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MODULE - 2

Waste minimization

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1. LEARNING OBJECTIVES:

After completing this module, you should be able to:

- Identify possibilities of waste reduction in your LGU;
- Identify possibilities of reducing the cost of waste collection and treatment in your LGU;
- Identify the possibilities to develop composting in you LGU, and use appropriate composting technologies;
- Define rules for your LGU concerning producer and operator responsibilities regarding inert, construction and demolition waste;
- Plan a recycling programme and discuss recycling programme elements;
- Identify commonly recycled materials/components of waste stream, and for what are used for;
- Discuss technical solutions on construction and demolition waste management and involvement of recycling industry;

2. WASTE MINIMIZATION/ REDUCTION

2.1 What waste minimization represents

Waste minimization represents a set of approaches, methods, activities and processes aiming the reduction of the volume of waste to be final processed. Recommended at all strategic documents and EU legislation, waste management should follow the following principles, starting from the most preferable to the less one:

- **Waste prevention:** To secure the conservation of nature and resources, waste generation must be minimized and avoided where possible preferable at source, so-called "source reduction", where waste should be prevented or reduced at source as far as possible,
- **Reuse:** Direct use of the waste product for its original intended purpose- Where waste cannot be prevented, waste materials or products should be reused directly, or refurbished then reused;
- **Recycling/ composting:** Use of waste material for its original intended purpose after treatment- waste materials should then be recycled or reprocessed into a form that allows them to be reclaimed as a secondary raw material;

Based on the "Waste Hierarchy", where useful secondary materials cannot be reclaimed, the energy content of waste should also be recovered and used as a substitute for non-renewable energy resources; for the time, this technology is out of the possibilities to the LGU.

2.2 Waste minimization programs.

a) Goals for a waste reduction program/ initiatives

Goals of a waste reduction program/ initiative may include:

Global national

- Reducing per capita waste generation;

- Changing consumer purchasing patterns to buy products that have less packaging and are more durable;
- Reducing packaging by the manufacturer;
- Reducing product volume or weight;
- Increasing product durability and reusability;
- Achieving greater efficiency in manufacturing processes, thus reducing the generation of wastes;
- Reducing toxicity of waste in the waste stream;

Possible for LGU actions

- Reducing waste collection and treatment costs;
- Reducing waste volume (with rules and education on cardboard and organic waste);
- Encouraging on-site composting and organic waste reduction, such as: at house composting, vermin composting, etc;
- Reducing toxicity of waste in the municipal waste stream;
- Reducing weight of waste entering the solid waste stream;
- Transferring responsibility and costs of the professional/industrial waste to the producers of the waste (construction and demolition, industrial, commercial, agricultural, gardens, hospitals, etc.);

b) Identification and selection of waste reduction strategies/programes

When selecting the waste reduction strategies to be used, the unique circumstances of the locality should be considered, including the following:

- Composition of the waste stream;
- Principal producers of different waste categories;
- Local industries or local activities producing large amounts of certain types of reducible or reusable waste;
- Toxic waste appearing in the municipal solid waste (MSW) stream;
- Demographics (population and economic distribution, cultural ethnicity, literacy, etc.);
- Availability of funding options or grants for planning and implementation of waste reduction plans and education programs (grants are not available to businesses);

2.3 Potential for waste reduction

Referring to the national composition of waste, as mentioned in the National WMP[1] as well as the composition of waste at rural and suburban level[2] constitute a basis to identify the main possibilities and interest of waste reduction. The following are given the overall results of waste composition at urban, suburban and rural level:

[1] According to INPAEL Program: "Waste composition survey in Albania" conducted by Co-Plan (summer& winter, 2009)

[2] According to COSPE's project: "Waste composition survey at 5 communes of Inter-communal Zadrima", conducted by Co-Plan (Spring, 2010);

Overall results from all cities (Summer Campaign)

	Cities average	Shkodra	Lezha	Vora	Tirana
	%	%	%	%	%
Organike	46.1	45	45.3	50.6	43.5
Leter&karton	14.8	13	15.5	12.6	18.3
Plastike	13.7	14	15	13.1	13
Qelq	5.6	6.4	6.7	4.3	5.12
Metalet	1.2	1.2	1.1	1.2	1.2
Te tjerat	18.6	20.4	16.4	18.2	18.9

Waste composition at Communal level (Qark of Shkodra and Lezha

	Commune average	Dajc	Bushat	Blinisht	Vau i Dejes	Hajmel
	%	%	%	%	%	%
Organike	31.2	39.4	38	18.5	51.1	33.9
Leter&karton	9.99	6.6	9.1	7.3	4.5	10.6
Plastike	15.12	13.2	27.9	14.7	11.8	4.3
Qelq	19.76	15.6	7.8	22.3	5.3	49.1
Metalet	2.91	3.6	1.3	4	1.2	1.1
Te tjerat	21.6	21.6	16	33.3	26	1

Based on the surveys' results and current information on municipal waste stream, we conclude that the main possibilities of waste reduction stand at three main streams: organic component, recyclables and inert and C&D waste.

In fact, organic waste constitutes the major portion of the waste stream in the commune and suburban (60-70%[3]) areas and as well as even for the waste stream in urban level (45-50%). Thus focusing on organic waste, it remains a huge possibility to reduce the weight of municipal waste stream. Recycled component constitutes a major part as well of the municipal stream, where the main streams consist of 35% at municipal level and 20-25% at communal level.

As the inert and C&D waste are collected out of the urban waste stream, the surveys haven't found out valuable data about these materials. According to the overall data claimed by some of the cities in Albania, it says that this component consists of 15-20% of the total amount of waste.

3. SOURCE REDUCTION

a) What is source reduction of waste?

Waste prevention is at the top of the waste hierarchy and includes measures to avoid the generation of waste by changing production and consumption practices, reusing or refurbishing products and materials, and preventing waste entering the municipal waste stream by measures such as home composting. Put differently, this refers to the activities that reduce the amount of waste generated at source as well as activities that involve any change in the design, manufacture,

[3] At rural level , a part of organic waste has already been using for animal food

purchase or usage of materials/products to reduce their volume and/or toxicity, before they become part of the solid waste stream.

Reducing waste before it is generated is a logical way to save costs and natural resources, and preserve the local environment. For instance, waste reduction cuts the municipal and commercial costs involved in waste collection and disposal, and improves the productivity by targeting wasteful processes and products.

a) Purpose

Source reduction can serve several purposes, including the following:

(i) **Product reuse:** Using reusable products, instead of their disposal equivalents, reduce the amount of materials that are to be managed as wastes. An example of product reuse is the reusable shopping bag.

(ii) **Material volume reduction:** Reducing the volume of material used changes the amount of waste entering the waste stream. This helps in controlling the waste generated and its disposal. For example, buying in bulk or using large food containers reduces the amount of packaging waste generated.

(iii) **Toxicity reduction:** Source reduction reduces the amount of toxic constituents in products entering the waste stream and reduces the adverse environmental impacts of recycling or other waste management activities. For example, substitution of lead and cadmium in inks (solvent-based to water-based) and paints is a source reduction activity.

(iv) **Increased product lifetime:** Source reduction facilitates the use of products with longer lifetime over short-lived alternatives that are designed to be discarded at the end of their useful lives. Put differently, it encourages a product design that allows for repair and continued use rather than disposal. Manufacturing long-life tyres is a good example of increasing product lifetime.

