



Mission Report

Case Study: Waste Recycling and Composting Value Chain in Yemen

For
SV PWF/ GIZ Yemen

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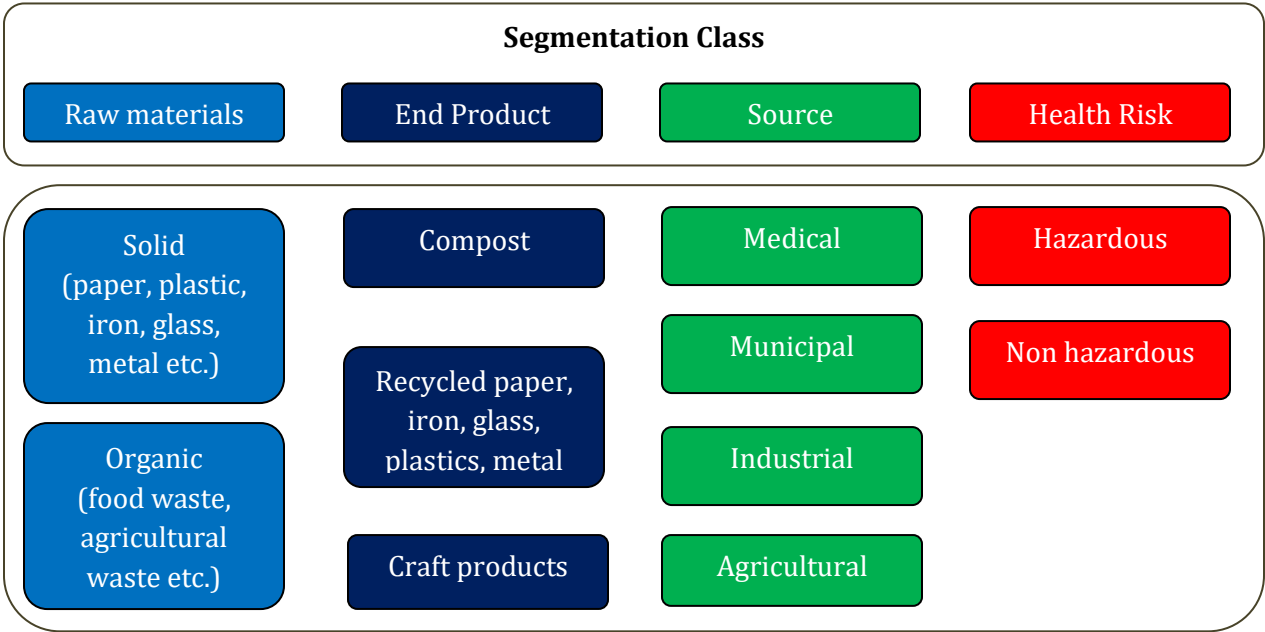
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Case Study: Waste Recycling and Composting Value Chain in Yemen

1.1 Defining the waste recycling subsector and the value chains

Recycling is a process to change waste materials into new products to prevent waste of potentially useful materials, reduce the consumption of fresh raw materials, reduce energy usage, and reduce air pollution from burning and water pollution from land fields by reducing the need for waste disposal. Waste recycling can be segmented into several subsectors based on the raw material that is being recycled (for example solid waste and organic waste) or based on the final product (for example compost). It can also be segmented by source; for instance municipal waste, agricultural waste, medical waste, industrial waste. Waste is also classified as hazardous and non hazardous depending on the health risk associated with it. Figure 2 illustrates the different types of waste recycling subsectors:

Figure 2: Classification of Waste Recycling Subsectors



For the purpose of this study we used the classification based on raw materials. This broadened the window to look at different prospects which includes production of different types of value added products, prospects for the products in local and international markets and engagement in both urban municipalities for household waste and rural markets for agricultural waste. Medical waste is kept outside the scope of this study since it is classified as hazardous and the methodology to investigate its scope would entail expertise that was unavailable with the team. Similarly, hazardous industrial waste, for instance chemical waste and effluence was also kept outside the scope of the investigation because of the technical nature of the product and unavailability of expertise within the team. The assessment is primarily relevant for municipal waste. In depth assessment of the composition and use of recyclable agricultural and industrial waste could not be done because of unavailability of secondary

information. Besides, time and resource allocation for field investigation did not allow for in depth field assessment in rural areas for agricultural waste.

