying (41.64% of households and 42.39% of businesses) b) bringing them to the waste collection area(31.83% of households and 38.04% of businesses) and c) giving them to the recyclers (21.22% % of households and 25.00% of businesses). Fewer respondents say they do not know how to manage electrical waste as compared those who do not know how to dispose of agricultural and small-scale mining wastes. It will be noted, however that 5.57% of households and 4.35% of businesses think burning is a proper way of disposing of electrical waste.

Table 18: Respondents who think special wastes can be burned

Types of Special Wastes	Households	Businesses
AGRICULTURAL CHEMICAL CONTAINERS `	6.37%	3.26%
MINING CHEMICAL CONTAINERS	9.57%	10.99%
ELECTRONIC WASTE	5.57%	4.35%

5) Attitudes and Opinions

a) Should open burning of waste be allowed?

The survey asked a few questions to gauge respondents' opinions on some issues pertinent of solid waste management.

On the issue of lifting the prohibition on open burning, majority of households (57.82%) would like to keep the ban on open waste burning. The number who favor allowing burning, however is still significant (42.18%). Not surprisingly majority of those who think burning is a safe way of disposing of garbage favor the lifting on the ban on open burning. We find however that one fourth (25%) of those who think waste burning is not safe still favor the lifting of the ban.

The percentage of businesses that favor keeping the ban on burning is much higher at 73.12%. There is also higher consistency in the answers of those who think open burning of waste is not safe. Only 15.63 % of these think the ban should be lifted.

The reasons given by those who favor waste burning reflect the lack of choices for proper waste disposal. Some say there is no waste collection in their area or the collection point is far. Others say waste brought to the collection point is sometimes not picked up. Burning the waste is preferred to having them scattered all over the barangay, some say burning will reduce waste. Others think burning waste would drive away mosquitos. Still others favor burning of selected types of waste only – leaves and paper are mentioned. Others say plastic and rubber should not be burned although others recommend burning of plastic. A few say burning can be allowed provided that burn sites are located away from houses and done only at specific times of the day.

b) Should single use plastic be banned?

Majority or households (69.23%) and businesses (62.37%) favor the banning of single use plastics to reduce waste. A significant proportion are willing to consider it (19.63% of households and 19.35% of businesses). Only 11.14% of households and 18.28% of businesses do not favor the banning of single use plastics.

Those who favor the ban say this will reduce waste. They recognize that much of the waste found around the barangays are plastics. Plastics, they say are hard to dispose. They do not decompose and cannot be burned because of the bad fumes and odor that burning emits. Single use plastics, they say cannot be reused and recycling is limited because single use plastic materials are not bought by the waste collectors. It is bad to the health and the environment – especially because they clog up the canals and waters. Besides, some say, there are alternatives available. Those who say they may consider the banning of single use plastics worry about the lack of alternative packaging materials. They say plastics are needed for some products such as fish and meat. Single use plastics might still be reused, they say. They are convenient and easily accessible and are therefore still useful. Some respondents say such a ban would be difficult to implement. For those who do not favor the ban, plastics are still useful especially for wet products. It is convenient to use and using plastic has become a habit. They claim there are no viable alternatives. Furthermore, they say, single use plastics and be reused and can be disposed of at the collection area. Some say we should improve the collection and management of plastics instead. Some business operators worry that the banning of single use plastics will lead to loss in profit. On the other hand, some business operators and households think the plastic ban would actually reduce the prices of goods.

c) Payments for waste management services

Since distance of waste collection areas and the available of household members and business operators to bring waste to the collection points were raised as a factor in proper waste disposal, we asked the respondents if they would be willing to pay someone to pick up their waste from their location. A significant proportion said yes, they would be willing to pay for garbage pick-up (59.95 % of households) or are at least willing to consider it (12.47% of households). Over one fourth of household (27.59%) would not be willing to pay to have their garbage picked up. Ironically, about one fourth of households (25.36%) who do not bring their waste to the designated collection point and 27.27% of those who sometimes comply with the proper waste collection are not willing to pay to get their garbage brought to the designated collection area. Perhaps, the fact that they have alternative means of disposal, albeit in violation of the law, make payment of waste collectors unnecessary. On the other hand, more than half (58.25%) of those who already bring their waste to the collection area would still be willing to pay someone to pick-up their trash.

Finally, there had been proposal to collect garbage fees from Itogon residents and businesses to cover the mounting costs of solid waste collection and disposal. Public hearings on this matter were on going around the time of the survey data collection period.

Many of the survey respondents favor the imposition of garbage fees. That is, 58.62% of households and 69.89% of businesses. Only 10.75% of businesses oppose garbage fees while more than a fourth of households (26.79) feel the

same way. Those who are willing to pay garbage fees see this as a way to guarantee proper collection of garbage. Some specified that paying fees may ensure collection in far flung sitios and the collection of all forms of garbage. Many say this may be a way to help keep the environment clean and to reduce improper waste disposal like burning. Thay also would like to help the barangay and especially the waste collectors. The amount to be collected, however, should be reasonable and affordable. Respondents who are still undecided on the matter may consider payment of garbage fees if the amount is reasonable and if it will guarantee collection and the maintenance of cleanliness. People who are opposed to the collection of garbage fees say waste management is the responsibility of the local government. There are funds allocated for this through taxes. Many say they may not be able to afford the fees. A few say they are already doing their responsibility of bringing their waste to the collection area or MRF. Others say the option to bring the waste to an open pit or to burn these is available and free.

