Deutsches Biomasseforschungszentrum
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DBFZ

SHORT VERSION

WasteGui: Guideline for organic waste treatment in East Africa

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Introduction to the Guideline

The guideline offers an overview of concepts and best practices for the collection and treatment of biodegradable wastes from different sources – mainly but not only from households – developed to be adopted in East Africa, particularly in Ethiopia (see figure 1). It is adapted to the local conditions of rural, semi-rural and urban living structures. Thereby it should help decision makers, planners and the private sector, not only by information about the various organic waste handling and treatment concepts, but also to implement a solution suitable to the local conditions.

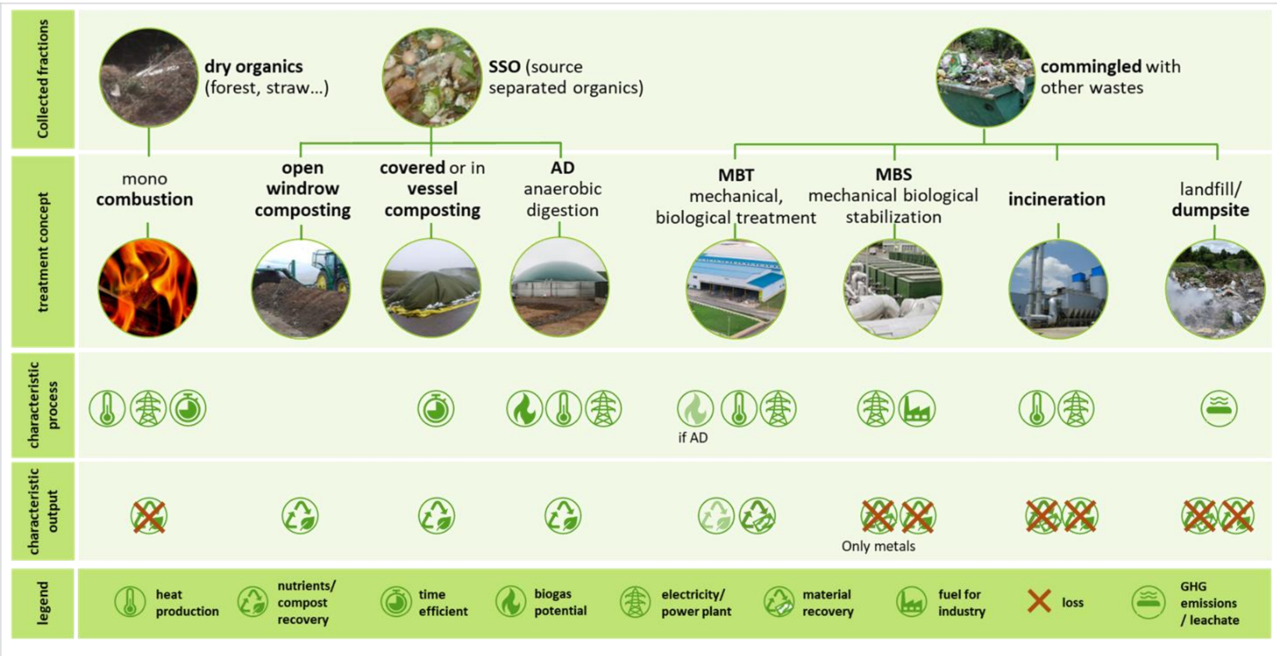
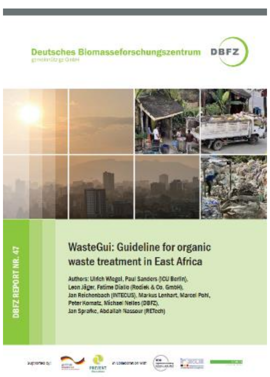


Figure 1: Overview waste treatment technologies - visualizing process- and output characteristics (ICU)

This publication was elaborated in the pilot project “Guideline for organic waste treatment in East Africa” as part of a call for solutions by the PREVENT Waste Alliance. The aim of the project is to provide a general overview of the current state of organic waste management in East African countries, described in the DBFZ Report Nr. 45 (Lenhart et al. 2022), specifically using Ethiopia as an example. Based on this, this DBFZ Report Nr. 47 focusses on detailed concepts for collection, transport and final treatment of organic wastes, as an additional information for politics, administration, research institutions and the private sector.
This document is an executive summary. For further details please refer to the reports below.

