

CRIC Training on Integrated Waste Management (IWM)

Module 3 Biowaste



Main learning objectives of this module



understand the basics
of biowaste
management



understand the benefits
of composting



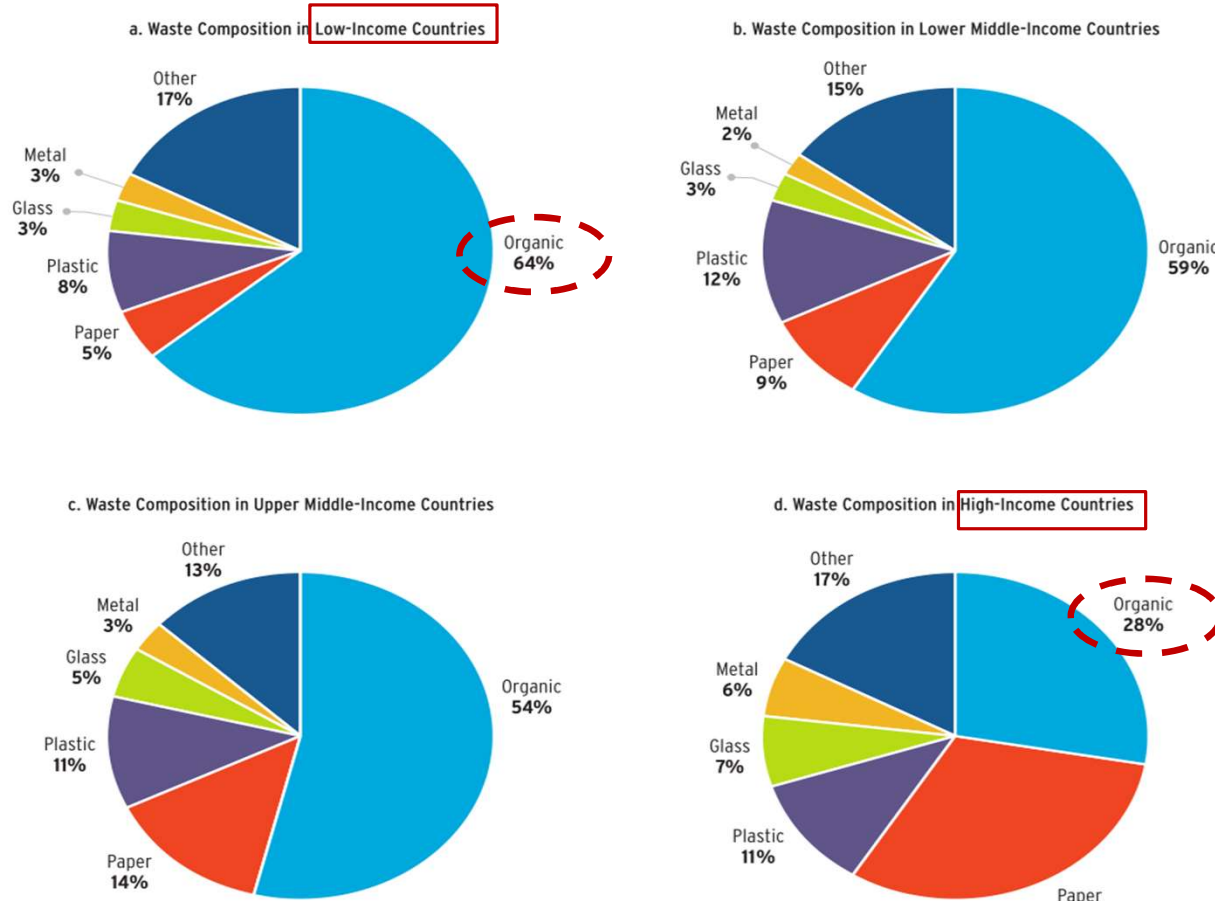
Get an insight about key
enabling factors and
good policies



See good case studies
from low and middle
income countries

1. Basics and Key factors

Biowaste in MSW across the world



Source: The World Bank, What a Waste, [link](#)

Different biowaste streams - generators

Source separated food waste: residential	Large generators (markets...)	Garden waste	Agroindustrial scraps	(Organic fraction from mechanically selected MSW)
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Running out of soil

- Some 40% of soil used for agriculture around the world is classed as either degraded or **seriously degraded**
- Soil is being **lost** at between **10 and 40 times** the rate at which it can be naturally replenished.
- According to the current rates of soil degradation we have about **60 years of topsoil left.**
- Nutrient depletion is exacerbated by **synthetic fertilizers**



Composting - Objectives

The main target of composting is to convert the organic fraction into a **soil improver** with standardized **quality** properties, thus giving back carbon to the soil (**carbon sink**) and reducing the emissions of **Greenhouse Gases**, particularly **methane** from landfills

COMPOST BENEFITS

Nutrient supply

Carbon sequestration

Weed, pest and disease suppression

Crop yield*

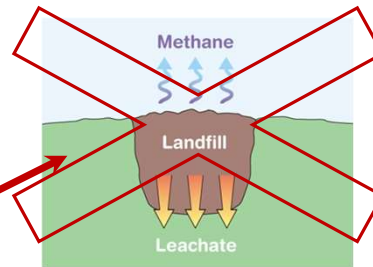
Soil erosion

Soil moisture content

Soil workability

Soil biological properties and biodiversity

Crop nutritional quality*



Short-lived Climate Pollutants and organic fraction of MSW

- Short-lived climate pollutants (SLCPs) are agents that have short atmospheric lifetimes and a quick warming influence on the climate.
- **Methane** (from landfills and dump sites): from the decomposition of the **organic fraction** is the key SLCPs emitted from the municipal solid waste (MSW) sector

In Europe, it's the major contributor to GHGs from inappropriate management of MSW (4 to 11% of total GHGs come from landfills)

Dhaka, Bangladesh (Photo source: Stratus Consulting)