Table 19: Summary of Attitudes and Opinions on Solid Waste Management Solutions

Variables	Categories	Households	Businesses
Should open burning of waste be allowed?	No	52.82%	73.12%
	Yes	42.18%	15.63%
Should single use plastic be banned?	No	11.14%	18.28%
	Maybe	19.63%	19.35%
	Yes	69.23%	62.37%
Willingness to pay someone to pick up their waste from their location	No	27.59%	Nd
	Maybe	12.47%	Nd
	Yes	59.95%	nd
Willingness to pay garbage fees	No	26.79%	19.35%
	Maybe	14.59%	10.75%
	Yes	58.62%	69.89%

d) Overall satisfaction with waste management in the community

There are more households and business who expressed dissatisfaction in the way solid waste is managed in the municipality. (65.69% of households and 53.76% of businesses). Understandably, respondents in areas where there is no waste collection or where the waste collection area Is too far are dissatisfied with the waste collection system. Inconsistent collection times is also one source of dissatisfaction in addition to the fact that not all wastes are collected. Improper waste disposal methods were noted including burning, dumping in open areas and rivers, and non- segregation of wastes were also noted. Thus, the observation that solid waste management rules should be implemented more strictly. Information about solid waste management also needs to be more effectively disseminated.

On the other hand, respondents who expressed satisfaction with the solid waste management note timely and regular collection of waste. They say waste segregation is observed. They also quite please of the regular clean-up drives in the community.

VI. Open Waste Burning and Health Concerns

In view of the survey results that indicate poor waste management practices and several observations of the burning of wastes that included plastics as documented by photographs (see Annex ___) taken during the duration of the project, it is but imperative to inform the Itogon residents of the impacts of burning plastics. The residents' inclination to consume plastic bottled water is another cause for concern as well as their penchant for drinking soda from a colored plastic bottle as evidenced by green plastic bottles lining up their gardens and being used as landscape ornamentation. It is also important to note that plastic water bottles as well as soda bottles are of the single-use type of plastic materials. Since they are ideally to be used once, disposable water and soda bottles usually get tossed back into the environment and leads to voluminous waste leading to a negative effect on the environment. Also, experts warn that repeated use of water& soda bottles made from PET can wear down the material, which could allow harmful bacteria to build up in the cracks. Washing PET bottles can also cause problems since exposure to hot water can cause plastic chemicals to leach into any drinkable liquid that is placed in the bottles for reuse. Maybe recycling can mitigate some of the environmental damage done by single-use plastic bottles but it would be much health- and earth-friendly to choose a non-plastic water bottle.

The impacts of chemicals in plastics and the additional effects of heated and burned plastics were presented in a validation meeting with the Itogon LGU and several community health practitioners (Annex _____) . Although studies show that the most common chemicals in plastics are the plastics themselves like polyethylene terephthalate (PET) which makes up most single-use plastic water bottles, there are also other phthalates and bisphenol-A (BPA). BPA was the main focus in the presentation since it is suspected to cause adverse health effects such as increased blood pressure, type 2 diabetes, and cardiovascular disease in adults. As an endocrine disruptor, BPA maybe a link to health problems involving the brain and prostate gland of fetuses, infants, and suspected to also affect children's behavior.

Moreover, new research shows BPA levels may decline initially after consumption, but may stay in the human body for longer than previously expected, potentially making it more detrimental. In addition to being concerned about too much consumption of water from plastic bottles, the worry should be on the accumulation of BPA in the body over time. Furthermore, when plastic water bottles are left exposed to the sun, it exacerbates the problem by allowing BPA chemicals to leach into the water. Likewise, the possibility of dioxins being released in the air, water systems and soil after the burning of plastic wastes was taken up during the meeting. The ill-effects of dioxins on human health include chloracne and other skin disorders, liver problems, impairment of the immune system, the endocrine system and reproductive functions, effects on the developing nervous system and other developmental events, and certain types of cancers. It was emphasized that dioxins work their way up the food chain by moving into and remaining stored in our body fat. The growing concern on the presence of microplastics in bodily fluids of humans and in fishes like bangus was presented as well in the meeting.

Another cause for concern is the wastes from the mining activities being undertaken in 7 of 9 barangays (Ampucao, Gumatdang, Loacan, Poblacion, Tuding, Ucab and Virac). The solid wastes, tailings and chemical wastes

generated by mining cannot just be overlooked as they also have dreadful impacts on the environment and human health. It can be noted that the study did not include survey questions on the mining practices being carried out in the aforementioned barangays nor on the use of mercury and cyanide but photo documentation shows piles of mine tailings on the mountain sides. The management of the solid wastes from mining could be an added inquiry into how waste management is undertaken in Itogon.