DBFZ Report Nr. 45

Status-Quo of organic waste collection, transport and treatment in East Africa and Ethiopia
Link



DBFZ Report Nr. 47

WasteGui: Guideline for organic waste treatment in East Africa
Link

Status-Quo of organic waste management in East African Countries

Due to the growth of population as well as wealth and intensified general consumption the amount of waste - produced and disposed - is simultaneously growing. One of the problematic side effects: the rate of proper waste logistics and treatment is not growing accordingly. Still, very few and only certain types of waste are handled in a circular way by adequate recycling systems.

Regarding Solid Waste Management (SWM), attention needs to be given to the emerging economies: countries that are shifting to a higher income level will experience a dramatic increase in per capita waste generation and an exacerbation of management difficulties due to the growth in prosperity and to urbanization (Kaza et al. 2018).

The share of organic waste in East African cities (as well as in the rural areas) is very dominant: 55 % to even 80 % (see figure 2). This waste composition characteristic not only demands particular attention but also offers a range of feasible management and treatment solutions. If unmanaged and not treated separately the organic matter is accountable for numerous negative environmental, health and social impacts. If landfilled or burned the general values of organics are lost: nutrient rich humus and energy potential. Improvement concepts can be relatively simple, affordable, low-tech and effective.

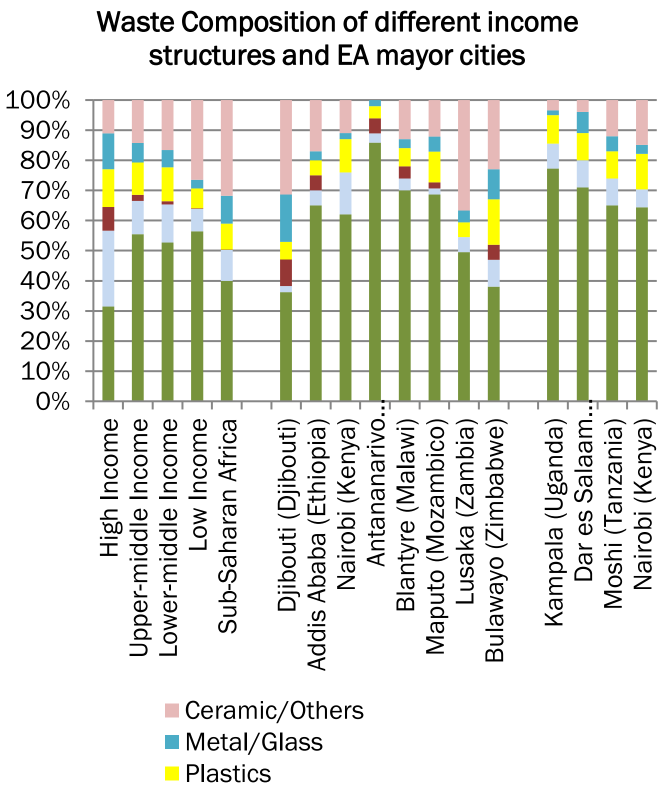


Figure 2: Waste composition in some capitals of Eastern Africa (Lenhart et al. 2022) from (ACCP 2019, 3.5) and (UNEP 2018, p. 27) and averages reported in What a Waste 2.0 (Kaza et al. 2018)

Figure 3: Biodegradable waste examples. Left: Branches from street cleaning; right: Mix of kitchen and garden waste (ICU).