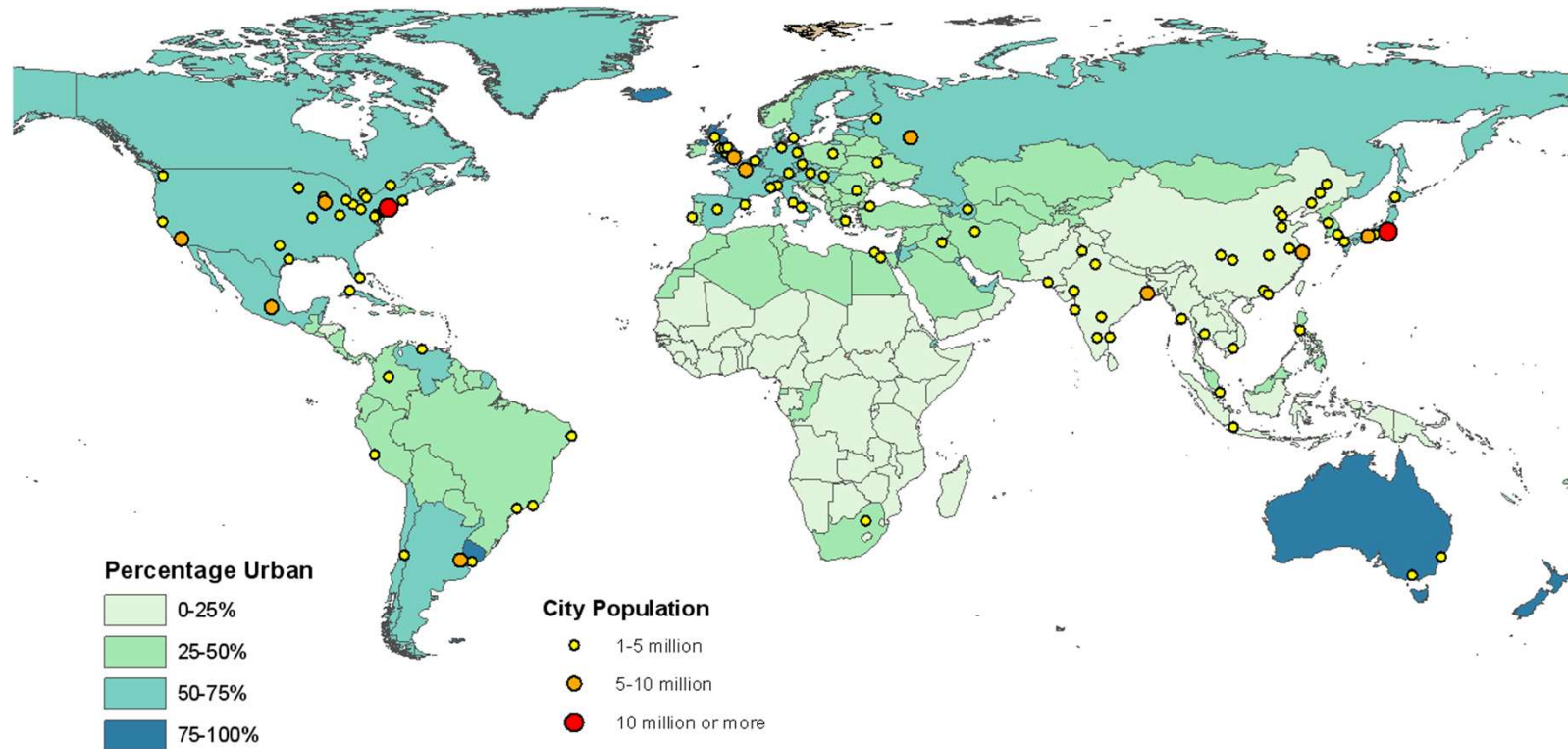
The paradox of biowaste

- It generates the highest environmental impact when landfilled -> **has to be diverted**
- Represents the highest share in MSW recyclables -> **has to be collected** to achieve high recycling targets

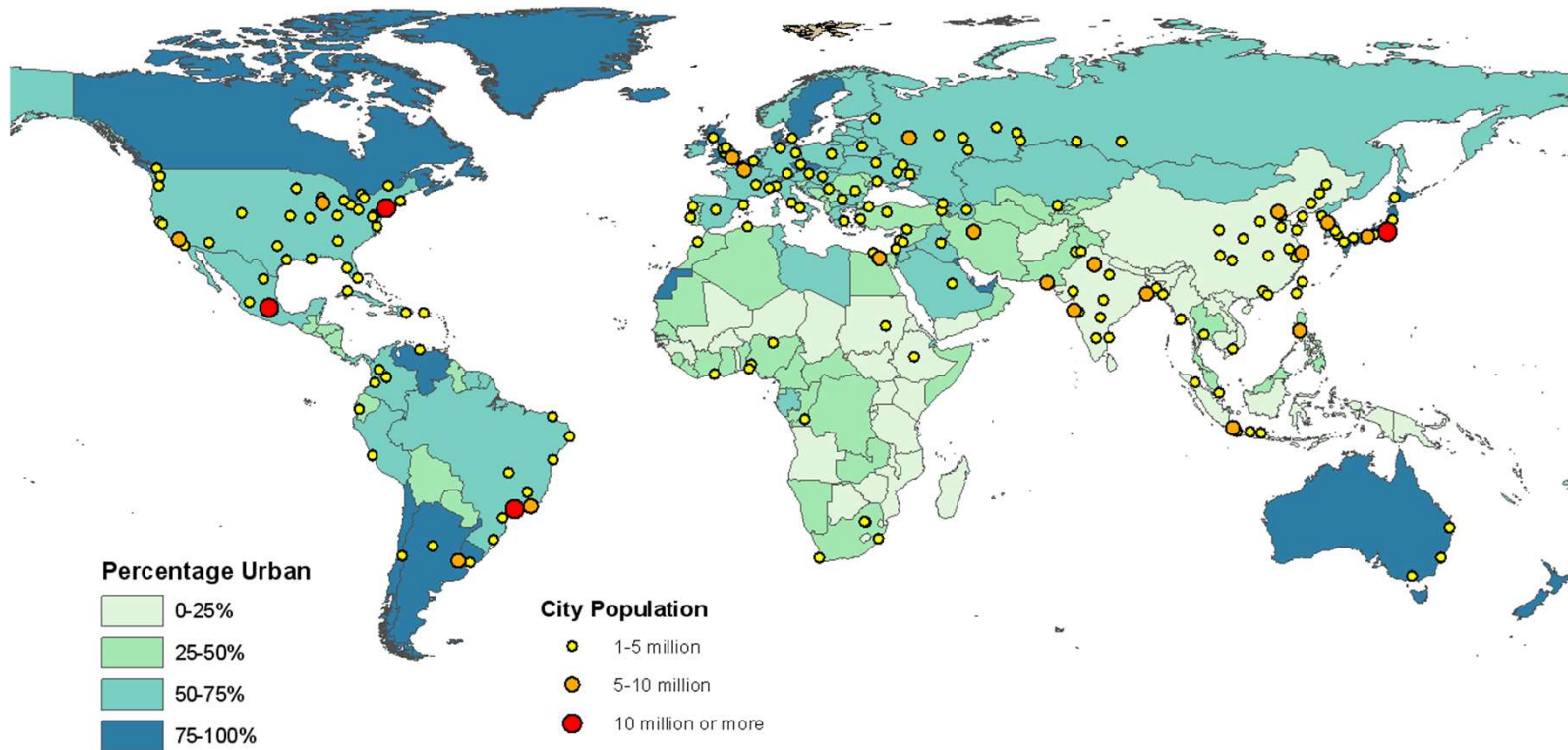


- Is not targeted by the collection of **informal recyclers** -> a viable and **effective collection scheme** is not easy to set up
- Does not benefit from Extended Producer Responsibility (EPR) schemes -> **should be supported** through other incentive schemes

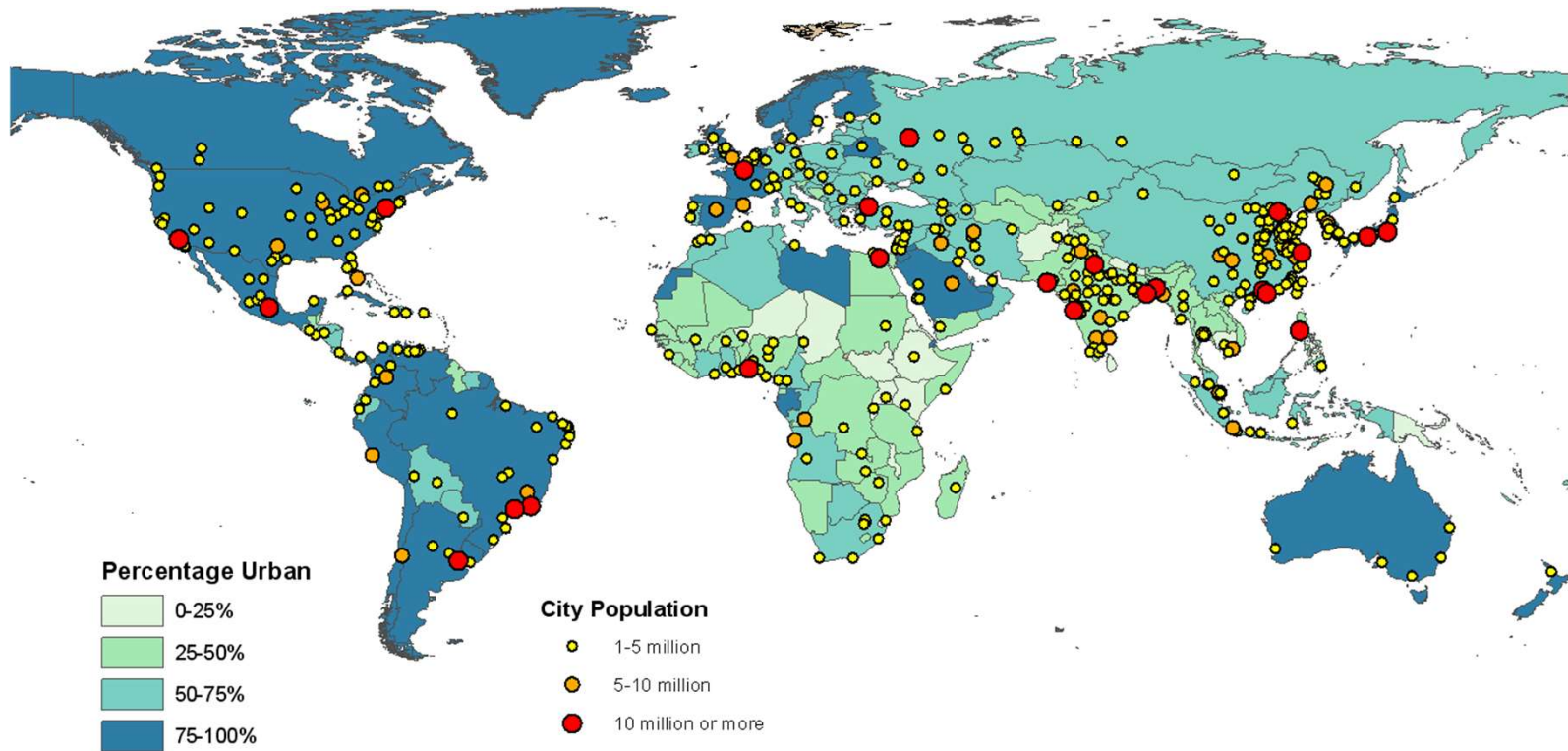
What's changing?