(v) **Decreased consumption:** This refers to the reduced consumption of materials that are not reusable (e.g., using a reusable shopping bag instead of picking up plastic bags from the store). Consumer education about the materials that are difficult to dispose of or are harmful to the environment is essential. Buying practices can thus be altered to reflect environmental consciousness.

b) Implementation

Even if source reduction is linked more with the national policy and its implementation on waste management and in changing consumer pattern, there is space also for local authorities to perform in line with national policy by giving their contribution on this issue. There are several specific actions that can take place at the local level to organize and encourage source reduction, some of which are given below:

(i) Regulation: Although most regulation occurs at the national level, local authorities can actively participate in developing local regulations that affect municipal SWM. It is possible, for example, to specify regulations, rules, even sanctions within local waste management regulation, for minimizing the amount of waste collected, and particularly on the following points:

- **Management of organic wastes** from agriculture, gardens and markets: a massive reduction of volume and costs is possible when reducing the volume of this type of waste

and promoting source treatment (composting) in the garden; specific rules can be specified and enforced targeting agriculture, arboriculture and farming activities and rural inhabitants as well;

- **Management of inert**, construction and demolition waste: their elimination doesn't have to be paid by the commune but by the owner. These materials don't have to be put in a landfill; Specific rules can be assigned for inert and C&D collection and producer responsibilities accompanied with sanctions for violations;
- **Determine specific taxes for the big producers of waste**, like industry, markets, commercial activities, hotels and restaurant, administration, businesses, etc; and for generation of organic waste aiming waste reduction or composting at source;
- **Additional personal rules** for the citizen on how to keep the city clean, like the duty of reducing the volume (to fold cardboard before to put it in the bin), putting the waste in the bins and not on the floor, cleaning the waste point, cleaning the sidewalk in front of the house/shop, etc.

(ii) Education and communication: Consumers, businesses, industries, schools, etc., can implement education and communication activities to address the possibilities for source reduction, its consequences, rules, benefits and costs. Essentially, the aim of such education and communication activities is to provide and develop information about source reduction goals, needs and methods and to bring out voluntary efforts from the public and private sectors. Some of the activities that reflect education and communication to encourage source reduction include:

- **Information and education are necessary tools to explain regulation, tasks and duties**: LGUs can prepare and deliver continuing information and education packages for waste producers in general and for specific producer clarifying local rules and sanctions;
- **Discussion and negotiation with the main producers of waste** of what they can do to reduce production of waste, and/or facilitate the source selection of waste and recuperation by formal or informal actors, as well as facilitate the collection of waste; Promoting home composting schemes and the use of household food digesters; working with business and retailers to promote reduced packaging;
- **Undertaking local awareness raising activities** with households and businesses, and in schools, colleges and community centres;
- **Developing information campaign** for public outreach, including posters, conferences and forums concerning source reduction, composting, inert waste regulation, clean city, tasks and duty of the citizens, cost of waste collection and possibilities of reducing it, etc;.
- **Developing curricula** for schools (cardboard, garden composting, individual duty, etc) and organization of learning hours promoting waste prevention and environmentally consumer patterns.
- **Developing and publicising reuse and refurbishment schemes** and promoting reuse and refurbishment of goods such as paints, furniture, PCs etc., and the creation and encouragement of civic amenity services for community recycling.

(iii) Financial incentives and disincentives: Linking an economic benefit to the implementation of source reduction activities encourages source reduction. For example, financial disincentives represent additional costs to the waste producing activities that could be avoided through source

reduction activities. The various measures that can be targeted at consumers and industries include the following:

- **Specific additional taxes** must be fixed for institutions (private and public) producing higher quantities of waste (markets, commercial, etc);
- **Differentiated fee structure** for garbage collection can be based on quantity and frequency or based on "pay-as-you-throw" approach, integrating specific social issues: rich people produce more waste than poor ones. Important is that globally the total income covers the expenses and waste produced is reduced;

  Product disposal charges can be assessed either on the producers at the time of manufacture or on the consumers at the time of purchase; At local level, LGUs cannot appoint product charges but can appoint several taxes for disposal or collection of certain materials with high potential for reduction, or with negative impact for the local environment.

However, a successful implementation of source reduction programme requires the co-operation of all stakeholders, (e.g., businesses, industries, consumers), as the goals and actions of the local waste management system are specific to local conditions.

4. COMPOSTING

4.1 Importance of composting

According to previous waste characterization audits performed in different location in Albania, the component of bio-waste (organic) constitutes the majority (around 45-55% in municipal area and up to 70% in rural area) which is very promising for the development of composting and justifies to put composting on a high priority of local and regional waste management plans, as a possibility of avoiding a big part from the waste stream. Alone, the composting of the organic waste could theoretically fulfill 100% of the objective of the National Waste management plan for 2015 and a majority of the objectives for 2020.

Composting is an aerobic biological treatment process for pure organic waste. The process aims on reducing strongly the quantity and volume of material and generating fertilizer or for soil improvement. The process directly reduces the amount of waste to be disposed.

Meanwhile, the success and effectiveness of the composting process is strongly related to the composting output which is directly affected by the sorting quality.

The quality of composting done upstream, in the garden, with separated organic waste is very good in terms of environmental contaminants. At the opposite, the quality of the compost produced downstream by selection of waste or 3 bin systems is generally of pour quality, the compost being contaminated by the other waste: the composting process has a strong effect of concentrating the pollutant. There is a danger that these plants will produce a product (compost) of unsatisfactory quality and/or for which there is no market or a dangerous use.

For this reason, the compost done in plant downstream contains residues of plastics and metals, and must generally only be used for ornamental trees or flowers and not for vegetable culture.

4.2 Policy and rules

Policy and rules both at national and local level are important features for encouraging, enlarging composting activities as well as further modernizing and improving composting performance especially at rural and suburban level.

In this line with above, as mentioned at regulation section for waste prevention, LGUs can integrate in their local regulation rules and sanctions about organic waste and its management which can favorite composting activities at rural level, as follows:

- **Permission and prohibition rules:** a) e.g., only the organic waste of the home/kitchen and small businesses must be put in the urban bins; b) organic waste from the agriculture is prohibited to be put on the bins or on the streets: it must be eliminated by the farmer at his own means and costs; c) Organic waste from the gardens (grass, wood, etc) is prohibited to be put in the bins or on the streets: it must be eliminated by the owner by composting in the garden or eliminated at his own means and costs to the landfill site;

- **Financing incentives and sanctions:** A LGU can encourage composting activities by financial support (grants, co-financing schemes), or by adopting its fiscal policy on waste management to establish new fees or by categorizing existing fees system, or by imposing specific fines e.g., in case of inadequate management of organic waste or illegal deposit of it at public space, a fine of _____Leke to _____Leke can be decided by 2011;

- **Education, communication** efforts and awareness campaigns to promote home and community composting, starting from big producers and ending up at local inhabitants as well as to encourage waste segregation which is essential for functioning of local composting plants

4.3 Composting Technologies

As a recommendation of the National Waste Plan, LGU are encouraged to consider the implementation of the composting of all biodegradable waste collection separated by 3-bins system. In reality, the 3 bins system is more adequate for big municipalities. The garden “at home” composting is more appropriate for communes.

A centralized composting plant is only recommended at regional and big municipalities. For communes, an alternative can be to charge a farmer to develop a local communal composting plant. By the time that the organic fraction is separately collected, it is likely that most of this material will be brought to facilities for composting to produce products suitable for use in horticulture, agriculture or land reclamation.

Inputs may be biodegradable waste segregated at source or at point of collection hopefully it is free of glass, plastics and metals etc. Alternatively, inputs may be a mixed waste stream that is subject to sorting prior to composting. Sorting does not usually remove all impurities and the resulting compost can contain residues.

a) At house (community) composting

At house comporting or home composting presents one of the most preferable composting methods especially on rural and suburban level. Home composting is less expensive and more efficient than transferring organic wastes to an incinerator, landfill, or even a centralized

composting facility. It is environmentally sound, can be done almost anywhere, and enables householders to substantially reduce their waste. Home composting is not difficult or time consuming. A key advantage of home composting is that it is a local solution to a waste management problem and directly involves the community in dealing with its own waste. Local, environmentally sound home composting schemes in city blocks and dense low suburban housing depend on the availability of sufficiently large green spaces such as garden lots, shrubbery, lawns etc. on which to use the compost.

The municipality could provide a shredding service to the home composters shredding their woody garden waste a few times yearly and possible supplement with extra wood chips if needed.