For more information on “Status-Quo of organic waste collection, transport and treatment in East Africa and Ethiopia” see DBFZ Report Nr. 45

Logistic concepts

Although waste collection rates occur to be comparably high in Ethiopia (which is an appreciable factor), the predominant praxis of landfilling almost all collected wastes has to be improved. New approaches of waste handling will demand adapted logistics concepts – primarily to separately manage biodegradable waste fractions.

The planning and design of waste logistics systems typically needs ~~real~~ reliable data on the status quo in the following areas as shown in Figure 6.

When designing logistics concepts for the collection of waste, a multitude of decisions have to be made, that each have significant influence on the final configuration of the system.

However, there are certain key principles, that all waste management solutions have in common:

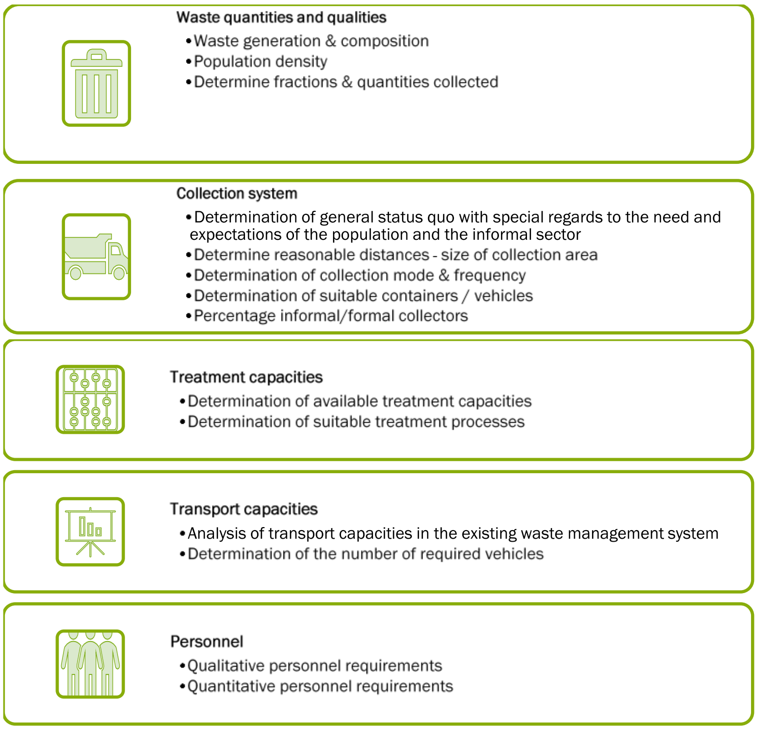


Figure 4: Data required for designing waste logistics systems (Rodiek)

- The selected technologies must work reliably under the local conditions.
- Transport cost typically make up for the largest part of the overall cost and therefore should be minimized.
- The characteristics of the logistics system should meet the needs and expectations of the local waste generators.
- The overall cost has to be recovered either through a waste fee and/or the sale of treatment products.
- There is a trade-off between minimal transport cost and maximum quality of treatment products, which needs to be solved for the individual context.

Decisionmakers should have sufficient knowledge of the available technology options and the design processes, as well as a broad idea of what waste logistics in their area of authority should look like. The further development and refinement of the concepts can be supported by specialized consultants with experience in planning and implementation of waste logistics systems in African countries.

For more information on "Collection and logistics concepts" see
DBFZ Report Nr. 47, chapter 4.

Logistic concepts

A concept for the collection of waste can only be successful in the long term if it is technically as well as economically feasible and if it meets the demands of the people it services. Additionally, any system that is designed should critically consider the ecological impacts.