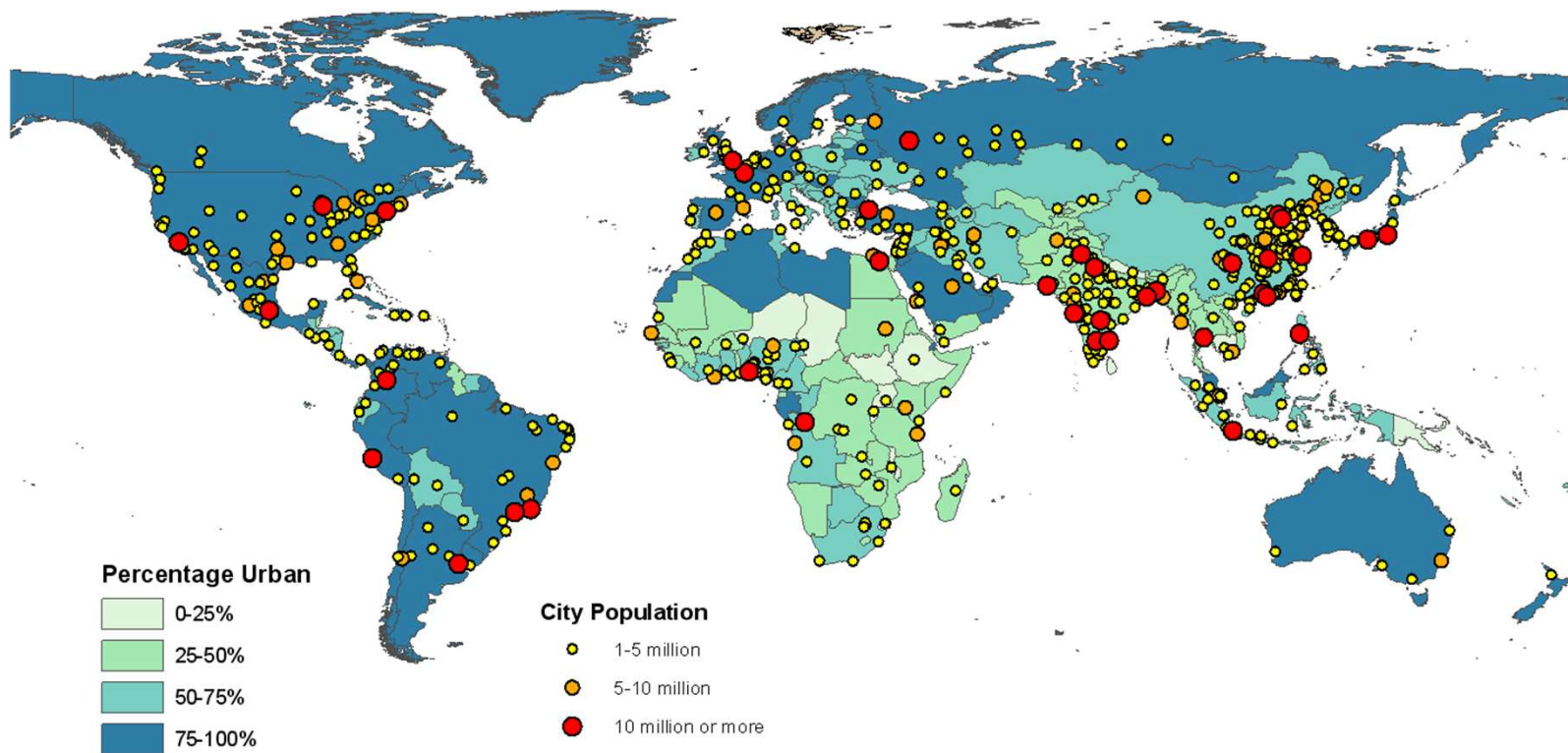
1960



198
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2011

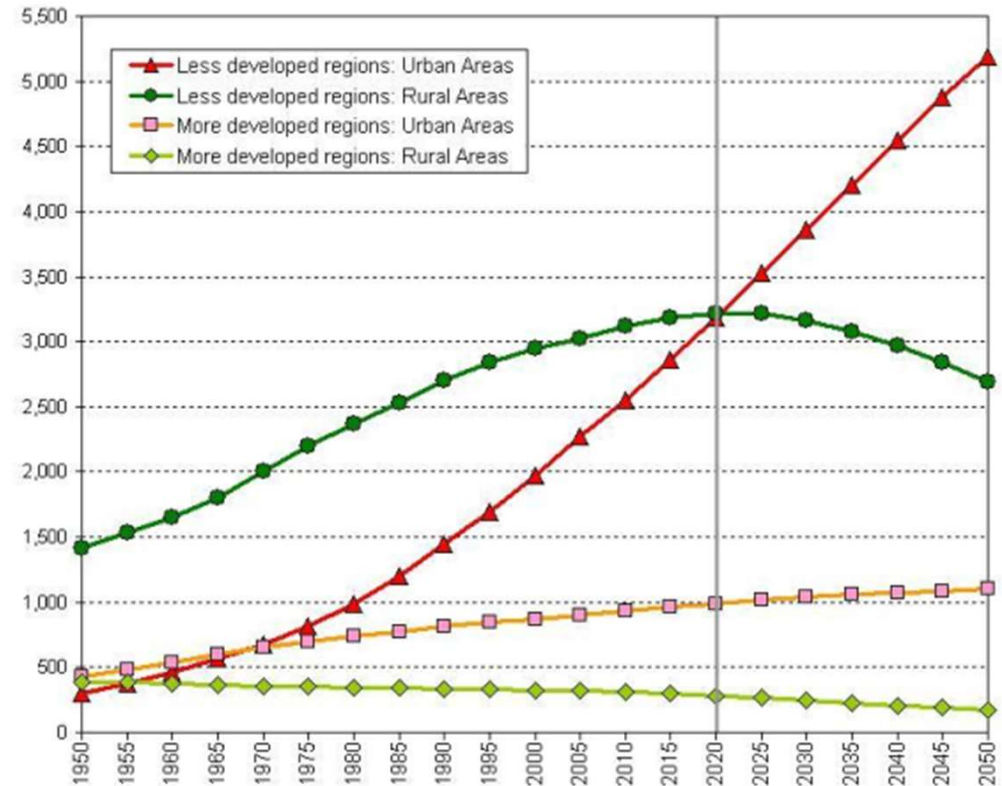


2025

Source: United Nations,
[link](#)