VII. Summary of Findings

This research found a high percentage of households and business establishments in the Municipality of Itogon resort to open burning as a means of waste disposal. Problem is intricately linked to the challenges of solid waste management in the area – from waste generation, to its collection and final disposal.

Itogon, like most places in the Cordillera is unable to establish its own Engineered Sanitary Landfill because the municipality is located within a watershed and is classified as a protected area. Hence, the LGU has to resort to bringing its waste to an ESL in Tarlac at great expense. The challenge of transporting waste is aggravated by the fact that the LGU only has 2 small dump trucks. The same trucks are used for waste collection at the barangays, putting a strain on efficient and timely collection of waste. The research found that problems in ensuring the transport of solid waste did affect collection of waste. Thus, residents resorted to alternative means of waste disposal including open burning.

Effective collection of solid waste is also constrained by the terrain and limited road network in the municipality. Many sitios are far flung and cannot be reached by the waste collectors. Open waste burning therefore has become a convenient option.

What do residents burn? In all likelihood, solid waste that is burned includes plastics – especially plastic packaging. The burning of plastic is known to release chemicals that may leach into the soil, contaminate water system and release toxins in the air. Foremost among these toxic chemicals is dioxin – a known carcinogenic substance.

Apart from plastic packaging, residents may also burn recyclable materials such as tin cans, paper and plastic bottles. Burn sites were observed to contain residue of these materials. Furthermore, data on waste segregation practices indicate that residents do not effectively segregate waste into the 4 different waste categories. Thus, recyclable waste and possibly even special waste (toxic and hazardous waste) are mixed with the residual waste that is disposed off through burning. This possibility is supported by the fact that many respondents do not know what special wastes are and how to properly dispose of these types of waste. Some respondents say burning special wastes is also acceptable.

Many residents are aware that open burning of waste is prohibited by law. They are also aware that the burning of waste can harm the environment and the health. Most respondents, however, unable to specify the harm that waste burning can bring or are able to identify only some of the common problems such as bad odor, air pollution, cough, migraine difficulty in breathing and the like.

None of the respondents talked about the possibility of toxic contaminants in the air, soil and water and the adverse effect of these on human health.

In spite of the general knowledge of the potential harm of open burning, a significant number of respondents would like open burning of waste be allowed. This is mainly because they do not see any viable solution to the waste management challenges that they face.

VIII. Conclusions and recommendations

Resolving the problem of open waste burning requires a wholistic approach. It is not sufficient to merely apply the law and penalize all violators. Apart from the fact that this solution is physically impossible to implement, the solid waste problem would remain and residents may resort to other equally improper and harmful means of disposal – such as burying or dumping in open spaces.

The collection of garbage, recyclable materials and special wastes will clearly have to be improved especially in the remote sitios. In this regard, the role of the barangays is critical. In the course of the research, we encountered some barangays mobilizing their resources to ensure that solid wastes from more distant sitios are collected and deposited in the designated pick-up points. More of such initiatives would be welcome. The waste collection schemes must be tailored to the specific situation of the barangay and its sitios. There cannot possibly be one model that would suffice.

Collection of recyclable materials and special waste also need to be intensified. The MRFs need to be activated. However, since distance is an issue and it is near impossible to build MRFs in all sitios, the system of collecting recyclable materials and special waste from the sitios needs to be developed. Collected materials can then be deposited in the MRF before they are properly dispatched. The role of informal waste pickers/collectors in ensuring proper collection of recyclable materials need to be maximized and supported.

The role of education is critical. There is clearly a gap in understanding how improper solid waste management, especially open waste burning impacts on human health. Understanding these effects on health may be pivotal in behavioral change. The role of BHWs and BNSs in health education is vital.

To clearly establish the link of open burning and human health, laboratory testing of air, water and soil samples is recommended. Testing of toxic substances in residents, especially those exposed to open waste burning will clearly establish the link of open waste burning and human health. It is also highly recommended that a study on presence of microplastics in human tissues and bodily fluids such as the investigation on microplastics in human blood done by Microplastics scientist Heather Leslie of Vrije Universiteit Amsterdam. The levels of cyanide and mercury concentrations in hair and blood samples of Itogon constituents who are involved in small-scale mining is likewise recommended following the procedure done in miners in Diwalwal, Compostela Valley. The said report also reflected that small-scale miners and other affected people in Itogon, Benguet showed high levels of mercury and cyanide concentrations in their hair and blood samples. A follow-up study cannot but emphasized the health hazards of these two chemicals that are used in mining activities.

Ultimately, RA 9003 provides the framework that would address the solid waste management problems of the municipality including open waste burning and the burning of plastics and other toxic substances. This framework emphasizes waste avoidance and waste reduction as the most important strategies in waste management. Given that plastic waste- especially single-use plastics, is the most prolific type of residual waste and is also most harmful to the environment and human health especially when burned, there is clear reason to institute programs and policies to reduce if not eliminate these. The municipality already has an existing ordinance of regulating single use plastics. This needs to be reviewed and implemented in order to improve waste management in Itogon.

Figure 1. Hierarchy of Solid Waste Management System