Transferring the criteria shown in figure 7 to the context of waste collection and logistics, the following decision areas can be derived, which will be further elaborated in the guideline:

1) Collection mode
2) Times and frequency of collection
3) Point of collection
4) Vehicle types
5) Container types
6) Transport stages
7) Storage
8) Transfer
9) Treatment
10) Digitalization

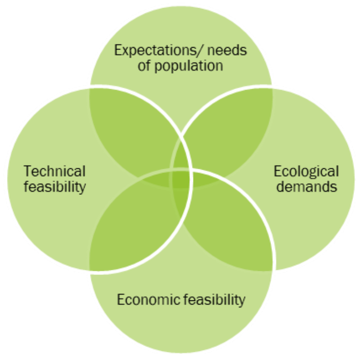


Figure 5: Success factors for waste logistics systems (Rodiek 1988-2022)

As shown in the previous section, development of suitable logistics concepts for biodegradable waste is a multi-dimensional, non-quantifiable and complex problem: A variety of decision areas for the development of a logistics concept exists, with an even greater variety of different characteristics. All of which need to be combined to meet ecological, technical and economic targets as well as satisfy customer needs and expectations. Morphological analysis is used within the guideline to develop recommendations for three different settlement structures as applicable examples (see figure 8).

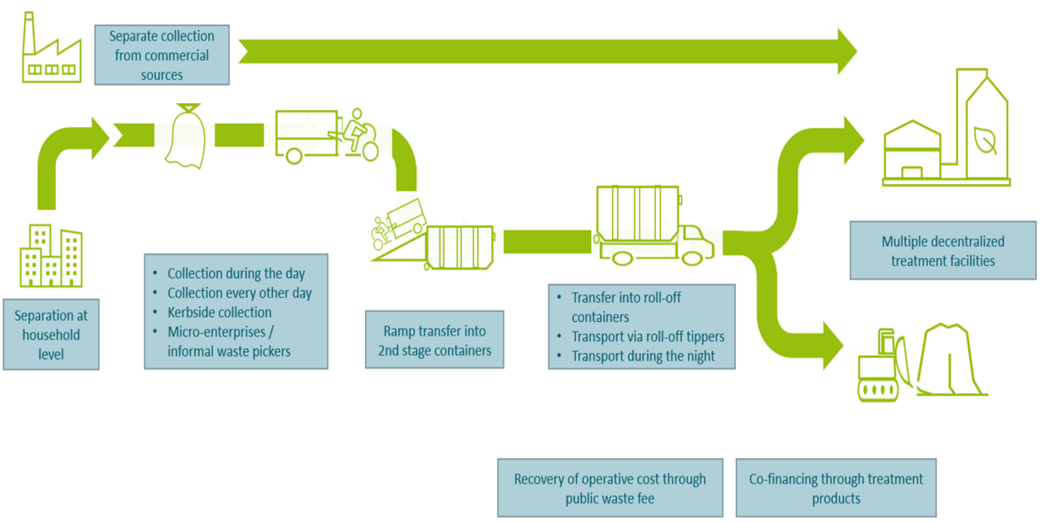


Figure 6: Concept for separate biogenic waste collection and treatment technologies for metropolitan area (Rodiek 1988-2022)

For more information on "Collection and logistics concepts" & "Conclusions for local specific implementation" see DBFZ Report Nr. 47, chapters 4 & 7

Treatment concepts

The main objective of organic waste management in general is to eliminate the high negative impacts of organic waste when landfilled, dumped or openly burned. The best way is to extract this waste from the mixed waste as source separated organics (SSO), to be able to produce high quality products such as compost. But even with a high degree of separate collection, there will always be a high, relevant share of organic waste in the remaining mixed waste, which has to be treated prior to landfilling, either by incineration or by biological processes.

The guideline provides details of these characteristics, focussing mainly on biological treatment options (see figure 7) and their specific effects in terms of energy and material recovery. Their two main subsystems are composting and anaerobic digestion –both being applicable for SSO and mixed waste. Both systems will be described by their basic characteristics and examples of local application will be given. Aside of this, an own chapter covers the main combustion systems.