1.2 Waste Recycling and Composting Value Chain in Yemen

End Market: The market is primarily export driven. Saudi Arabi, Dubai and India are reported to be the largest importers of recyclable paper, glass, plastic, rubber and metal products from Yemen. According to respondents some of the exported recyclable products are then re exported to countries like Pakistan where it is transformed into recycled finish products. Low wage rate in comparison to Saudi Arabia and Dubai, subsidy on diesel and therefore comparatively lower cost of transportation is reported to be major comparative advantages for export. Data on the market size of different types of recyclable products in the Middle East could not be availed from secondary sources. Reports suggest that there is increasing investment on waste recycling especially in Saudia Arabia and United Arab Emirates and it is suggested that the production of recyclable products in the Middle East will continue to grow fast.

However, Yemeni exporters of recyclable glass, paper, metal, tyre and plastic products are yet to take full advantage of the growth prospect which is evident from the fact that there are only few exporters of the recyclable products under the different categories. According to the respondents, the number of exporters of recyclable products from Yemen has remained low because of unavailability of raw materials. This can be related to the fact that large percentage of the waste remains uncollected and the rest is dumped in land fill areas or openly. The waste that is collected is therefore soiled and loses its value. The exporters reported that they have contracts with institutions like super markets and factories from which they collect recyclable solid waste directly. It can thus be articulated that by supporting the local exporters to have functional and efficient collection and segregation system could foster growth of the sector and attract new investors. Nevertheless, growth might be constrained because of the fact that the current political instability in Yemen has hurt the investment climate and investors are likely to refrain from capital investment that is required for preprocessing of the recyclable products.

Besides, the high degree of seasonality in demand and period of reportedly sluggish export associated with losing price competitiveness in the international market indicates at a highly competitive international market for which the Yemeni exporters are yet to be ready because of a weak backward linkage. During the investigation, we could identify only one exporter of recyclable paper (Yemen Zeenat Industrial and Recycling Corporation) and one exporter of recyclable glass (Ayma) which is currently not operating in the recycling industry because of high price of export.

Absence of a local recycling industry is a major bottleneck for the growth of the waste recycling subsector in Yemen. Traditionally, Yemeni businesses are reported to be trade centric and are less inclined towards manufacturing. Besides, as has been underscored, the political instability has hurt investment without direct government support. Interview with the Minister of the Ministry of Industry and Trade (MoIT) revealed that waste recycling is not a priority sector for the government. Because of lack of a favorable local industry and local market demand, the growth of the waste recycling subsector in Yemen, will continue to be slow and non dynamic.

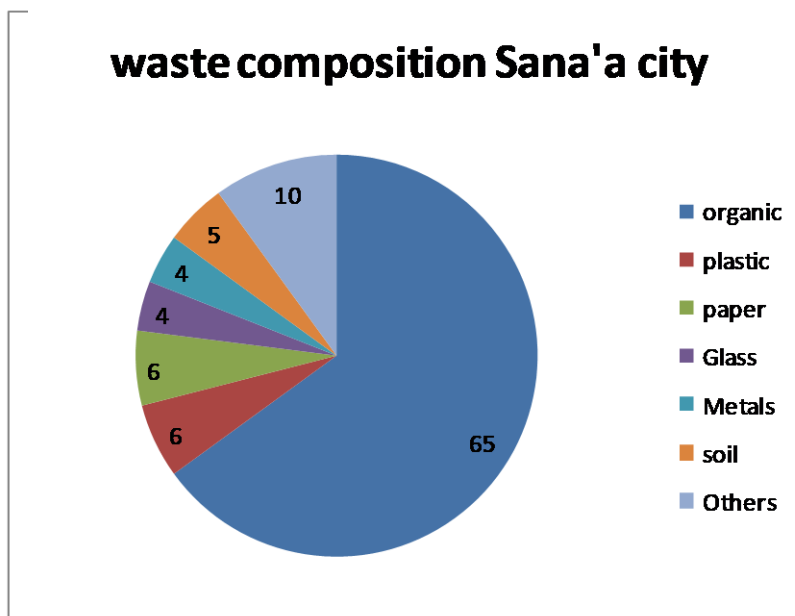
Collection, segregation and trading: There is no prevailing system of segregation at source. Some of the collectors (locally called scavengers) collect waste from streets and from dump sites in the residential areas. Others work along with the municipality workers that collect the waste, load them on trucks and then unload on land fill areas or designated dump sites. It is reported that there are around 21 controlled and semi controlled land fill sites in Yemen. The scavengers segregate paper, plastics, metal and glass scrap from the top of the trucks. Another group of scavengers work on the land fill