Think large

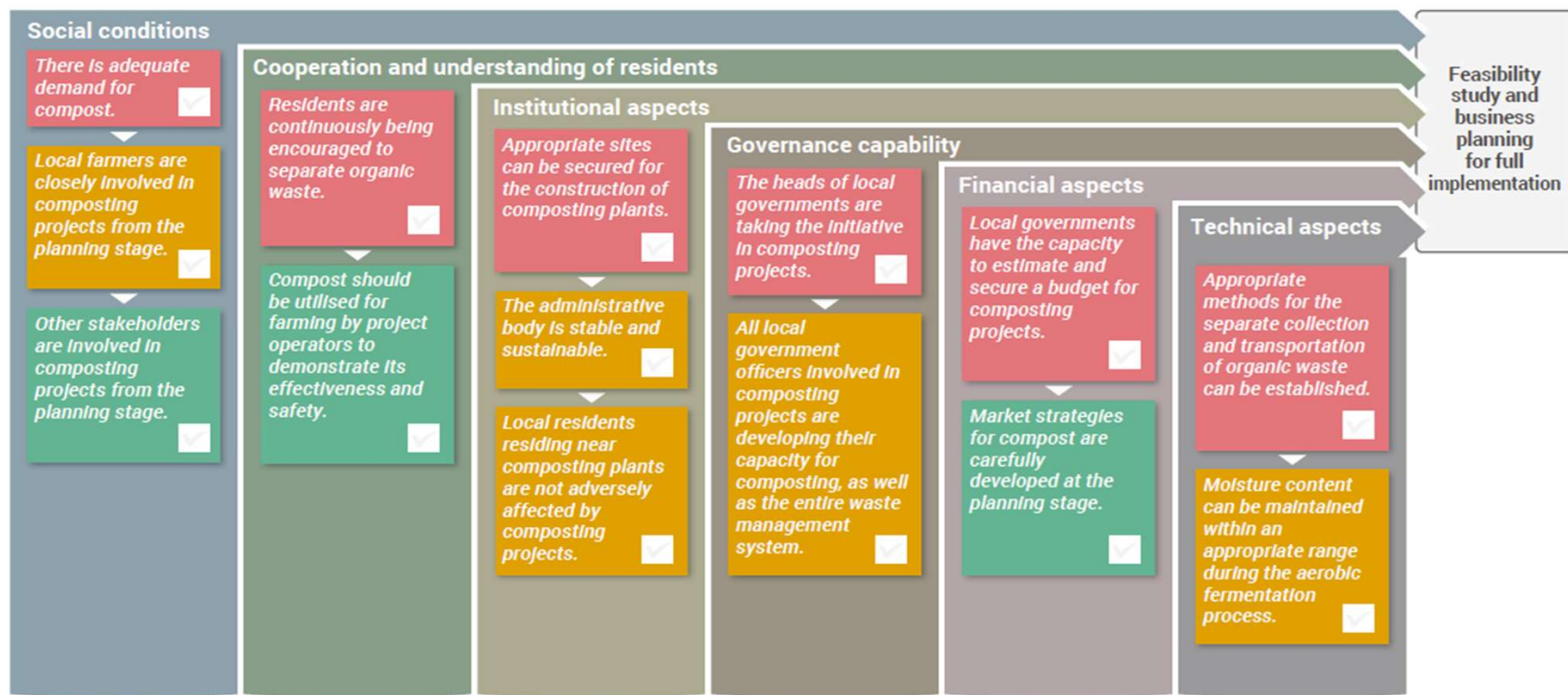
- Focus on all possible solutions for **urban areas** and particularly transitional megacities



Urban and rural population as percentage of world population (Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, 2007).

Key elements for a successful biowaste management





☒ Mandatory key criteria	in cases where mandatory key criteria are not met, suspend the evaluation or re-evaluate after improvements are made
☒ Strongly advisable key criteria	in cases where strongly advisable key criteria are not met, consider improving the situation through support measures or alternative proposals
☒ Advisable key criteria	in cases where advisable key criteria are not met, consider it risky to implement

Source: [CCET guideline series - composting](#)

Key elements for successful biowaste composting

- Regulatory framework
- Visibility of compost as a valuable product
- In low income countries: low cost facilities
 - Second hand machinery, rental, network of facilities sharing equipment
- No impurities in biowaste collected

Reward and inform citizens

- Citizens must be **informed and sensitized**, even not economically, just about the final destination of their waste.
- Final treatment plants / areas must be visible and visited
- The misconception that an **end-of-pipe facility** can separate all fractions generating high quality end product is dangerous when it comes to explain citizens the role of their behaviour in **separating at home**



Compost give-out days in Italy



Community composting in Spain

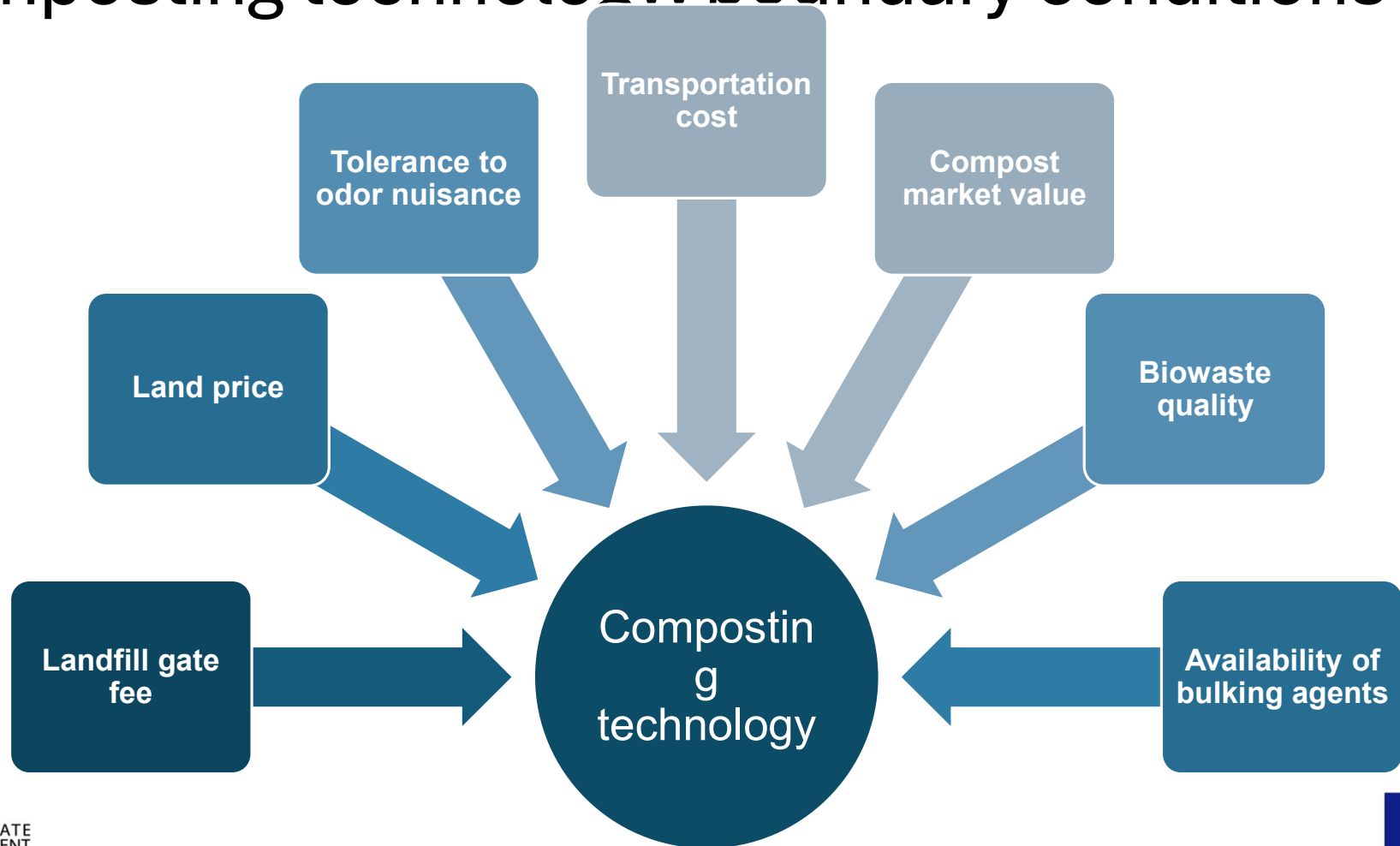
Convenient tools

- Highest participation is ensured when citizens have the feeling that separate collection of food waste is, first of all,
 - Convenient
 - clean
 - easy
- E.g. door to door collection
- reduce collection frequency of residual waste, increasing frequencies for food waste