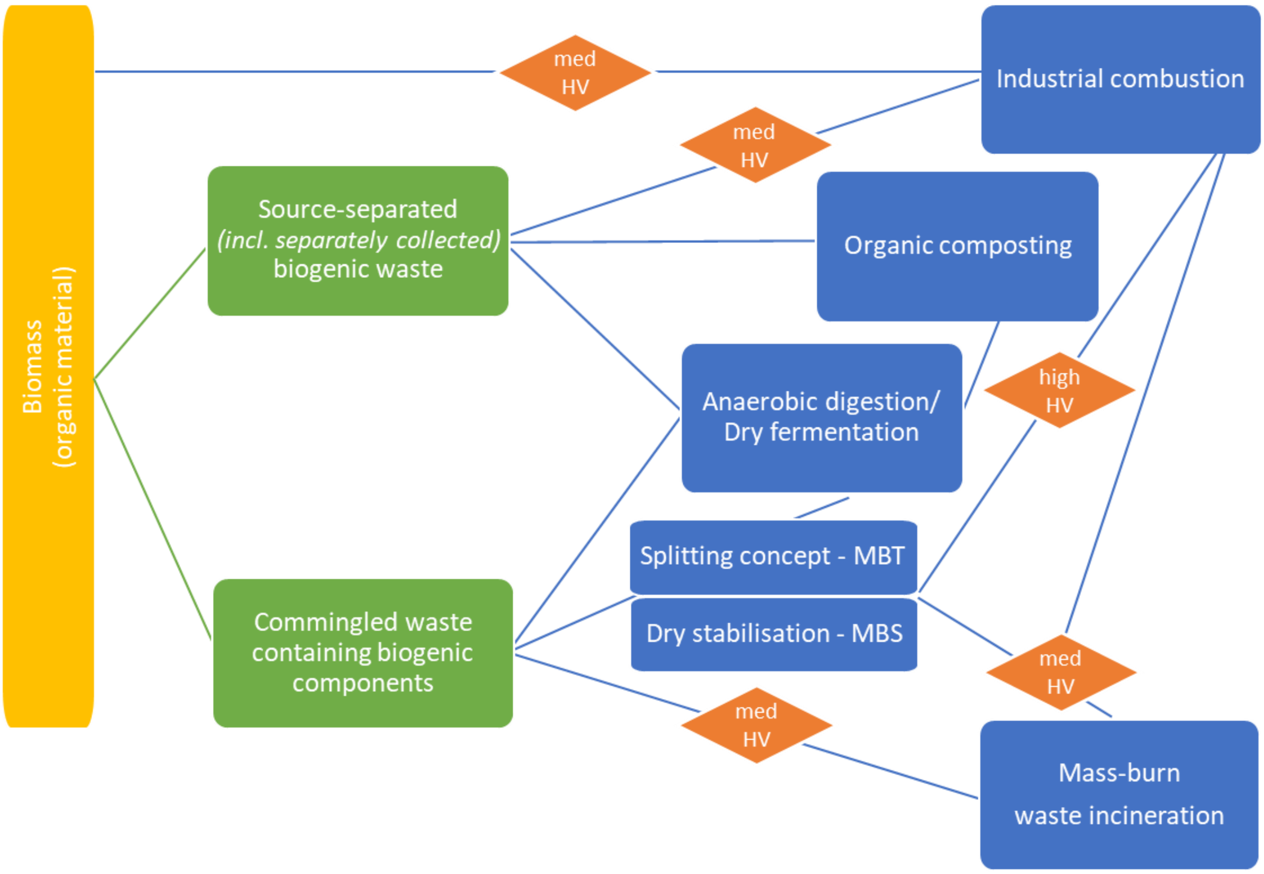


Figure 7: Treatment techniques and their possible interrelations with each other and the to be treated waste (fractions) (INTECUS)

The guideline outlines three treatment techniques and their respective technological variants: composting, anaerobic digestion and mechanical-biological treatment including combustion.