sites. These scavengers usually sell to local segregators who then supply to medium level segregators. Subsequently these are sold to the large segregators who work as the exporters. It is usually the large segregators who maintain waste collection yard, employ workers for sorting and grading and invest on capital machineries for grinding, thrashing and such other intermediate processing. The large collectors also get their supply directly from institutional sources like office, factories and super markets. The value addition is highest at the level of intermediate processing. Value addition at the intermediary stage primarily takes place in the form of bulking.

Because of unavailability of a local industry, organic waste is not collected for production of value added products like compost. Thin plastic bags are also not collected since there are no local buyers. Iron and cast iron are usually directly sourced by the local industries from scrap yards. Currently there are two factories in Sana'a which specializes in melting and molding cast iron for the production of covers for sewers and telecommunication manholes.

Waste generation and supply: An estimated 3.9 million tons of solid municipal waste is generated every year in Yemen. Annual growth of waste generation is estimated to be 3%. Only 38% of the generated municipal waste is collected and disposed of. Of this, only 6% is recycled, 26% is land filled and 68% is open dumped. Sixty five percent (65%) of the municipal waste in Sanaa city is reported to be organic waste. Per capita waste generation in Yemen is estimated to be 0.6 kg/day in urban areas and 0.35 kg per day in rural areas (Sonbul & Alaryani, 2010). Assuming an average production of 500 gram/ person/ day an estimated 11.5 million tons of waste is generated every year in Yemen. Figure 3 illustrates the composition of municipal waste in Sanaa city in Yemen.

Figure 3: Waste Composition in Sana'a City
Source: Sweepnet Country Report



A report published by Sweepnet and supported by GIZ revealed that Sana'a city is responsible for the generation of the highest volume of waste in Yemen (47%) followed by Aden (16%), Taiz (13%) and Hodeidah (11%). This suggests that the interventions that these cities should be given priority for future interventions in the sector. Table 9 provides the detailed comparative scenario of generation of solid municipal waste in the major cities in Yemen.