2. Composting technologies

Composting technology: boundary conditions



Composting at different scales



Home composting 1



Home composting 2



Community based composting



Decentralized plants

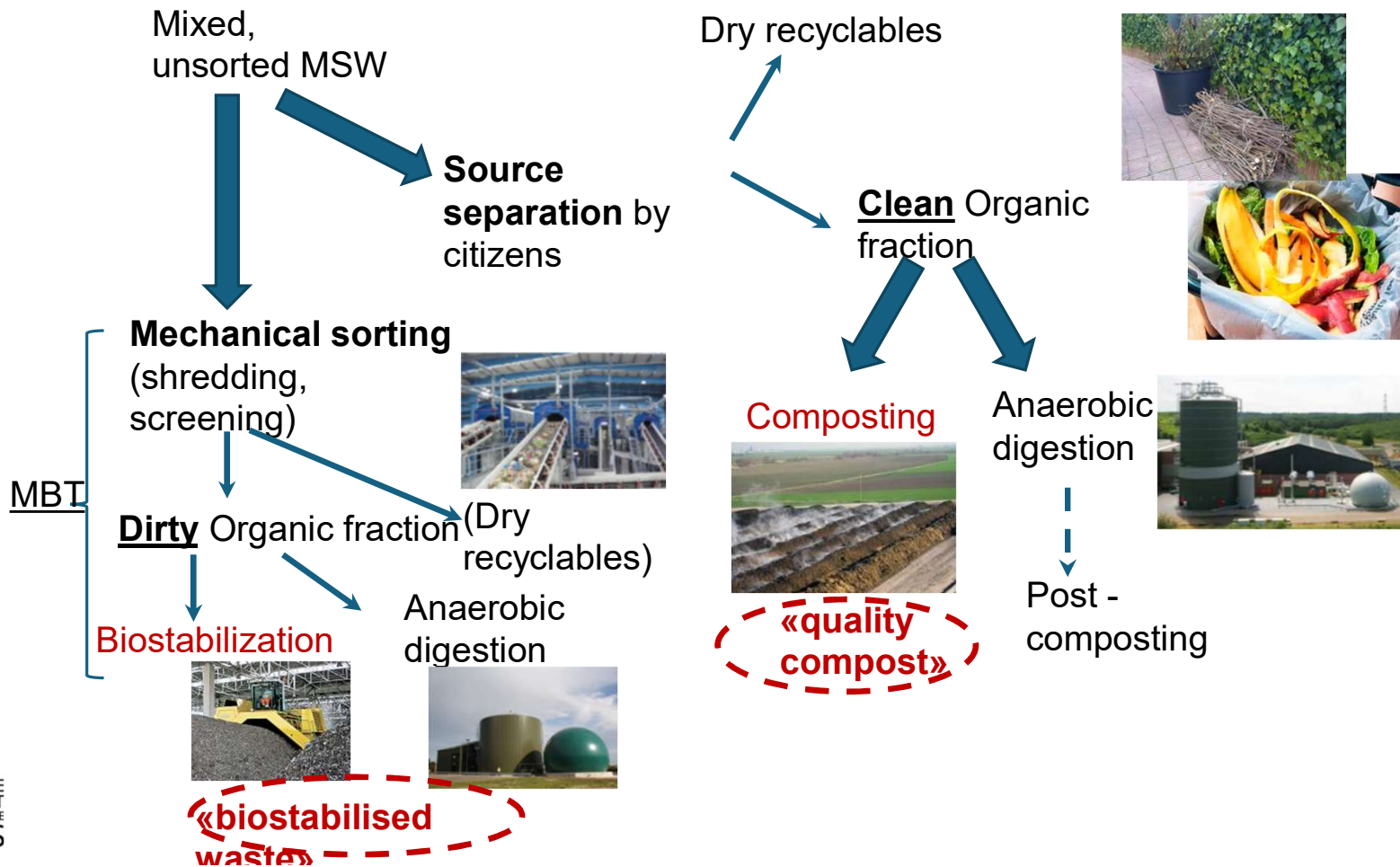


Modular industrial plants



Centralized industrial plants

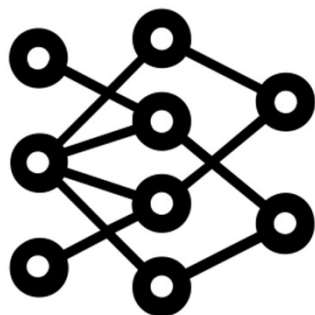
Treatment options



Centralised / decentralised

- Various policies in middle-low income countries promoting both:
 - Decentralised composting (e.g. TPS3R, Indonesia)
 - Centralised solutions (e.g. India, «City Compost» support)

Composting: the proximity conundrum



Decentralized

Decentralized plants can be built quickly

Community engagement

Could help in changing the mindset of people towards waste management

Local compost sale at higher prices (if high quality)

Large scale plants need huge investments

Centralized

Economies of scale in pre- and post-treatment equipment (can accept feedstock with higher plastic contamination)

Higher contribution to organics diversion from landfill

Possible carbon credit support

The 'Not in My Backyard Syndrome' may hinder the provision of hundreds of micro plants.



Transportation to final usage area



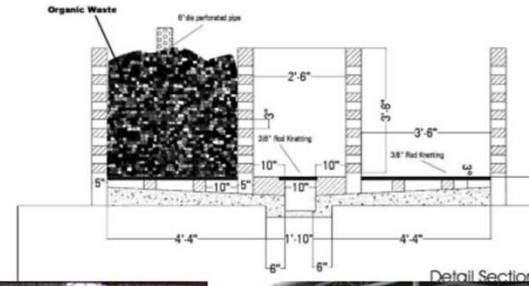
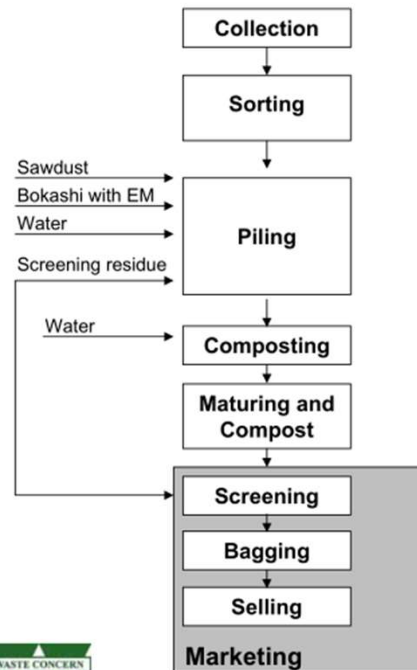
- **Compost must be used close to the production source** otherwise transportation cost could make compost not appealing with respect to mineral fertilizers.



- In some megacities, the production of compost if all citizens and producers collect biowaste could be **too much** to be used inside urban territory.

A basic decentralized composting model

- Up to 3 / up to 10 tons/day (1,000-3,000 t/year)
- Box type composting system



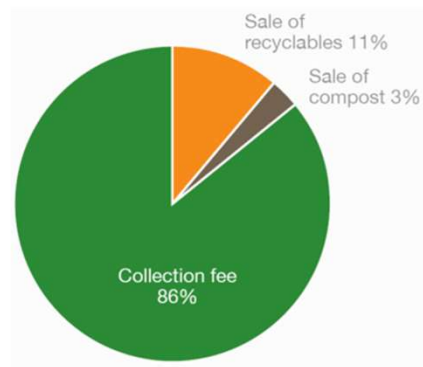
Large scale composting – key issues

- Odor emissions
 - Need for enclosed buildings with air treatment
- Input biowaste quality -> need for pre- and post-treatments in order to get a quality compost
 - Use of compostable bags
 - Sensitization campaigns
- Compost marketing