	Simple pile	**Small container**	**Medium sized container or composting area**
Acceptable waste	BMW of vegetable origin only, garden waste without branches, chopped garden waste	BMW of vegetable origin only; soft green garden waste; small amount of chopped garden waste.	BMW of vegetable origin only; soft green garden waste; small amount of chopped garden waste.
No of households	1	1-4	50-250
Price of installation (€)	0	50-500	3000-25,000
Estimated work (hr./month/installation)	0-2	1-4	5-25
Need level for information and control	Low	Low	High (avoid visible impurities)
Composting time (months)	12-36	9-18	2-9
Use of compost worms	Possible Unusual	Possible Common	Other possible Unusual
Agricultural quality of product*	Low (weeds, plant, pathogens)	Low-medium (weeds, plant, pathogens)	Low-medium (weeds, plant, pathogens)

***** Environmental – and commercial - quality of compost depends mostly of the quality of the organic material: preselected material gives a good quality, post-selected a bad quality

Overview of three types of home and community composting facilities

(i) Home composting methodology

Most of the work is done by soil organisms, which work together to decompose, or recycle, organic materials into humus. The process needs food, oxygen, and water for survival.
Composting a diverse mix of materials generally results in a good balance of carbon and nitrogen. Oxygen must be available for aerobic organisms to thrive. Oxygen can be supplied by periodically turning or mixing the pile with a pitchfork or by poking holes in it with a broom

handle or special aeration tool. Aeration keeps the compost pile from developing unpleasant odors. Water is essential. With too little water, the organism will slow down and can die. Too much water will eliminate oxygen and odors may result. The material in the pile should be kept as damp as a wrung-out sponge.

Acceptable materials

In compost jargon, food scraps are referred to as “greens” and bulking materials, such as dry leaves or wood chips, are called “browns.” In a compost pile, a ratio of browns to greens gives the decomposers a balanced diet; alternating layers of browns and greens helps maintain this ratio.

These materials contain carbon for energy, and nitrogen for growth and reproduction. Dry, woody things like dead autumn leaves, straw, paper, and sawdust are high in carbon. Fresh, moist materials like grass clippings, vegetable scraps, garden waste, coffee grounds, and manures are good sources of nitrogen.

Several things can be composted at home - citrus rinds, vegetable stalks and peelings, spoiled fruit and vegetables; coffee grounds, coffee filters and tea bags; egg shells, peanut shells, straw, weeds, garden waste, and paper towels to name a few. But not everything belongs in the compost pile. DO NOT ADD meat or fish scraps, bones, fats, grease, oil, peanut butter; or dairy products, such as milk, cheese, butter, mayonnaise and yogurt. These foods can attract pests or cause odors. DO NOT ADD diseased plants, weeds that have gone to seed, or the roots of invasive plants such as quack grass, wild morning glory, and other materials which carry parasites (Dog and cat waste) transmittable to humans.

Leaves alone will compost, but it will take a bit longer than if they are mixed with grass clippings, manure, or other nitrogen materials. Although not essential, shredding leaves will accelerate the composting process and quickly reduce their volume when space for composting is limited.

Composting place or bin

Using a compost bin to contain organic materials may be preferable to an open compost pile because it discourages animals, makes the pile easier to manage, helps retain heat and moisture, and tends to look neater.

There are small bins, designed specifically for kitchen waste.. Others are large enough to accommodate both yard and kitchen waste. With little expense and effort, you can build your own bin using scrap lumber, fencing, cinder blocks, pallets, or a combination of materials.

A bin must be at least 1 meter wide, 1 meter long, and 1 meter high to provide enough mass to retain the heat generated by the microbes. It shouldn’t be bigger than 1.5 meter in any dimension for ease of handling and to prevent compaction. The bin usually has an open base, which provides drainage and allows the composting materials to come to contact with natural soil organisms. A top is optional.

Time needed

How fast composting takes place depends on the kinds of materials you add to the pile and the amount of time you are willing to dedicate to composting.

- *Passive composting bin*: It is one of the easiest ways to compost since no labor is required other than placing wastes in a bin and harvesting the compost from the bottom of the pile about 8 to 12 months later.

- *Active composting bin*: If you have a large volume of organic wastes or want finished compost sooner, the "active" method may be more appropriate, using a turning unit. Turning units typically consist of a series of bins or a rotating barrel. This is an active method because the pile is periodically turned or moved into the next bin, which supplies oxygen to the organisms allowing them to break down the wastes quickly. Weekly aeration can result in finished compost in less than two months.

The composting process will slow down during the winter months, but will speed up again when spring arrives

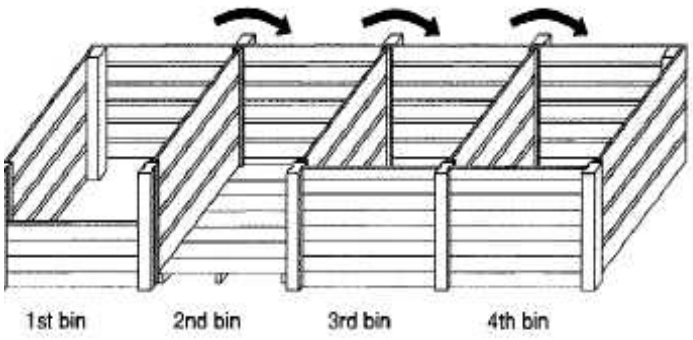


Illustration of active compost

Start by placing your bin in a convenient location with good drainage no matter if it is sun or shade. Gather some materials to be composted keeping in mind diversity, texture, carbon, and nitrogen. Chopping or shredding the material will help speed up the composting process. Put a layer of dry, woody, high-carbon materials such as leaves, straw, or sawdust from untreated wood in the bottom of the bin. Sprinkle with water to dampen the materials to the consistency of a wrung-out sponge. Then, add a layer of moist nitrogen-rich materials such as grass clippings, garden spoils, and cow or horse manure. The thickness of the layers isn't critical, but no layer should be more than 15 cm deep. Mix the two layers together. A shovel full of soil or finished compost every so often will add even more organisms to the pile. Continue alternating, mixing, and watering the layers as materials become available or until the bin is full. Appropriate kitchen scraps can be added as they become available, and should be buried in the center of the pile. Over time the volume of material in the bin will shrink.The compost is ready when it's dark brown, crumbly, earthy smelling and no longer resembles the original material. If you have used the passive method, the more finished compost will be found near the bottom of the pile.

b) Vermiculture or Vermicompost[4]

Vermiculture means artificial rearing or cultivation of worms (Earthworms) and the technology is the scientific process of using them for the betterment of human beings. Vermicompost is the excreta of earthworm, which is rich in humus. Earthworms eat cow dung or farm yard manure along with other farm wastes and pass it through their body and in the process convert it into vermicompost. The municipal wastes; non-toxic solid and liquid waste of the industries and

[4] Source: Punjab State Council for Science and Technology, Chandigarh

household garbage's can also be converted into vermicompost in the same manner. Earthworms not only convert garbage into valuable manure but keep the environment healthy. Conversion of garbage by earthworms into compost and the multiplication of earthworms are simple process and can be easily handled by the farmers.

(i) Community Scale-Vermicomposting Methodology

A thatched roof shed preferably open from all sides with unpaved floor is erected in East-West direction length wise to protect the site from direct sunlight. A shed area of 4mX4m is sufficient to accommodate three vermibeds of 3mX1 each having 30cm space in between for treatment of 9-12 quintals of waste in a cycle of 40-45 days. The length of shed can be increased/decreased depending upon the quantity of waste to be treated and availability of space. The height of thatched roof is kept at 2.5m from the centre and 2m from the sides. The base of the site is raised at least 15cm above ground to protect it from flooding during the rains. The vermibeds are laid over the raised ground as per the procedure given below.

The site marked for vermibeds on the raised ground is watered and a 10cm-15cm layer of any slowly biodegradable agricultural residue such as dried leaves/straw/sugarcane trash etc. is laid over it after soaking with water. This is followed by 3cm layer of Vermicompost or farm yard manure.