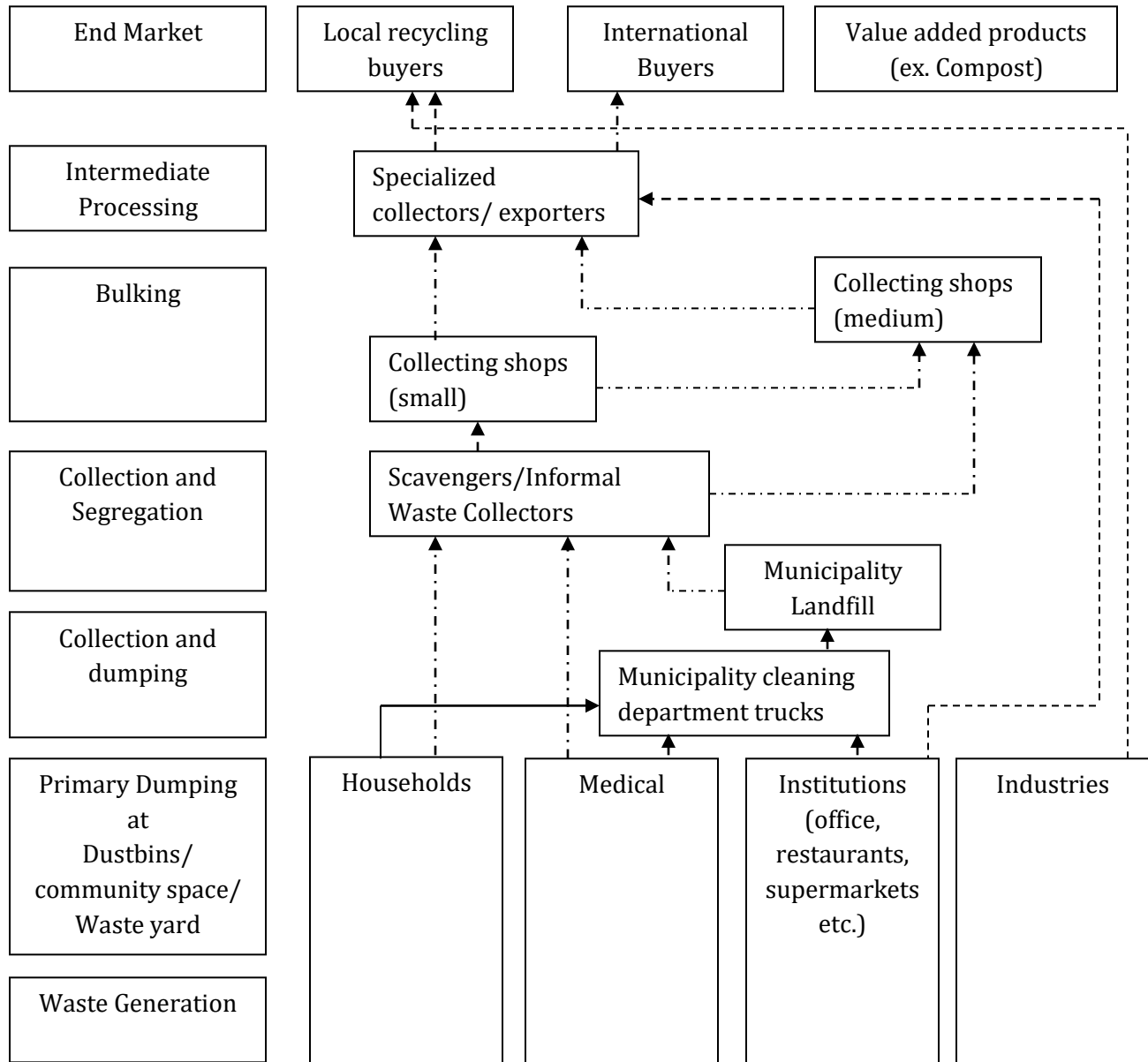
Table 9: Comparative scenario of municipal solid waste generation

in Yemen in 2010
Source: Sweepnet Country Report 2010

Name of city	Estimated Population in 2010 (000)	MSW generated in 2010 (tons)	% of the total
Sana'a	2140	468660	47%
Aden	715	156585	16%

Taiz	570	124830	13%
Hodeidah	505	110,595	11%
Ibb	390	85410	9%
Mukallah	225	49275	5%

Figure 4: The waste recycling value chain in Yemen (based on primary investigation)



- Legend:
- Primary channels
 - - - - - Secondary channels
 - Weak channels

As can be seen in the value chain map, the value chains leading to production of value added products, for example compost, is currently absent. Segregation at source is also very weak. The primary channel leads to land fill sites. The secondary channels leading to export market is weak. Local recycling is available only for selected products (cast iron) and remains very weak. The waste recycling value chain in Yemen can thus be classified as generally weak and at early stage of development. This suggests that it would require significant long term investment and coordinated public and private sector driven approach for the development of the waste recycling and composting value chain in Yemen. Following is a brief summary of the different waste recycling subsectors in Yemen.