For more information on "Treatment concepts" see DBFZ Report Nr. 47, chapters 5.1, 5.2 & 5.3

Treatment concepts

Choosing the right combination of treatment technologies should be based on a differentiated assessment and intensive screening in order to fulfil individual needs under local conditions. These considerations and the decision-making process itself shall be supplemented and deepened within the guideline by referring to steps to take and methodical concepts that can help to perform such thorough review and enable reasoned decisions.

Most often in decision-making, particular attention is paid on the economic and financial viability of the treatment concepts, not at last to raise the necessary funds for investment and not to overburden state budgets and/or the public who is paying for the waste services. The amount of investment is only one side of the coin; often the subsequent expenditure for the ongoing operation of the technical facilities is no less enormous and a more difficult burden on which treatment projects also tend to fail. The whole subject is particularly critical for countries with less strong developed economies and a high proportion of the population having minimal monetary income and who may not pay or be able to afford to pay for waste management.

Beside the economic dimension, a wide range of different decision-areas must be considered for an organic waste management strategy (see figure 8). For the part of treatment technologies an exemplary SWOT analysis was carried out within the guideline to support the decision-making process on the technical level.

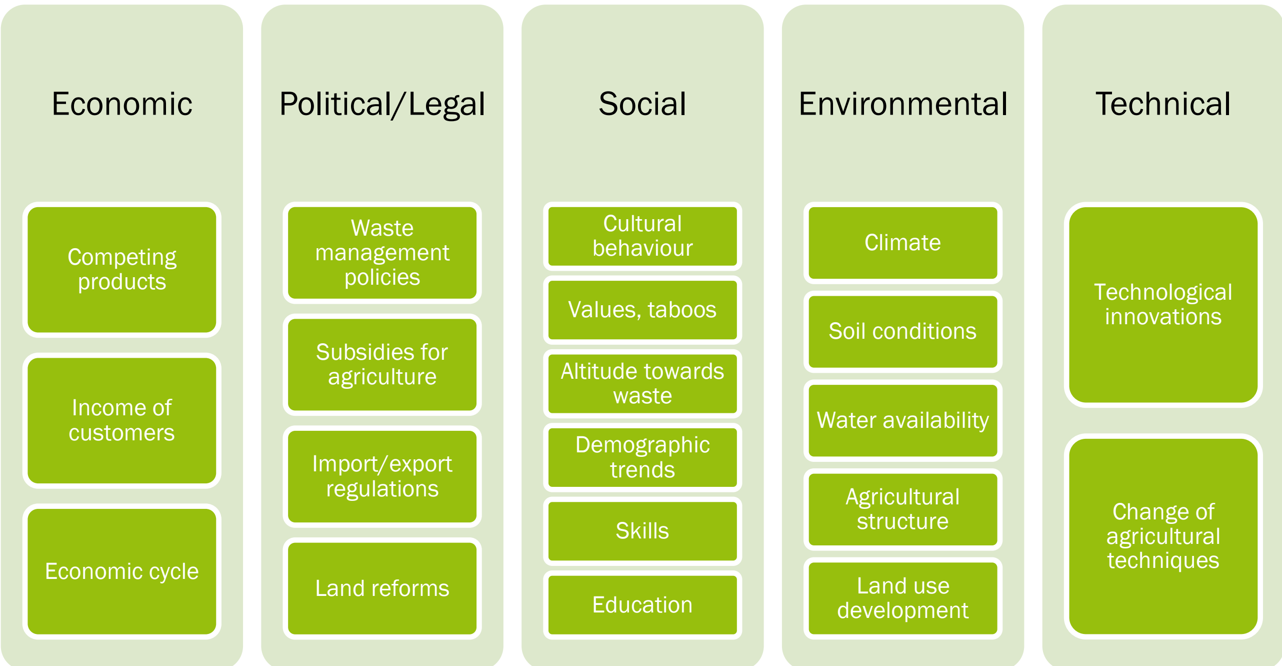


Figure 8: Exemplary overview of factors influencing a business environment (DBFZ adapted from Decentralised Composting for Cities of Low- and Middle-Income Countries. Manual published by Waste Concern and Eawag, 2006)