Earthworms are released on each vermibed at the following rates:

- For treatment of cowagriculture-waste: 1.0 kg. per
- For treatment of household garbage: 1.5 kg. per

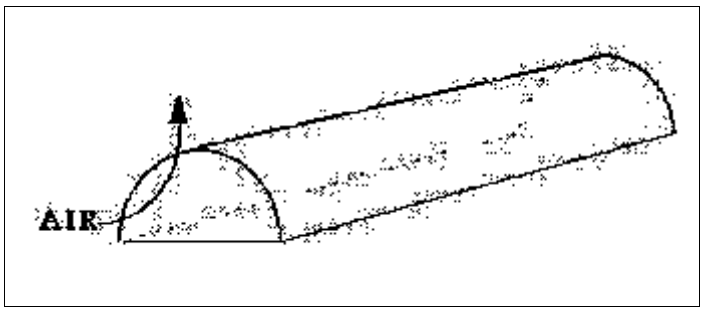
The frequency and limits of loading the waste can vary as below depending upon the convenience of the user:

Frequency	Loading
Daily	5cm /bed/day
In Bulk	30cm-40cm (3-4q/bed/cycle of 45 days)

The loaded waste is finally covered with a Jute Mat to protect earthworms from birds and insects.Water is sprinkled on the vermibeds daily according to requirement and season to keep them moist.The waste is turned upside down fortnightly without disturbing the basal layer (vermibed).The appearance of black granular crumbly powder on top of vermibeds indicate harvest stage of the compost. Watering is stopped for atleast 5 days at this stage. The earthworms go down and the compost is collected from the top without disturbing the lower layers (vermibed). The first lot of Vermicompost is ready for harvesting after 2-2 ½ months and the subsequent lots can be harvested after every 6 weeks of loading. The vermibed is loaded for the next treatment cycle.

c) Open composting (windrow)

This method is recommended for separate collection of green waste only – garden waste and is not suitable for organic waste containing animal by-products or mixed MSW; The windrow system is the least expensive and most common approach: Can produce quality compost; relatively cheap compared to IVC and AD; Potential problems with odours and leachates;



Windrow Composting

d) In-Vessel Composting (IVC)

Can use as input not only separate collection garden waste but also the organic waste containing food and kitchen waste including animal by-products; Not suitable for mixed MSW; Can produce a quality compost; Does not produce energy like anaerobic digestion (AD); More expensive than Windrow; Potential problems with odours;

e) Anaerobic digestion (AD)

Anaerobic digestion is a biological treatment method that can be used to recover both nutrients and energy contained in biodegradable municipal waste. In addition, the solid residues generated during the process are stabilized. The process generates gases with a high content of methane (55–70 %), a liquid fraction with a high nutrient content (not in all cases) and a fibre fraction. Anaerobic digestion is fully suitable for treatment of the food fraction of BMW presuming that the waste is pre-sorted. Anaerobic digestion produces biogas that can be used for heating or combined heat and power production, provided that there is a market — or the gas can be used to power public transport vehicles such as town buses or waste collecting lorries. The liquid fertilizer, slurry or fibre fraction from anaerobic digestion is optimally used in cooperation with agriculture. Anaerobic digestion is not suitable for treating newspaper, textile and wooden park waste.

(ii) How to perform a general composting process? - Stages

There are five basic stages involved in all composting practices, namely preparation, digestion, curing, screening or finishing, and storage or disposal. However, you must note that differences (among various composting processes) may occur in the method of digestion or in the amount of preparation and the finishing required.

Preparation

This preparation phase of composting involves several steps, and these depend upon the sophistication of the plant and the amount of resource recovery practiced. A typical preparation process, however, may include such activities as the sorting of recyclable materials, the removal of non-organic, the shredding, pulping, grinding. A final step in the preparation phase of composting may be to adjust the moisture and nitrogen content of the solid waste to be composted. The optimum moisture content ranges from 45 to 55% of wet weight, while the optimum carbon to nitrogen ratio should be below 30%.

Digestion

Digestion techniques are the most unique feature of the various composting processes and may vary from the backyard composting process to the highly controlled mechanical digester.

Curing

Organic materials, remaining after the first (rapid) phase of composting, decompose slowly, despite ideal environmental conditions. The second phase, which is usually carried out in windrows, typically takes from a few weeks to six months, depending on the outdoor temperatures, humidity, intensity of management and market specifications for maturity. It is also important the coverage of compost mass to avoid excessive water or protect from birds, animals etc.

Screening or finishing

Compost is screened or finished to meet the market specifications. Sometimes, this processing is done before the compost is cured. One or two screening steps and additional grindings are used to prepare the compost for markets. During the composting operation, the compostable fraction separated from the non-compostable fraction, through screens, undergoes a significant size reduction. The non-compostable fraction retained on the coarse screen is sent to the landfill, while the compostable materials retained on finer screens may be returned to the beginning of the composting process to allow further composting.

Storage

Even when a good market for compost exists, provision must be still made for storage. Storage is necessary because the use of composting is seasonal, with greatest demand during spring and winter. Therefore, a composting plant must have a 6-month storage area. Many composting operations combine their curing period with the storage period.

4.4 Management models of decentralized composting

Table 4.1: Management models for decentralised composting

Options	Characteristics	Main Actor(s)	Role of City Government or Municipality	Advantages	Constraints
Model 1 Municipally owned - Municipally operated	Integrated into the existing municipal SWM system and focused on reducing waste which otherwise has to be transported and disposed of in landfills. Cost reduction through lower transport and disposal costs.	Municipality	Introduces recycling and composting into the SWM policy. Implementing agency	Composting is an alternative treatment system, which can be integrated into the existing system (waste collection, transport, disposal). All composting sites can be centrally controlled. City gains valuable soil conditioner to maintain parks and green areas.	Financial constraints due to the low priority given to SWM projects. Operating efficiency and marketing potential may not be fully exploited. Lack of coordination between departments regarding the use of the compost product.
Model 2 Municipally owned - Community operated	Benefiting community is involved in the management of primary waste collection and composting. Non-profit seeking model. Cost reduction through lower transport and disposal costs.	Municipality Local community NGOs	Introduces recycling and composting into the SWM policy. Implementing agency Supports communities in finding composting sites and develops a proper system for waste collection and disposal of residues. Provides support funds for construction of composting plants and the setting up of a primary waste collection.	Alleviates the municipal burden of SWM through community inputs. Improvement of solid waste management scope through voluntary participation. Clear contracts ensure reliable partnerships with community groups. Creates new jobs in the neighbourhoods.	Lack of community awareness and interest. Need for a reliable informal leader among the community. Highly complex management.
Model 3 Municipally owned - Privately operated	Benefiting community is partly involved. Profit seeking model is possible. Requires at least full cost recovery (from fees and compost sales). Cost reduction through lower transport and disposal costs.	Municipality Private sector or NGO	Introduces recycling and composting into the SWM policy. Implementing agency Selects composting sites, constructs plants (investments); develops a proper system for waste collection and disposal of residues. Contracts out the operation and maintenance. Monitors performance of contractors.	Alleviates the municipal burden of SWM through private sector participation. Provision of additional funds and know-how through private investors. Clear contracts ensure reliable partnerships with private entrepreneurs. Creates new jobs in the neighbourhoods.	Lack of community awareness and interest. Need for a reliable and skilled partner with sense of entrepreneurship. Complex management.
Model 4 Privately owned - Privately operated	Profit-seeking enterprise based on ideal compost market conditions. Income is generated through compost sale and collection fees.	Private sector	Introduces recycling and composting into the SWM policy. Transparent regulations for public - private partnerships. Cooperates in supplying raw waste and disposal of residues.	Alleviates the municipal burden of SWM through private sector participation. Provision of additional funds and know-how through private investors. Clear contracts ensure reliable partnerships with private entrepreneurs. Can create employment and business	Lack of private land for composting activities. Lack of vital compost markets if compost is not a well-known product.

5. INERT WASTE (CONSTRUCTION AND DEMOLITION WASTE)

5.1 Importance/ Content and generation of inert (construction and demolition Waste)

Construction demolition (C&D) waste or so-called inert waste is waste such as stones, soil, concrete, tile that are left from the activities of construction, re-construction, repair and demolition of buildings and other structures.