Overview of the waste recycling subsectors in Yemen

Iron recycling: Three types of Iron are collected for recycling in Yemen (i) Wrought iron (alloy Iron) (ii) steel iron and (iii) cast iron. Most of wrought and steel Iron scraps are collected from cars and trucks body as well as from constructions companies. These types of scrap are collected by trucks to exporter's yard for dismantling. Cast Iron Scrap is collected from sewer pipes and some parts of the engines and some machines (parts which is exposed to high pressure). Cast Iron scraps are used by two factories in Sana'a specialized in melting and molding cast iron producing covers for sewer and telecommunications manholes.

Plastic recycling: Plastic consist of five different types but the main are HDPE – high density polyethylene (impermeable bottles); PVC – poly vinyl chloride (widely produced in construction), PET – poly ethylene terephthalate POLESTER (bottles and textile applications). At present nearly all types of plastic (except the thin plastic bags) are collected and exported out of the country.

Paper recycling: At present papers and cartons are collected from printing establishments, shops and exported to Saudi Arabia, Dubai and India. Yemen Zeenat Company is the biggest in collecting papers and carton for exporting.

Glass recycling: Glass are separated according to the color: Green , Brown and Clear. Some of the glass bottles are reused for same products or for another purpose. Before the Yemeni revolution two years ago broken bottles were collected with broken glass from four Juice factories construction and other sources for export to Jabal Ali in Dubai (a glass factory in Sana'a city was supposed to be opened one year ago but until now it is still under construction) Two years ago some shipment was exported by AYMA Company (the only one company in Yemen collecting glass) to Jabal Ali in UAE about 1060 MT. The company currently has postponed its operation because of high cost of labor and transportation.

Medical Waste: Medical waste have the high potential to be infectious and therefore must be disposed of using special methods such as autoclave, incinerations and others system. At present all medical waste are disposed mixed with household waste (municipal waste).Scavengers are collecting some materials from this waste which is very dangerous for their lives. Sana'a Secretariat with financial support of the Social Fund for development (SFD) is in the final stage for setting up the autoclave unit in the landfill site.

Construction waste: Many spots of open dump areas of waste accumulated with municipal waste are commonly noticed. No recycling for construction waste in Yemen due to the cheap prices of the construction materials.

The Terms of Reference had a specific focus on the compost value chain and therefore a separate review was undertaken on the prospect for compost value chain in Yemen. The findings are presented below:



Prospects and challenges for compost value chain in Yemen

Prospects: Since 65% of the waste generated in the municipalities is organic, establishing compost plants in major cities like Sana'a or Hudhramout appears to be a viable business proposition. However, because of lack of segregation at source, the organic waste is soiled and it would be difficult to turn it viably into compost. Furthermore, because of depletion of ground water level in Sana'a, cost of production will tend to get high. Subsidy on diesel will offset the cost of production to certain degree but because of unavailability of any feasibility study, the consultant is not able to provide any conclusive recommendation on initiating an intervention on compost production in Sana'a city or such other cities in Yemen.

Interview with SMEPS revealed that there is high potential market for compost for high value agricultural products, for instance mango and coffee. Compost could prove to be vital in increasing productivity. For instance, productivity in tomato in Yemen is reported to be only 14 t/ha in comparison to 40t/ha in Egypt. One of the larger farms engaged in mango cultivation is producing its own compost and plans to expand its capacity to cater to the demand of the other farmers. SMEPS is working with around 600 farmers having around 5000 coffee trees. Assuming the requirement of 3kg compost per year per tree, the farmers currently involved with SMEPS require around 375 mounds of compost per year. There is also demand for compost among the nurseries supplying seedlings for coffee. They require a different mix of compost which is much higher priced than the regular compost and is currently being served through import. This indicates at a potentially viable market in Yemen. Of concern is the competition from import. According to respondents imported compost is marketed for around USD 45/ 50 kg bag. A compost production facility was established in 2002 with financial support from Social Development Fund (SDF). The facility cease to operate once the support was withdrawn since it could not bear the cost of labor. A feasibility study is thus essential before a conclusive scenario could be developed on the prospect for compost targeting the agricultural value chains.

Challenges: The local consultant conducted a field investigation on the prospect for compost in Yemen and reported the following challenges:

Supply side challenges: Large volume of compostable material in the waste stream about 65% of total municipal solid waste generated. Lack of source separation and awareness of the value of organic waste is a major supply side challenge.