For more information on “Technology assessment” see DBFZ Report Nr. 47, chapter 5.4 & 5.5

Economic feasibility – the COST frame

The realization of any approach to improve waste management depends on the availability of financial means. Extent and quality of all measures in waste management are determined by the achievable budget for it. The size of this budget necessarily follows the economic power of the concerned state/region and the available income of the households. Worldbank (2018) states here:

For a coarse orientation the following affordable and acceptable shares can be applied:

- For the household waste: 1 % of the available income of the households
- For all produced wastes: 0.5 % of the local Gross Domestic Product (GDP)

Since both, the household and the GDP income, differ extremely between the different states and as well as between the regions of one state (e.g. city higher than rural), this realistic yearly budget for waste management must be determined per region.

Think big, but start small: Model Projects

Based on the local conditions and the given planning aspects costs for a waste management system might pile up to some million $ per year. This high amount leads to the question: Does it work as forecasted, especially the efficiency of separate collection?

This question was set wherever an extended separate collection was projected, especially for SSO. Since the specific complications, the degree of participation, the masses of separated SSO and its quality are not predictable, some central rules can be given in order to introduce a reliable organic waste management system stepwise:

Step 1: Installation of a composting site

- Set up a first lower scaled, open windrow composting site and start it with the "easy to get" organic fractions.
- Ensure the quality-adapted utilization of the produced compost.

Step 2: Introduction of separate collection of organics by the citizens

- Don't focus on large-scale solutions.
- First of all, gaining experience on a small scale, with only some thousand inhabitants.

For more information on "Economic feasibility" & "Model Projects" see DBFZ Report Nr. 47, chapter 8 & 9

Conclusion & outlook

The current waste management in Ethiopia and East African States produces strong negative environmental effects, endangers the health of population and fails to recover material and energy.
When landfilled, the untreated waste produces heavily contaminated leachate, strong emissions of methane as a greenhouse gas, this added by occasional explosions, landslips and a permanent infection risk for people working on or close to the landfill.
Almost all these negative impacts are caused by the biogenic components in the waste, holding a very high share of around 70 % - quite similar in all East African states.
Therefore, the untreated biogenic waste must no longer be landfilled. Viable ways to achieve this:

- Complete regular collection of all waste to direct it in controlled disposal ways.
- Source separate collection of organic waste – this can reduce the remaining waste and let produce applicable compost with almost no contaminations.
- Treatment of the remaining waste to eliminate the biological reactivity before it goes to the landfill.

This guide provides in this respect examples, detailed data, information, realization options and regional recommendations for the different systems of

- collection, with logistic aspects, needed equipment and planning hints for the local configuration,
- treatment, for both separate collected organics and mixed waste, here with biologically concepts in the focus, since they are powerful and easier to realize especially for lower capacities.

Criteria for concept decisions are provided in both fields, helping at the final selection following the local conditions. An own chapter handles the framing conditions to realize the improved waste management, with integrated hints increase both:

a) local financial budget, esp. determined by an affordable share of the household income. This shows that the budget will allow to realize the first, most important steps of a later full-scale implementation.

b) public and political awareness, which is recently low for the subject “waste”, but very important to win for the needed willingness to participate.

Waste management is an evolutionary process following the economic power of the concerned state or region. Aside of the upcoming long-term planning and realization of the complete system, recommendations are given for the first steps of well payable model projects to collect experience in treatment and separate collection of organic waste.

For more information on other PREVENT pilot projects as well as interesting insights into circular economy activities visit https://prevent-waste.net/

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