Actually, some local authorities organize public service that consists of collection of inert and bulky waste thrown informally close to urban waste collection points or in some informal dumps within city area. The authorities claim that there is a large quantity of inert materials generated and present a very serious problem for the city and a raised cost for waste management. There are no official data on the amount of inert waste but it says that consists of 15-20% of the total amount of waste.

The inert waste has to be considered as a professional waste and should not be accepted in the bins and in the normal communal waste flow.

There is a high potential for recycling and re-use of C&DW, since some of its components have a high resource value. In particular, there is a re-use market for aggregates derived from C&DW waste in roads, drainage and other construction projects.

In addition, if not separated at source or not brought separately, can contain small amounts of hazardous wastes, the mixture of which can pose particular risks to the environment and can hamper recycling. Certain construction and demolition materials are hazardous, e.g., asbestos, lead, tars, paint and preservative residues, adhesives, sealants and certain plastics. If such materials are mixed with non-hazardous materials, e.g., lead-based paint tins thrown onto a pile of bricks and concrete, the whole pile becomes hazardous and must be disposed of as hazardous waste.

5.2 Policy and regulation: regulation and local and producer responsibilities

a) Legal framework on waste

Based on the Albanian legislation, it is a producer responsibility (including commercial and households) the transportation of their C&D waste directly to municipal sites assigned for this purpose.

The processing and neutralization of the inert waste is carried out through reuse and neutralization (art. 12 of the Law on Solid Waste Management).

Minister of Environment and Minister of Public Works Regulation prepared a regulation (No. 1, dated 30.3.2007), 'On the treatment of construction waste from its creations, transportation to neutralization'; The scope of this regulation is to discipline the process of waste management in the field of construction by establishing concrete rules and requisites for all entities operating in the area of construction and treatment of waste generated by the construction activity (art. 1).

This regulation applies to (a) the adoption and implementation of construction works, reconstruction or demolition of buildings; (b) the adoption and establishment of plants and areas for temporary storage of construction waste; (c) the handling and transportation of construction waste; (d) the functioning of plants and waste disposal areas for construction (art. 2).

b) Producer responsibility

According to this regulation any physical or legal person whose activity produces, possesses, transports and manages construction waste or performs preliminary processing, mixture or other processes that alters the nature or composition of these wastes, is obliged to keep, deposit, transport and deliver them for allocation in specified plants in accordance with the requirement of this regulation (art. 4-5)

Each physical or legal person, prior to obtaining the construction or demolition permit, must deposit with the local government authority a financial guarantee amounting at least to 5% of the value of the building or other facility. Such deposit shall be returned back to the owner upon fulfillment of the criteria of this regulation by the developer (art. 10, 11).

c) Institutional responsibility

The local government units, environmental inspectorate and construction police must carry continuous control over the generators of the construction waste, the areas of deposit of such waste and processing plants. The institutions in charge for the implementation of such regulation are the Ministry of Environment, the Ministry of Public Works and the local government authorities.

The role of the local authorities in respect with the law is seen in that they are the responsible authorities to designate the appropriate dumpsite for the construction waste as well as for receiving the guarantee payment made by the constructors when obtaining construction or demolition permit. Each commune and municipality must determine in their local plans and communicate specific sites for processing and depositing of the construction waste (art. 8). The plants for processing, storage or recycling of construction waste, among others, shall meet some essential conditions such as: to be equipped with an adequate system for collecting and drainage of surface water for preventing pollution of surface and underground waters; to determine an area where the un-selected remains will be deposited etc. (art. 9).

Each local authority should implement all national rules and obligations on local level through establishing local regulation on management of inert waste or municipal solid waste. This document will facilitate the implementation of national requirement on local level.

5.3 Technical Solutions

It is important that the local authorities should assure separate collection of inert waste, safe storage and environmental treatment of inert waste aiming its reuse or recycling and then other methods. It is fundamental to collect this very valuable resource, in order to avoid the contamination of the environment and to be able to profit from the very high recovery potential of this waste stream

a) Collection schemes

Even if the collection and transportation of inert waste is the producer responsibility, the city or commune should provide – often by means of payment - appropriate service and establish infrastructure for collection of inert waste originated from community (families) and safe storage

toward their final treatment. For this purpose it is recommended that the local authority should take the leading role in organizing their collection and their reception based on the national rules and regulations and should charge a fair and direct fee for their management costs.

- **Drop-off" scheme"**: where local authorities or the waste companies contracted by the vendors provide drop-off places (collection points within city boundaries) to be used by community which are regularly emptied out by company itself.

- **"Bring scheme"** where people entail to bring their waste to collection stations and "call schemes" where citizens contact the responsible authorities or companies when they have inert waste or bulky waste to give away.

b) Transportation and temporary storage

The transportation of C&D waste, materials and equipments to and from the dumpsite is conducted safely and with fewer concerns for the persons within the plant and along the way. The C&D transport equipment is cleaned prior leaving the dumpsite, covered so they do not cause any contamination during transportation.
Dumpsite for storage or recycling of C&D waste should meet the following conditions:

- Are flat surfaces
- Be equipped with an appropriate surface system to collect and drain water, in order to prevent contamination of surface water and ground water
- To have specified area where unselected waste can be deposed
- To have scales for recording entries and exits of waste quantities
- To have containers for the temporary storage of selected waste
- Adequate system for fire prevention and reaction
- Safety and protective clothes, equipments, procedures and information.

c) Demolition procedure and treatment of C&D waste

(i) Methodology for selective demolition of buildings: Selective demolition methodology follows the procedure below to maximize recovery and separation of recyclable materials at source:

- **Step 1**: Remove furniture and fittings
- **Step 2:** Remove permanent fixtures (e.g., doors, windows, etc)
- **Step 3:** Remove hazardous materials
- **Step 4**: Selectively demolish structure
- **Step 5:** Segregate demolition materials into individual waste fractions

- **Step 6:** Remove waste materials and prepare site for the new construction works

(ii) Re-use and recycle: Many materials can be used many times before they need to be thrown away or can be recycled. Some examples of C&D materials which can be reused or recycled are shown in following table:

C&D waste	Treatment	Uses and destination for the recovered materials
Concrete	**Recycle**	Aggregate in roads, fill or new concrete
Blacktop	**Recycle**	Bound layer of roads/ bulk fill; paving of compounds; trial paths
Excavation Spoil: Topsoil	**reuse**	Landscaping
Timber	**Reuse/ recycle**	Shuttering/ hoarding; chipboard
Metals	**Reuse/ recycle**	Smelt
Tiles, blocks, bricks, clay, architectural features	**reuse**	
Packaging& plastics	**Reuse/recycle**	Pallets
Oil, paints& chemicals	**Reuse**	

"Waste worth segregating for re-use and recycling[5]"

d) Encouragement of recycling industry:

The involvement of the private sector should be seen as a priority to set the system or to improve it. Involvement of the private sector, through concession or public private partnership shall be encouraged as a mechanism for the provision of an economically optimal solution that shall also be acceptable from environmental point of view.

Typical instruments that can be used to stimulate markets include:

- Restrictions or bans on certain materials for landfill (gate fee, taxes, local rules, etc)
- Environmental or planning controls on landfill of C&DW
- Subsidies for recycling processes and businesses
- Positive waste planning measures – requirements to consider
- C&DW recycling capacity under regional waste management plans
- Education & Training
- The use of recycled aggregates in public projects, i.e. local government procurement policy

[5] Source: FAS and NDP,(2002), "Construction and demolition waste management- Handbook",

- The development of recycled products that can substitute for natural raw materials to the greatest possible extent

- Local planning authorities to require developers to submit an integrated demolition and C&DW management plan as part of their planning application, which could be judged against its ability to deliver a reasonable level of recovery, either on-site or off-site.

6. WASTE SEPARATION AND RECYCLING- HOW TO START A RECYCLING COLLECTION PROGRAM

6.1 Significance of recycling

Recycling is perhaps the most widely recognized form of source reduction involving the process of separating, collecting, processing, marketing and ultimately using a material that would have otherwise been discarded.