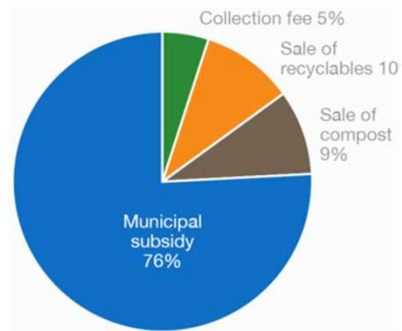


3. Economics and Policies to support biowaste

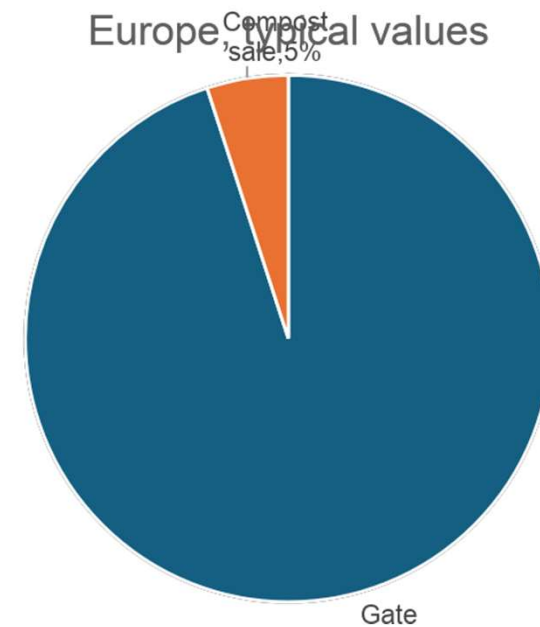
Composting plants: revenues



Quy Nhon, Viet Nam

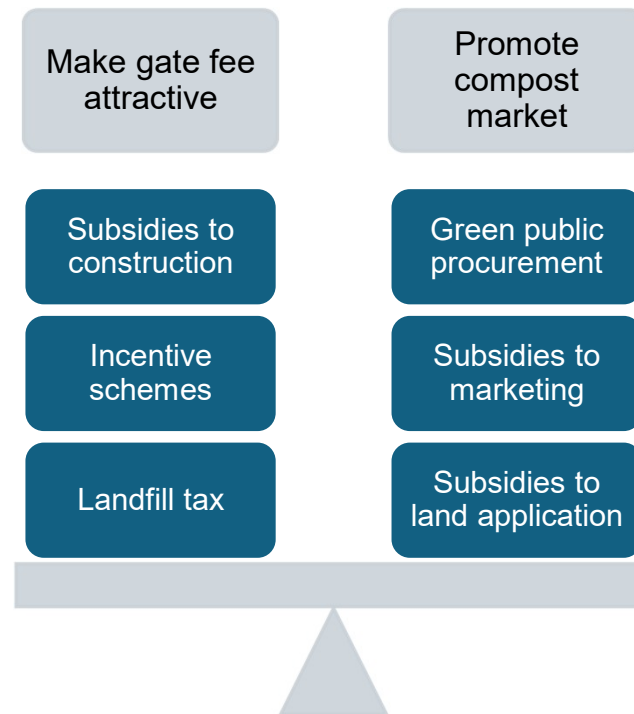


Matale, Sri Lanka



Europe, typical values

Key factors: gate fee, compost value



Additional information: EAWAG, marketing compost in low and middle income countries, [link](#)

Promote separate collection at source

- Act on landfill gate fee, introducing a tax to be returned to municipalities with the specific purpose of supporting **source separation of organics**.
- **Set up incentive schemes to support pioneer experiences** keeping municipalities challenged
 - E.g. Catalonia, Sardinia
- Look for international funding only if there is a local governance support and willingness to increase landfill gate fee

Composting plant Mabwepande

Annual operation costs (calc)

	Input	compost	residuals
amount [t]	18.250	10.220	4.380
normalized water content			
	unit costs	total costs	revenues
	[€/t]	[€]	[€]
O+M costs	11,89	216.928	
depreciation	7,12	129.920	
disposal of residuals	2,00	20.440	
gate fee	1,50		27.375
compost sales	33,26		339.913
		367.288	367.288

Source [Florian Kolsch, CCAC meeting Berlin, 2021](#), composting plant Dar Es Salaam, Tanzania

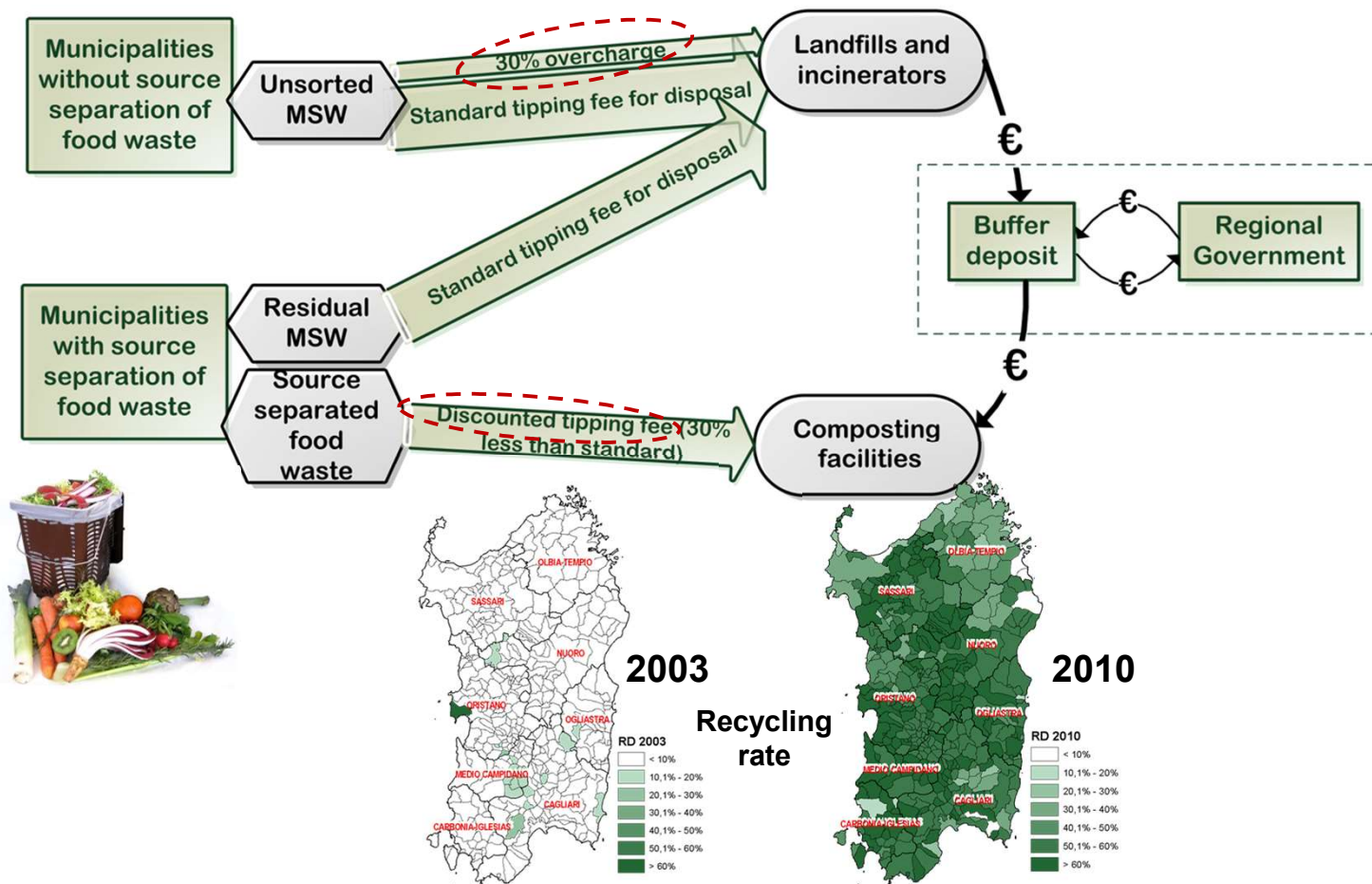


Michele Giavini @mgiavini · 29 set

Hoy inicié un debate en Berlín en el foro de Latino América sobre [#residuos orgánicos](#). Para qué sirve financiar el [#compostaje](#) con fondos internacionales si los gobiernos no se atreven a subir la tarifa de entrada en rellenos sanitarios?

umweltbundesamt.de/en/document/la...

Sardinia – incentive scheme



Improve the image of compost

- Compost does not enjoy a ready-made market because of
 - **lack of awareness** and knowledge on how, how much and when to use compost
 - **misunderstanding** about what compost is (e. g. expecting it to behave in the same way as a chemical fertiliser);
 - the inclination of many farmers to focus on **optimising their yield** within a short time;
 - **competition with chemical fertilisers**, similar low-cost products like manure or products perceived to be the same;
 - high **transport costs** relative to product value, as compost is often produced far from its market;
 - **unfair regulations and policies** (e. g. subsidies for chemical fertilisers) hindering the composting approach.



Picture M. Centemero, CIC



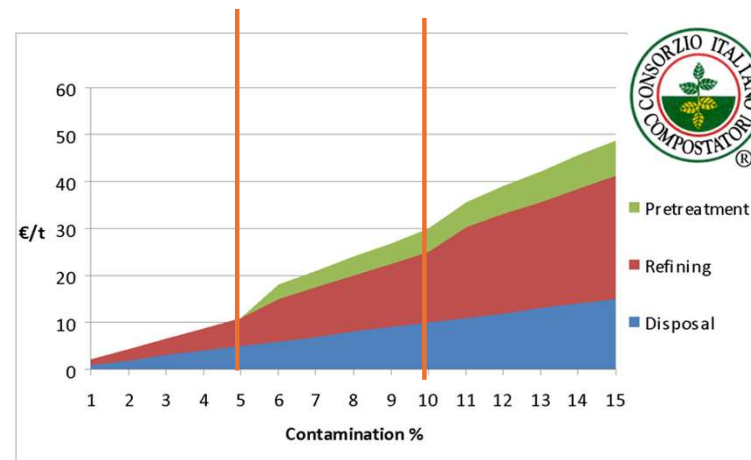
CIC, 2018

Increasing cost of input contamination for the composting plant

Imatge 1.1. FORM amb diferents nivells d'impropis.