Demand side challenges: Low use and low perceived value of compost; high cost of compost compared to poultry droppings etc. has resulted low volume of sales of compost and low market demand.

Challenges related to Technology and Product Development: Unavailability of low cost, labor intensive composting technology; lack of technical education for compost producers; lack of compost research facilities are major technological barriers that need to be solved.

Regulatory/Policy barriers: Low incentives for source separation or reduction of waste going to landfill or dump sites; absence of regulations and guidelines for construction and operation of compost facilities; no standardization or certification of compost are key regulatory barriers.

1.3 Environmental Hotspot Analysis

As underscored in chapter 2, the environmental hotspot analysis was constrained because of lack of time for indepth primary investigation and also because of lack of secondary literature on the subject matter. The following analysis is based on the primary field investigation and the stakeholder workshop.

Impact of value chain functions on the environment: Waste recycling begins at the stage of collection and segregation when recyclable products are separated, segregated and then traded at bulk for the production of recyclable products. Collection and segregation is a non resource intensive value chain function that involves primarily manual labor, especially in the case of Yemen, where waste recycling is still at a very rudimentary stage. However, collection and segregation poses health risk to the workers/ labors who are called scavengers. Since they work primarily as self employed, they are often not supported by the bulking shops, traders or the exporters. The health risk of the workers involved in collection and segregation is not considered under the current framework of the hotspot analysis. At the stage of bulking, unused materials are usually dumped on the waste yard. If not managed appropriately it can lead to land pollution, air pollution and water pollution especially in the case of chemical waste and plastics. Composting generates methane gas which needs to be reused in the plant. Otherwise it can cause air pollution. Composting can also create air pollution and should therefore be done in non residential areas. Energy consumption is also reported to be high for compost production.

Impact of the environment on value chain functions: Reduced water availability in Sana'a city is a challenge for viable compost production. Other than that no other climatic conditions were found relevant to waste recycling and composting in general.

Green opportunities: As has been underscored in chapter 2, the waste recycling value chain is inherently green since it aims to convert environmentally harmful waste into environment friendly green products. However, since the existing market is export driven, the green opportunities do not contribute directly to the economy of Yemen. Production of value added products like compost for agricultural value chains and recyclable paper and handicrafts from reusable glass, tetrapack, plastic, iron etc. could ensure direct contribution to green jobs and environmentally responsive businesses in Yemen. Besides, promotion of segregation at source could also contribute to green environment.

1.4 Gender and Youth Inclusion Prospect

Women are currently not much engaged on the waste recycling value chain since the major activity, collection and segregation in land fill sites and open dump areas is not a suitable occupation for women. Limited number of women are engaged by the exporters in their waste yards for intermediate processing which includes cleaning and grading activities. Prospect for engaging women is high if local industries for recyclable paper and handicrafts from recyclable products could be promoted targeted niche local and international markets. This is evident from the case of fish waste recycling in Hudhramout where a private association for women is engaged in collecting fish waste and producing organic fertilizer. The case is presented below.

Prospect for women inclusion in the waste recycling value chain: The case of fish waste recycling in Hudhramout

There are three factories for Canned Tuna production in Hudhramout. These factories are equipped with minor sections for treating fish waste generated during the canning process. Such sections process the fish wastes by grinding them up to produce fishmeal. There are 30 companies for fish production in Hudhramout. These companies do not make use of and recycle the fish waste. In addition, there are 18 fish landing sites and many fish retail markets. These sites generate large

volume of fish wastes which are dumped in landfill sites. Such opportunities could be availed for recycling of fish waste as being done by a private association for women in the coastal area of Beer Ali. Women workers engaged by the association perform a number of activities which include: collecting fish wastes and producing organic fertilizer. However, the procedures followed to produce the fertilizer are very traditional and primitive. Technical support on training and product development could facilitate the women engaged in fish waste recycling earn higher profit and expand their market. The association employs around 20 workers, of them 5-7 are engaged on the production of organic fertilizer.