Recycling is one of the fundamental parts of the waste management. Although it alone cannot solve a community's municipal SWM problem, it can divert a significant portion of waste stream from transportation and disposal in landfill. But it is nevertheless relevant to insist that the most important effect to reducing the quantity of waste is reducing the organic and components which represents more or less the 50% of the Albanian waste and sometimes also the inert waste. Recycling has a lot of direct and indirect significance for the society, and this can be grouped under the following broad areas:

a) Legal and Policy Compliance

Recycling helps to achieve legal and policy compliance with national standards, laws and national objectives on waste reduction: 25 % of the waste is recycled or composted in 2015 and 55 % by 2020; Recycling rates and waste diversion from landfill rates will become mandatory soon as the national strategy and national plan will come in force as well as the country is progressing to fulfillment of European standards even on environment protection and waste management.

b) Economic significance

Economic assessment of waste recycling is a difficult task as many of the beneficial environmental and social impacts of recycling are long-term and are intangible, and, therefore, are difficult to quantify. Some of the short- and long-term economic benefits are:

(i) Cost reduction: Reduction of waste flow and resource recovery through recycling of solid waste could be of interest to waste management authorities as a means of reducing the waste disposal or treatment cost. They can save cost from fuel for transportation, operation and maintenance, and generate some revenue by sale of recyclables. It is nevertheless important to mention that generally the revenues generated by the recyclables material don't cover the total of costs of collection and treatment. On another hand, it is to be mentioned that the revenue depends strongly to the quality (purity) of the selected material and can vary strongly with the international market evolution.

For these reasons and for verify the financial sustainability of the recycling activities, it is of high importance to have a clear and prudent evaluation of the effect of recycling on the global cost of waste management.

(ii) Employment: Recycling of waste is a labour intensive activity, and its potential to ease the unemployment problem is high. Enhanced recycling activities, for example, can create an additional job market for skilled and unskilled workforce, and they can adapt to any of the occupations such as a labourer in recycling business or industry or a dealership.

(iii) Energy saving: Use of recyclables in some industrial processes is known to consume less energy than the use of any other raw material.

c) Environmental and health significance

The volume of waste is increasing rapidly because of population growth and economic development. At the same time, polluted waste fractions are increasing because of increasing complex processes being used in industries, and these contribute increasingly to environmental degradation. However, recycling helps, among others, in the following ways, to facilitate effective waste management:

(i) Improved environment: Recycling reduces the volume of waste that has to be finally dumped, and thereby causing reduction in pollution at the waste disposal sites.

(ii) Natural resource conservation: Use of more and more recyclable solid wastes in industrial production will relieve the tremendous pressure on natural resources. For example, recycling of waste paper means a lower demand for wood, which means less cutting of trees and an enhanced possibility for sustainable use of the forest. Using recyclable items in the production process would reduce the demand for energy as well.

d) Social significance

People engaged in waste collection activities are normally of low social and economic standing. This is especially true with scavengers, which is evident from persisting poor quality of their living and working conditions.

A formal recycling arrangement will help promote the social esteem of waste workers and facilitate their upward social mobility due to increased earning. In addition, the improved recycling activity will increase the economic value of the waste and will reduce waste scavenging activity providing opportunity for scavengers to switch to a more socially acceptable occupation.

e) Market positioning

Eco-friendly management or services such as recycling can give an appreciated status and enhanced customer relations; each public or private company and local authority itself aim to demonstrate their eco-friendly behaviour in front of customer and inhabitants for political and market benefits.

6.2 Commonly recycled materials

Except organic (biodegradable) waste and inert waste mentioned earlier, there are other components of the municipal waste stream with significant potential to be recycled. The more used and required recycled materials are as follow:

a) Paper and cardboard

Paper and cardboard form the second biggest component of domestic waste after organic waste, and contribute to about 10-15% of the total weight of the domestic solid waste, and even much more considering the volume of waste. Cardboards have the very bad effect to reduce the volume of the waste in the bins, and this increases the interest of a selective recycling.

Paper and cardboard recycling is one of the most profitable activities and is practiced extensively. A typical input-output model of the paper processing technique consists of the following:

- Material inputs: Paper/cardboard scrap, magazines, newspapers, computer paper, wrapping paper, craft sacks, cartons, etc;
- Product outputs: Paper sheets, boxes, filter paper, mosquito mats (to absorb chemical.

b) Glass

Glass is one of the most commonly recycled materials, and the market for post consumer glass has historically been steady. Glass generally accounts for 2-7% by weight of the total solid waste generated. Glass manufacturers purchase glass for reprocessing into new, clear, green and brown glass jars and bottles. The market for recovered glass has been strong and stable for brown and clear containers. Green glass, however, is seldom used to package goods domestically, so fewer companies produce glass of this colour.

c) Metals

Ferrous metals like iron, steel, etc., and non-ferrous metals like aluminum, copper, zinc, lead, silver, etc., are some of the metals, which exist in the waste stream. On an average, metals account for 1-3% of total solid waste generated. Metals have generally the highest value for recycling. For this reason, metal is generally partially recollected on the source by the informal sector and a significant part escape from the waste collection and from the statistics.

The typical material inputs and product outputs in this industry are the following:

- Material inputs: Aluminum, brass, copper, zinc, tin, iron, steel, etc;
- Product outputs: Sanitary and gas fittings, funnels, buckets and storage bins, reinforced steel bars, hand tools, etc.

d) Plastic

These days, plastic is posing serious littering problem in cities and around collection points and dumping sites, as well as road and river sides. With an average 10-15% by weight of the total amount of domestic waste, plastic is one of the important constituents in waste stream. The most recycled type of plastics comprises high-density polyethylene (HDPE), polyethylene (PET)

plastics, polystyrene, polyvinyl chloride, low-density polyethylene (LDPE), polypropylene (PP) and mixed plastic.

Generally the different types of plastics must be separate to respond to the requirement of the market. This separation is mostly out of the competence of the producers and must be done in a specific plant with high cost of work for reduced weight of plastic. More, the plastic must be clean, dry and pressed for the transportation. This makes the treatment for the plastic quite expensive.

Most plastics are densified locally by flattening, baling, or granulating, and sold either to converters, where the resins are turned into pellets, or directly to domestic or export end users for remanufacture into products such as bottles, carpet and carpet backing, flower pots, and insulation material.

- Material input: Plastic scrap (thermoplastic and thermosetting);
- Product output: Toys, boxes, slippers, shoes, pellets, buckets, cans, etc.

6.3 Planning a recycling programme

Numerous recycling options are available, and recycling programme development requires strategic planning. Planning for recycling involves: identify main and specific waste generators, understanding markets, assessing local expertise, setting goals and fostering public participation.

a) Identify main specific generators in the LGU

As a first understanding of the priorities of recycling it is important to identify the most important generators of specific wastes and the type of waste they produce, like for example:

Generators	Type of specific wastes
Markets	Cardboards Plastics
Commercial zones	Cardboards, papers Plastics Organic wastes
Restaurants, touristic zone	Organic wastes Glass
Administrative activities	Paper
Center of cities	Paper, cardboard plastics
Suburbs, communes, gardens	Organic wastes
Industry	Specific waste depending of the specific production

b) Define the actors of the actual selection

Generally they exist formal, but often informal, actors of a certain recycle activities. To have a discussion with them can give an appreciation of the potential of the different materials that can

give interest to be recycled, as well as main sources, prices and market for the products. These actors can also play a role in the recycling activities.

c) Define what materials are recyclable and -What else to separate?

Generally, materials that have recycling potential are those that can be collected in quantity and free of contamination, and that can be economically transported to a processor or end user and has a certain value in recycling market. (Metals, plastics, papers and cardboards, bottles, glass, etc). Engaging commercial and institutional waste selection requires a major importance mainly for packaging waste with strong interest from recycling industry.