ARC Catalonia



3. Case studies

Spain: Vila-seca

- Small scale composting with modular boxes in an amusement park



Municipality

Vila-seca (Catalonia, Spain)

Location

Park "La Torre d'en Dolça"

Promoters

Training and Employment
Labour Insertion Company and
Catalan Waste Agency

Inauguration date

February 16, 2022

Treatment capacity

80 tons of biowaste a year

Technology

Community composting
in 24 composters

Total investment of the composting area

€87,470.

**Formació
i Treball**
empresa d'inserció

The Catalan pilot area was built in Vila-seca, a southern Catalonia village that lays in a very touristic area with one of the most visited theme parks in Europe (PortAventura) and many hotels and touristic venues. **FITEI signed agreements with one of the restaurants of PortAventura and two local hotels** (La Marinada and H10 Imperial Tarraco). The terrain was ceded by the local city council, who also provides with shredded pruning, which is used as structuring dry material for the process.

Thanks to these agreements, the area has had a steady income of biowaste without impurities that has generated high-quality compost. The area works with 24 1m³ in rows of 6, being one of them used to store dry materials. This system allows 80 tons of biowaste to be treated yearly.

FITEI carried out two separate trainings there of 12 people each, especially aimed at **NEETs and women at risk of social exclusion**. Half of these people were hired after to work during 6 months in the area. In total, **24 people have been trained and 12 have been hired in circular economy jobs.**

The **facility's future is now ensured** for the following year after the project, thanks to the collaboration with the local authorities, and **the area employs now 2 persons trained under SIRCLES**. Additionally, a local educational campus in Tarragona, the biggest nearby town, has signed an **agreement to build a similar facility**. FITEI will train workers of the facility in organic waste management and the composting process, **replicating the lessons learned thanks to SIRCLES**.

Greece: Andros

- Low cost composting with modular boxes in a small touristic island



Municipality

Andros (Greece)

Location

Ormos Korthiou

Promoters

National Technical University of Athens and Organisation Earth

Inauguration date

November 30, 2022

Treatment capacity

160 tons of biowaste a year

Technology

Community composting in 24 composters of 1m³

Total investment of the composting area

€158,000.



ΕΓΝΙΚΟ ΜΕΤΣΟΒΙΟ
ΠΟΛΥΤΕΧΝΕΙΟ



The Greek pilot in Korthi, Andros is highlighted by a **holistic approach in waste collection**. Due to the small scale of the village, the partners were able to **cooperate with restaurants, markets, cafes, schools and households**.

Through community events, the information regarding food waste handling was shared with inhabitants and professionals. The citizens and shops used a key to access the food waste bin, which was locked so that only informed citizens would use it. This way, the **impurities collected were below 3%**. The households were provided with leaflets, key to the bins, a portable brown bin and compostable bags.

The 24 1m³ boxes were mixed manually 3 times per week. One month after staying in a box, the mixture was transferred to a second box. Then after another month it was transferred to a third box, where it stayed for one more month before sieving. **The fine fraction after sieving was bagged and returned to the citizens as a reward.**

The pilot facility was able to withstand the summer tourist season, where waste production is at its peak. During the winter months the biowaste collected was on the average 350 kg/week, but in August it reached 750 kg/week.

The pilot was embraced by the municipality, which after the end of the in-job training, **hired 5 of the trainees** to continue the work. **Other areas of Andros not participating in the project** are willing and asking for a similar pilot to be built in their area.



Source: SIRCLES project

<https://www.enicbcmmed.eu/deliverable/sircles-policy-toolkit-circular-economy-employment-and-training>



Palestine: Beitello

- Low cost medium scale composting and biowaste collection in restaurants



Municipality

Ramallah (Palestine)

Location

Beitello village

Promoters

Ramallah Municipality and
Beitello village Council

Inauguration date

December, 2015

Treatment capacity

1300 tons of biowaste a year

Technology

Open windrows

Total investment of the composting plant

€181,394



HOUSE OF WATER & ENVIRONMENT

The Palestinian composting plant in **Beitello village**, near Ramallah, had been built in 2015 under the ENPI CBC Med SCOW Project. However, the plant only incorporated organic waste from local farmers. HWE saw in SIRCLES an opportunity to **enhance the circular economy in the area**, involving also the **people at risk of social exclusion**, hotels, restaurants and the local municipality by setting up a **new collection system**.

Under SIRCLES, **sensitization campaigns** were undertaken with local stakeholders, extending the knowledge of the importance of separate collection and composting.

A system of **separation at source** at the local restaurants, hotels and vegetable markets was developed. The **organic waste** was then treated at the composting plant and **transformed into compost**. This fertilizer was then delivered to local farms and hotel gardens, whose owners saw improve the physical, chemical and biological **properties** of their **soils**. **59 NEETs and women at risk of labour exclusion** were trained during this process and **23 of them were hired** afterwards.

The lessons learned at the plant have been shared with local students, allowing visits at the composting plant and distributing compost. This has had a great impact in the society, as the **Ministry of Local Government has adopted composting in its future Solid Waste Management Strategy**.

SIRCLES Project had a **good impact** not only on **biowaste management**, but also on **people** and even the way of thinking of many **stakeholders**.

Jordan: Aqaba

- Local made composting boxes and biowaste collection in hotels



Municipality

Aqaba (Jordan)

Location

Alkhadraa

Promoters

EDAMA, Association for Energy, Water and Environment

Inauguration date

January 31, 2023

Treatment capacity

728 tons of biowaste a year

Technology

10 Modular composters and 13 open windrows

Total investment of the composting area

€77,326.04



In Aqaba, Jordan, SIRCLES pilot plant was initiated with a **primary focus on transforming organic waste from local hotels into valuable compost.**

Five hotels in the area actively participated in the inaugural project phase. **The achievement is a testament to the robust partnership between EDAMA and the local government authority, ASEZA,** underscored by an official agreement offering essential support.

Aqaba composting plant showcases impressive capabilities, capable of processing up to 728 tons of diverse organic waste types, including food, garden, and agricultural waste, resulting in an annual output of 100/120 tons.

During the pilot phase, a dynamic team of **eight NEETs and women individuals, actively contributed to the project's implementation and operation.** Their training and experiences they gained will play a vital role in shaping **future sustainability initiatives,** as well as exploring broader opportunities within the green sector.

This reflects SIRCLES' adeptness at transforming challenges into opportunities, **promoting sustainability within the Aqaba community.** It is important to note that the long-term sustainability of the project remains a subject of ongoing consideration.

Lebanon: Hbeline

- Composting in tunnels, locally built, medium scale.



Municipality

Union of Jbeil Municipalities
(Lebanon)

Location

Hbeline

Promoters

René Moawad Foundation

Inauguration date

November 8, 2022

Treatment capacity

1000 tons of biowaste a year

Technology

Composting tunnels with forced
aeration

Total investment of the composting area

€165,000



RENÉ MOAWAD FOUNDATION
مؤسسة رينيه معوض

The composting pilot in Hbeline, Lebanon implemented by RMF is **demonstrating the role of composting in shaping a circular economy in the country**. The project, which is part of the SIRCLES project funded by ENI CBC Med, is composting **food waste from restaurants and wholesale vegetable markets in addition to municipal landscape waste**.

The facility in Hbeline consists of **four container composters** placed in 4 corners centred by the waste receiving area. The waste receiving area is close to the composting chamber, and the wood chipper is also nearby, so that food waste and carbon material can be mixed easily with minimal hauling. Moreover, being composted in an **enclosed volume with odour control** and leachate management present the outmost advantage for the community that once perceived composting as a putrid process generating odours and attracting pests.

The facility also has a solar grid system that provides off-grid power, which reduces operating costs. Additionally, **the collaboration with local restaurants and wholesale vegetable markets represents an essential good practice**. This partnership ensures a **clean source of organic materials with minimal contamination**.

To summarize, **Lebanon pilot faced three primary obstacles: changing local attitudes toward composting, ensuring a steady energy supply, and obtaining pre-sorted organic waste at the source**. These challenges were effectively addressed by the mitigation measures described earlier, which can be regarded as exemplary composting practices.



Source: SIRCLES project

<https://www.enicbcmmed.eu/deliverable/sircles-policy-toolkit-circular-economy-employment-and-training>



Tunisia: Bizerte

- Open pile composting, hired many people at risk of social exclusion



Municipality

Bizerte, Tunisia

Location

Beni Amar

Promoters

Tunisia Ecotourism

Inauguration date

June 9, 2022

Treatment capacity

650 tons of organic waste a year

Technology

Open windrows

Total investment of the composting area

€99,104.5



The trainings carried out by TET in Tunisia reached 121 NEETs and Women at risk of social inclusion, 80 of which have been hired afterwards. These numbers have been the biggest success of the consortium regarding job creation.