The association is also engaged on several other activities which are of relevance to the handicrafts value chain interventions being undertaken by GIZ PSPD in Yemen. The activities conducted by the association include:

- Producing straw mats and baskets made of palm leaves among other palm products
- Grinding the fruits of Sesbania (a thorny tree whose fruits are like horns filled with seeds) and selling them as fodder for livestock
- Making prints on clothing
- Conducting courses for illiterate women in the region

Source: Mr. Ahmed Ba-Ghawitah, Maher Khan (SMEPS); Hanan Ba-Hamaid (PSDP)

Prospect for engaging youth is very high since they are the primary workers engaged on collection and segregation. According to respondents the exporters who are also engaged on intermediate processing of the waste products, employ nearly 300 workers per site. Besides, they also provide livelihood indirectly to a large number of youth engaged on collection and segregation. According to an estimation done by the local consultant based on field investigation, there are around 6000 informal workers engaged on collection and segregation of waste. Besides, there are around 20 specialized exporters, 51 medium scale collecting shops and around 226 small scale shops that are engaged in the waste recycling value chain in the major cities. Expansion and growth of the waste recycling value chain can thus clearly lead to creation of employment for unskilled and unemployed workers. However, there is a risk of exposing child workers to the value chain. Many of the segregators and collectors are reported to be child workers. Given the health risk of collection and segregation, GIZ PSDP will have to invest on promoting safety, health and environmental standards in the value chain and on protecting child workers from engagement in the value chain, especially on activities that are directly related to the activities of the project.

Table 10: Number of labors and scavengers working in collecting recyclable materials in Yemen
Source: Extrapolation based on field investigation

City	Numbers	Remarks
Sana'a	2260	Including the scavengers from Municipality trucks
Aden	1380	
Hudidah	1120	
Taiz	1450	
Mukalla	400	
Total	6610	

Note: Numbers of labors fluctuate heavily depending on demand.

1.5 Evaluation of the Attractiveness of the Waste Recycling and Compost Value Chain for the GIZ Private Sector Development Program

Economic Prospect: Our findings, as presented in the previous sections, suggest that the project could facilitate creation of jobs for youth as well as women by facilitating expansion of the existing industries or by facilitating growth of new SMEs specializing on value added recyclable products. However, absence of a local market and the political instability in Yemen that has caused new investment to cease in Yemen, would make it difficult for the project to facilitate growth of the market and resolve constraints like lack of source segregation, weak linkage between the public and the private sector for waste management etc. that would be pivotal in the development of the waste recycling value chain. Scalability and profitability is expected to be constrained because of these factors. We therefore conclude that the economic prospect for waste recycling in Yemen is moderate and long term rather than immediate. It would be pertinent to note that the stakeholders in the workshop rated the sector as having high economic prospect. We understand that this is because of the fact that they have considered the prospect without taking into consideration the likelihood of resolving the constraints that may impede the progress towards the prospect. Table 11 provides an illustrative comparison between our score and the score given by the stakeholders in the workshop.

Table 11: Score: Economic Prospect

Criteria	Weight	Score		Weighted Score	
		Stakeholders	Regional Expert	Stakeholders	Regional Expert
Opportunities for employment creation	5%	5	3	0.25	0.15
Local or export market demand	4%	4	3	0.16	0.12
Prospect for value addition	3%	5	4	0.15	0.12
Prospects for growth in demand in local or export market	3%	4	4	0.12	0.12
Comparative advantage to serve the local market	4%	3	2	0.12	0.08
Comparative advantage to serve the export market	4%	4	3	0.16	0.12
Potential net profits for the SMEs	5%	5	3	0.25	0.15
Potential for engaging large number of private sector enterprises in the value chain	4%	4	2	0.16	0.08
Potential for replicating the intervention in different parts of the country	3%	4	2	0.12	0.06
Total Weighted Score: Economic Prospect				1.37	1.00