When determining what recyclables your program should collect, it is important to know what waste the city (waste stream) or certain type of consumer generates; Buyers of recovered materials will be interested in both the quantity and quality of your recyclables:

- *Quantity Considerations*- Aggregating sufficient quantities of recyclables is important to make feasible their handling and transporting; To assure significant amount of recyclables, local collectors should establish temporary storage of recyclables till the quantity enable its transportation to the final processor in a profitable manner. In this line, local authorities should first reach major recyclables generators to raise interest of the private recycling entrepreneurs to invest and be involved in local recycling schemes.

- *Quality Considerations*: The second key to selling recyclable materials is meeting the buyer's quality requirements. Quality refers to the extent to which the materials are pure, clean, consistent, and contaminant-free*;* sometimes the dirtiness of recyclables can turn down them in an invaluable product or can reduce its value in market or even can increase the cost of processing as the recyclables need additional separation efforts through undergoing to mechanical sorting facilities. For this reason awareness and education are important processes which should precede and go with the segregation/separation process.

The preliminary assessment of waste stream (waste characterization survey) helps in choosing the right material to separate and recycle, and designing the logistics of the programme as well as deciding long-term goals.

Waste separation or sorting has other purposes, when one of most important is to sort out hazardous material from municipal waste, so segregation process should aim at diverting hazardous materials from municipal waste stream.

d) How do I start a collection programme?

(i) Have political and management support: The base for planning a recycling program is to have a strong support of top management, municipal council;

(ii) Clear goals and set priorities to recycling material: It is important to be very clear on the hierarchy of objectives for the recycling: is the priority to fulfill with the National

strategy? or to reduce the volume and costs of collection? or to reduce the environmental effects of wastes? or to give a service to specific activities?

If the main objective is, for example, to reduce the environmental effects on the waste stream, the consequence could be to focus to recycle very little quantities of specific and toxic waste like batteries. If the objective is to reduce the costs of the waste collection, transportation and land-filling, the activities should probably be concentrated to reducing waste by "at home" composting, regulation of inert wastes and by collection of papers and cardboards. The next step is to define the priority zones or activities in witch the first step of recycling activity should begin as a pilot process, considering the main producers as mentioned.

(iii) **Form a team**: Forming a waste reduction team helps to ensure a successful program. Together with the recycling coordinator, this group will plan, implement, and manage the program; the group could include responsible for collection, interested people or LGU, representatives of main producers, etc.

(iv) **How do I find a market?** Before the recycling program begins, a market must be found for the materials that will be collected. If no market for a material exists, it should not be collected for recycling. Not all markets will pay for recyclables. Some will require you to pay a fee. However, you may still find this to be more cost effective than paying for disposal of the material. Local or regional recycling organization might be able to help you find or develop markets for materials you intend to collect. They can give you ideas about prices for the recycled material as well as about the required quality, quantities and packaging of the material.

(v) **Start with pilot project**: It is better to start with small-scale projects, as it is easy to compare and evaluate the programmes and techniques that are considered most successful within the community, until the time comes to develop a large-scale programme, there will be practical experience.

(vi) **Effectiveness and efficiency:** Some principles of sound recyclables storage and collection should be understood, while developing a programme, and these include:

- More the separation is done upstream of the system, if possible by the producers themselves (citizens, companies), better will be the quality of the recycling material and the possibility to sell it. At the opposite, the quality of material obtained by separation of collected waste represents generally a big work for a pour quality of product.
- Resident convenience: The easier it is for residents to separate materials, the higher the participation and recovery rates will be;
- Collection crew convenience: The system should be convenient for collection crews. For example, loading and sorting activities should be as simple as possible;
- Quantities and quality of the selected material have to be estimated at short term and middle term vision, in order to estimate the quantity of collection, work for selection and packaging, and revenues of the system, based on reasonable estimations of waste characteristic, awareness of the population and efficiency of the system.
- Cost effectiveness: Equipment and procedures must be designed to maximise collection crew and vehicle productivity; a realistic estimation of the investment cost

(including bins, vehicles, technical installations, buildings, etc.), quantities and annual costs (personal, maintenance, fuel, revenues, etc.) must be done to ensure the financial sustainability of the system and to obtain the support of the political management.

- Integrity of materials: The storage and collection system should keep recyclables in the best shape possible. It should be properly handled, dry and contaminant free.

(vii) Foster public education and involvement: Public participation is one of the most important factors deciding a programme's success. The public has a right and a responsibility to understand the full costs and liabilities of managing the waste they produce. A well-planned public education and involvement programme will foster public interest in recycling.

(viii) Coordinate the programme: Recycling programme is considered a public service. Therefore, local governments are required to ensure that all services are provided properly. Like any other public service, recycling programmes should be consistent, predictable, equitable and efficient.

6.4 Recycling programme elements

Once you have decided what materials to collect and you have located a buyer, it is time to set up your recycling program and its infrastructure. Recycling programmes are designed according to the needs and priorities of the communities. Elements of a recycling programme include source separation, curbside collection, material resource facilities and full stream processing.
In order to be convenient to community (citizens and businesses) the separate collection infrastructure should be placed as close as possible to area where recyclables are generated.

a) Source separation (primary system)

As mentioned, it is generally recognized that sorting at source provides the most efficient sorting result.
Source separation refers to the segregation of the recyclable and reusable materials at the point of generation.
The strategy must be clearly defined from the beginning:

- õ One specific container for each specific waste to be recycled.
- õ System with two containers: one for the mixed dry recyclables material, and one for landfill material (and perhaps a third one for organic material), solution needing a downstream selecting plant.

Specific bins for source separation can be viable for business and industry items and could bring promising results as soon as for them is provided an individual waste collection system For individual house or apartment building, specific bins for source separation is generally only realize in a second phase, because it requires a great number of actors and material..

b) Curbside program (primary system)

In a curbside system, source separated recyclables are collected separately from regular refuse from the curbside, alley, (where a certain number of containers are distributed in the streets to be shared by a whole area), or commercial facility. This is the most frequent solution for a pilot project including residents.

Curbside programs vary greatly from community to community. Some programmes require residents to separate different materials that are stored in their own containers and collected separately. Other programmes use only one container to store recyclables or two containers, one for paper and the other for heavy recyclables (e.g., glass aluminium, etc.).
In Albanian context, it has been strategically agreed that we will move towards a three bin system for the management of municipal waste as soon as practically possible. This would involve establishing a colour coded three-bin option for citizens to deposit their waste.

It is envisaged that there will be:

- Green/ or Brown Bin for Organic compostable material;
- Blue Bin for Dry Recyclable material;
- Black/ or Grey Bin for municipal waste residues.

The 3 bins system constitutes a basic step to the further development of the system which foresees the development of composting as one of the major method for final waste treatment. A second option, more realistic, but less preferable for some scenarios (especially for composting), could be to move gradual towards 3-bins system by implementing firstly a two-bin system and then expand it out to a three bins system in time. Note that the three bins system needs second downstream plant for composting, which represents another big challenge.

c) Drop-off/buy-back (or Secondary collecting-sorting system)

This system can work as complimentary to such solutions and often receive an expanded number of fractions such as hazardous or bulky waste and other special waste fractions.

(i) A drop-off program requires residents to separate the recyclable materials and bring them to a specified drop-off (collection point) or collection centre. However, we must take into account local conditions when designing a collection programme. A recycling centre can be established at the same location where residents deliver waste. Mobile recycling drop-off trailers can also be used.

(ii) Buy-back program refers to a drop-off program that provides monetary incentives to participate. In this type of program, the residents are paid back for their recyclable material directly or indirectly through the reduction in collection and disposal fees. Establishing a buy-back centre (i.e., a place where recyclables are purchased) may help induce citizens to recycle. Some buy-back centres purchase some materials and accept others, depending on current market conditions.

It is recommended that secondary collecting-sorting facilities should be located close or within local area to enable the functioning of programme schemes and at the same time to encourage the community and businesses to bring by themselves their recycled materials.

d) Collection vehicles for recycling:

It is preferable that the collection vehicles that are designed specifically for collecting recyclables have several storage bins, which can be easily loaded and often equipped with automatic container-tipping devices.