The area has hosted over 300 schoolchildren and 50 environmental associations, too, and continues to promote the circular economy through environment education & management of organic waste treatment and learning about agriculture. This action is part of the promotion of good practices of the SIRCLES project. The employees are part of the coaching and practical training process, they accompany the visitors, provide them with the necessary support and share with them all their knowledge in the field.

The cooperation with the Ministry of Agriculture AVFA & CFPA training center, continues even after the finalization of the 4 sessions of trainings. TET often welcomes at the composting site groups of young people who follow a professional training on the production and exploitation of aromatic and medicinal plants.

The feasibility of such sustainable projects should not be evaluated only on an economic basis, but also by taking into account socio-environmental considerations, such as decreasing environmental threats and the negative impact on human health, providing work opportunities, increasing incomes, as well as reducing operating costs linked to landfilling. And the facility in Tunisia has been such a success scenario for all these objectives.



Source: SIRCLES project

<https://www.enicbcmmed.eu/deliverable/sircles-policy-toolkit-circular-economy-employment-and-training>



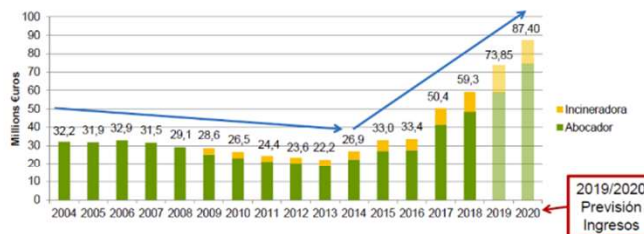
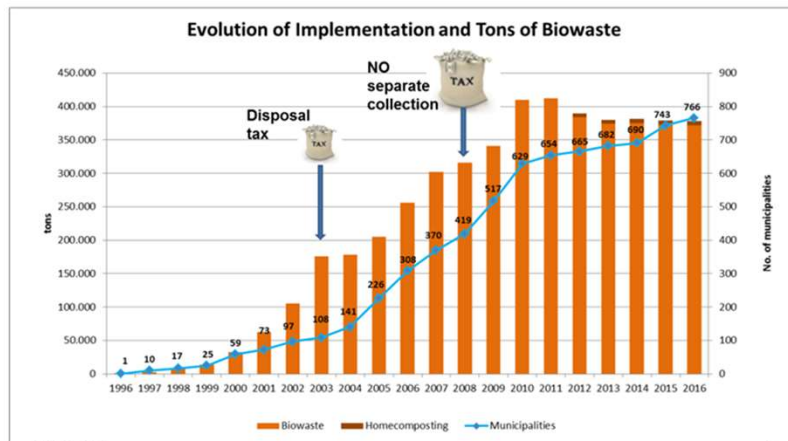
Case study: Catalonia government, Spain

- Landfill and incineration tax, steadily increasing over years. Refund system to municipalities to promote high quality biowaste collection
- Since the introduction of the tax, municipalities with biowaste collection increased from 17 to 766 in 13 years. More than 600M€ returned to local municipalities since its creation
- Compulsory food waste characterizations every trimester
- Incentives for continuous improvements in composting plant and innovation in biowaste separate collection
- A lot of promotional campaigns on biowaste

Source: [ARC](#), [ARC](#), [Urbanwins](#)

Case study: Catalonia government,

Impact of the Waste Disposal Tax



647 M€UR des de la seva creació (2004) !

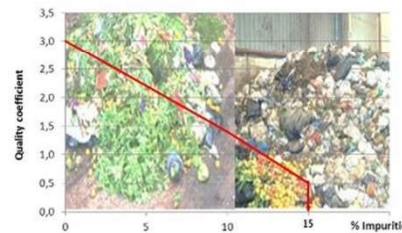
621 M€UR (96%) retorna als ens locals

Refund criteria

- **Separate Collection of Bio-waste 10,- €/t**

Refunding is subject to a **quality coefficient** applied per ton, based on **periodical characterisations**.

At 15 % of impurities the refunding is 0.



Refund criteria

- **Biological Treatment of Net Biowaste**

Type of activity	Beneficiary	2004 €/t	2011 €/t	2015 €/t
Biowaste (Organic Fraction of MSW)	Local authority performing separate collection	32,50	33,50	34,00
Green Waste	Local authority performing separate collection			3,00
Home composting	Local authority that has installed composting units		20,- per unit	20,- per unit
Community composting	composting units		60,- per unit	60,- per unit

Case study: Pune, India

- India's ninth-most populous city - >4 million people
- Best practice of informal waste pickers organized in a cooperative (SwaCH): 2,200 workers-members, More than 80% are women. 80% of the city served.
- Door to door collection, sensitization, separation, income from selling recyclables, composting
- Users pay a fee to SWaCH
- Network of small scale composting plants

Source: [UNESCAP](#) , <https://prizeforcities.org/project/swach-pune-seva-sahakari-sanstha> , [WIEGO](#), [Down2earth](#), [Youtube](#)

Case study: Pune, India



Case study: Dhaka, Bangladesh

- 14 million people
- First case of a large scale composting facility in low income country
 - Financed partly with carbon credits
 - Primarily market waste
- Multilevel models, from small scale to large scale composting

Source: [Waste Concern](#) and others

Case study: Dhaka, Bangladesh

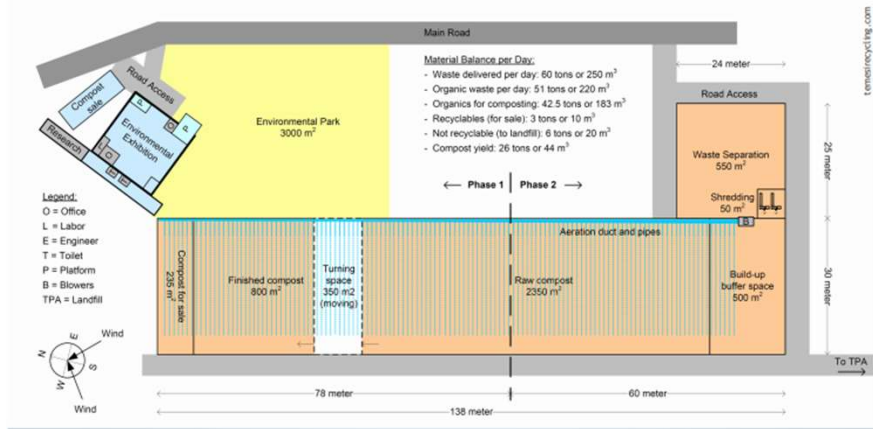


Case study Temesi, Bali, Indonesia

- Large scale low cost composting facility (about 60 tons per day) operating since 2007
- Highlights:
 - Ownership transferred to village foundation
 - Employment opportunity for marginalized women
 - High importance given to quality control
 - Carbon credits for methane avoidance
 - Compost sold mainly to tourism industry
 - Extends landfill lifespan by factor 10
 - Environmental park

Source: EAWAG, course on MSW management in low income countries, and www.temesirecycling.com

Case study Temesi, Bali, Indonesia



Source: EAWAG, course on MSW management in low income countries, and www.temesirecycling.com

Pontevedra, Galicia, Spain

- Label and visibility (Plan Revitaliza)
- Community composting areas for 47 municipalities, even in urban areas.
- Unique EU experience in a training course for “master composters” supported by the Province. Job creation, continuous monitoring and citizens involvement
- Whole management cost kept at a minimum level, including the task of master composters
- High quality of feedstock
- Shredded wood is provided in big bags by the Province

Source: [County Pontevedra](#) and others

Pontevedra. Galicia, S



References

- **Collection**
- [World Biogas Association \(2018\): Global food waste Management: an implementation guide for cities](#)
- Waste collection and transport
- [Collection of MSW in Developing Countries. UN HABITAT. 2010](#)
- [UNHABITAT \(2011\). Collection of Municipal Solid Waste, Key issues for Decision-makers in Developing Countries](#)
- [GIZ \(2020\): Guide on separate collection of municipal waste in Greece, with many insights on biowaste and Guide on biowaste](#)
- [Shared container systems for megacities: AIA webinar \(New York\), 2021](#)
- **Integrating the informal sector**
- [Integrating the informal sector for improved waste management. Sanjay Gupta](#)
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