Social inclusion prospect: Prospect for engaging unemployed, unskilled and poor youth is high because of the nature of the collection and segregation activities. Barriers to entry for the youth are low in the collection, segregation and bulking functions in the value chain. Youth could also get engaged as entrepreneurs if cottage based industries for paper recycling and handicrafts from recyclable products are promoted. These interventions could also attract women as both

entrepreneurs and workers. This is evident in the case of the fish waste recycling activities in Hudhramout. Control of assets and equipment is usually low with both youth and women since capital equipments and assets are owned by large firms led by experienced businessmen. If composting for agricultural value chains is seen as a product for the Bottom of the Pyramid (poor farmers), then the scope can be defined as moderate. Other than that there is little scope for development of products targeting the bottom of the pyramid. The recyclable products that could be potentially produced under cottage based industries will have to target premium niche markets rather than the poor. Table 12 illustrates our score in comparison to that done by the stakeholders in the workshop.

Table 12: Score: Social inclusion prospect

Criteria	Weight	Score		Weighted Score	
		Stakeholders	Regional Expert	Stakeholders	Regional Expert
Potential to engage poor entrepreneurs (small scale of production, low start-up costs, not requiring major capital investment, using low-tech skills)	5%	3	2	0.15	0.10
Potential for income generation by women (as employees or self-employed)	5%	3	3	0.06	0.06
Do women control equipment, assets and sales income	5%	2	2	0.10	0.10
potential for income generation by youth (as employees or self-employed)	5%	3	4	0.15	0.12
Potential of generating new products which are affordable for the poor (BoP)	5%	2	3	0.10	0.15
Total weighted score: Social inclusion prospect				0.51	0.53

Environmental prospects: As the hotspot analysis revealed, the environmental prospects are higher particularly because of the green growth opportunities. The impact of value chain functions on the environment is low. Effect of environmental changes on the value chain functions is also low. The value chain thus scores high with respect to environmental prospects. Table 13 summarizes the scores.

Table 13: Environmental aspects

Criteria	Weight	Score		Weighted Score	
		Stakeholders	Regional Expert	Stakeholders	Regional Expert
Low level of negative impact of sector on environment	9%	2	4	0.18	0.32
low vulnerability of the sector to climate change and degraded environment	8%	4	4	0.32	0.32

Potential for products and/or services that compensate for Green House Gas (GHG) emissions	4%	3	1	0.12	0.04
Potential for products and/or services which are conducive for a green economy	4%	4	4	0.16	0.16
Total weighted score: Environmental aspects				0.78	0.84

Institutional Aspects: GIZ PSDP could potentially collaborate with SMEPS to promote compost production and marketing targeting agricultural value chains. There is no current plan for tangible government support. We did not find any specific rules and regulations pertaining to waste recycling. GIZ and JICA previously invested on solid waste management. JICA provided support on procurement of purpose made trucks for transportation of waste. The government has put a ban on manufacture and use of non degradable plastic bags and has made it compulsory to use a degrading agent called D2W for the manufacturing of plastic bags. Yemen is a member of the GCC specification and standards authority which bans the manufacturing of non degradable plastic bags. The government also restricts export of scrap iron since it is needed for the local iron factories. The private sector was found to be willing to invest on development albeit the general response has been that due to the political instability, the private sector might be unwilling to make investment on capital equipments and infrastructure. Table 14 summarizes the scores against the criteria.

Table 14: Institutional Aspects

Criteria	Weight	Score		Weighted Score	
		Stakeholders	Regional Expert	Stakeholders	Regional Expert
Evidence of private sector having plans for investment on the value chain	3%	2	3	0.06	0.09
Tangible government support is provided or expected	3%	3	2	0.09	0.06
Donors /support organisations are ready to collaborate and invest	3%	2	3	0.06	0.09
Sector promotion policies and regulations are in place and effectuated/enforced	6%	2	2	0.12	0.12
Total weighted score: Environmental aspects				0.33	0.36

Consolidated Score: In a scale of 5, the waste recycling and composting value chain scores 2.99 as per the assessment of the stakeholders and 2.73 as per the assessment of the regional expert. It can be concluded that the sector has moderate prospect for intervention. The interventions are summarized in chapter 5 under recommendations for interventions and next steps.