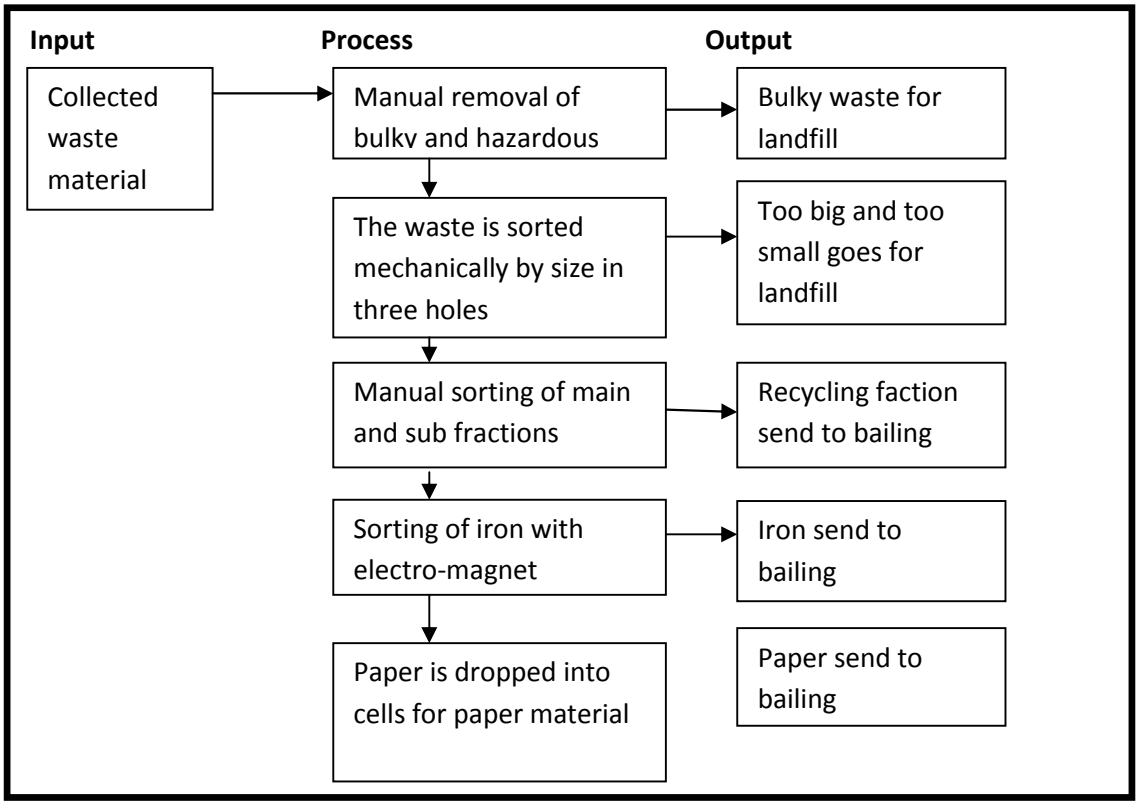
e) Material recovery facilities (MRF)

MRF is a centralised facility that receives, separates, processes and markets recyclable material. It is necessary when operated with drop off and curbside programmes. The primary advantage of MRF is that it allows materials directly from the municipalities and processes them uniformly. It is generally designed to handle all type of recyclables. Implementation of MRF in a municipality depends upon a number of factors as follows:

- **Market demand:** When additional processing is required, MRF is useful as buyers may have certain material specifications.
- **Separate collection:** In systems that require residents to separate their recyclables, intermediate separation and processing is required.
- **Number of different recyclables:** In general, a MRF will be more beneficial when a large number of different recyclables are collected.
- **Quantities of materials:** Because MRF involves substantial capital and operating costs (e.g., buildings, equipment and labour), it is expected to handle a significant amount of materials to justify its operation.

(i) Mechanical Sorting: Mechanical sorting is an expensive and sometimes necessary process within MRF and serves for two purposes: to improve the sorting for material recovery and/or to prepare the waste stream for further treatment. The mechanical sorting is a costly process and strongly related to the waste treatment solution, type collection system chosen and/ or the quality of waste collected. Various types of technology are used in the mechanical sorting process, making use of sorting criteria such as size, weight, the speed of falling, elasticity and form. A mechanical sorting process often utilizes combinations of criteria in order to sort out the relevant materials. The sorting process foresees the involvement of manual sorting mainly used for ‘negative sorting’.

(ii) Manual separation is considered as a wearing, monotonous work, but it is difficult to avoid when upgrading the purity of a fraction e.g. when sorting paper into sub-fractions, e.g. cardboard and carton. These facilities comprising mechanical and manual sorting infrastructure are called recycling facilities. It is recommended they should be within city border or close to it to reduce transportation cost or encourage and make feasible the bringing of recyclables there by community.



"Example of diagram of mechanical sorting plant for packaging"

(vii) Processing equipment for recycling

- **Balers**: Balers must generally be used to densify many types of materials including paper, cardboard, plastics and cans. Balers improve space utilization and reduce material transportation costs.
- **Can densifiers:** Can crushers are used to densify aluminum and steel cans prior to transport.
- **Glass crushers:** These are used to process glass fraction separated by colour and break it into small pieces. This crushed material is then called cullet, and can be reprocessed into new glass products.
- **Magnetic separators:** These are used to remove ferrous material from a mixture of materials.
- **Wood grinders:** These are chippers and are used to shred large pieces of wood into chips.
- **Scales:** These are used to measure the quantity of materials recovered or sold.

a) Informal waste segregation

Supporting existing recycling activities should be taken in consideration, mainly in the beginning, to bring them inside the development scheme. The combinations of the above mentioned sorting possibilities are expected to give the best results.

An objective is to enhance the contribution of informal waste collection and recycling workers through improving their organizations and facilitate they collection. The measures proposed on this subject remains on formalizing their activity them, establishing micro-enterprises and providing economic assistance to them. Some other measures probably shall include:

- . Improving working conditions and facilities for waste pickers;
- Achieving more favorable marketing arrangements for services and picked secondary material; and
- Introducing health protection, educational facilities and social security measures.

e) How do I involve, educate, and motivate community?

Community involvement, education, and motivation are critical to the success of your entire waste reduction program. In order to have an efficient and well-functioning waste management system, it is important that the public understands the system and supports it. The success of some recycling schemes relies almost completely on the support among the users, e.g. the households, businesses, etc.

(i) Information: Information is a basic tool to improve public knowledge and awareness on waste issues. When a new initiative is to be launched, such as collection of recyclables, suitable media may be TV advertising or adverts in newspapers. The follow-up campaigns are necessary in order to upgrade the community knowledge e.g., the sorting quality. Experiences elsewhere have shown that sorting mistakes can be reduced as a result of extensive and continuous informative activities.

(ii) Education: It is clear however that the success of any waste management initiatives or community behavior e.g. segregation system will be dependent on a robust and far reaching public awareness campaign which should be enhanced by educational inputs at all levels of education and should include vocational training within employees and relevant industries involved in the scheme. In the longer term awareness will be raised through the educational system and the increased integration of environmental topics into the school curricula and higher education programmes.

(iii) Legal and economic incentives: Legal and economic incentives may change people's behavior and are seen as effectiveness tools to motivate and invite community and business to be actively involved. Local authorities may also stimulate waste minimization incentives (composting at home or waste segregation) through application of lower local fees or direct financing support for private investments on waste management.

6.5 How do I monitor and evaluate the collection programme?

Monitoring and evaluating the program should be done on a regular basis. Maintain accurate and up-to-date statistics, such as the types and amounts of material collected, recyclables prices, and quality.

The monitoring and evaluation of collection program serve to improve and either extends the collection system and the quality of waste segregated. More concretely, could serve to:

- Increasing the collection rate per material;
- Extending – or reducing – the collection zone and pilot project;
- Adding materials to your collection program, or focusing to the more interesting material;
- Reducing contamination through customer, employee education or by redesigning the collection system;

- Increasing employee or community education;
- Initiating community projects to increase recycling;
- Reorganizing the structure of the recycling system to make it more efficient.