



Global Programme of Action for the Protection of  
the Marine Environment from Land-based Activities

# Recycling wastewater yields multiple benefits

Dr Birguy Lamizana, UNEP



World Congress & Expo on Recycling, July 20-22,  
Barcelona, Spain

## New approach, turning waste into wealth

Worldwide, the new environmental paradigm is to eliminate the concept of **throwing away waste** and replace it with the concept of considering **waste as a resource**

Focus on “**Reduce, Reuse, Recycle**” paradigm

Considers both **solid waste and wastewater**

- Solid waste
- Wastewater
- Faecal sludge





# Waste management options



**Reduce:** reduce the amount

**Reuse :** someone's waste used else

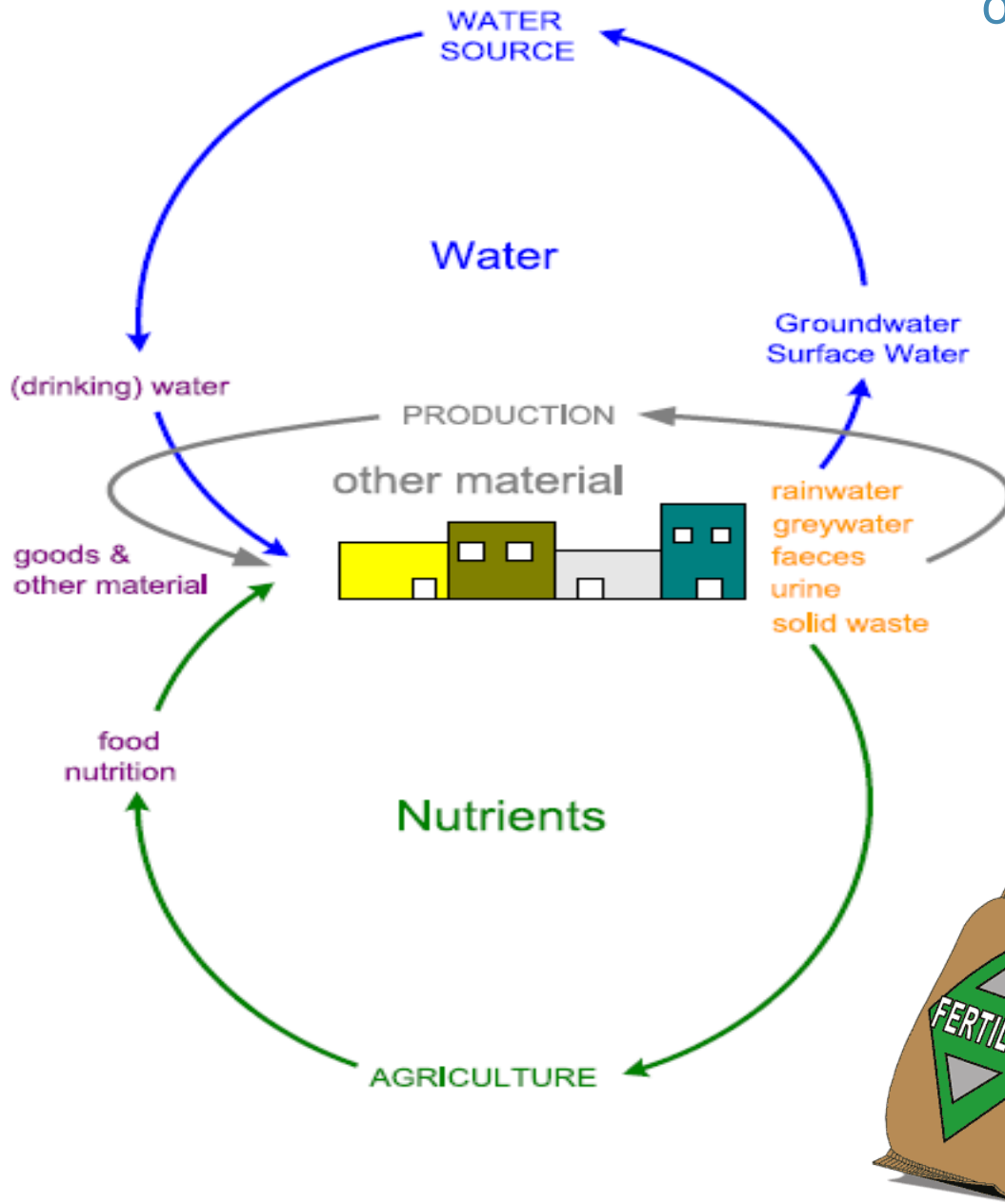
**Recycle:** use in another way or process

**Recover:** handle, keep, clean, transform, improve, return to the economy

Many other **R's**:..... repair, rethink ...

- **Repair:** take old and little defected things and repair them
- **Rethink:** environmentally sound management of waste

# Closing the loop....



→ This approach has fifth fold outcome:

- Reduce the contamination load on water bodies
- Reduce water scarcity
- Reduce CO2 emission
- Recycle fertilizers in food production
- Produce renewable energy



# Looking through the sustainability lens



## Considering the institutional aspect..

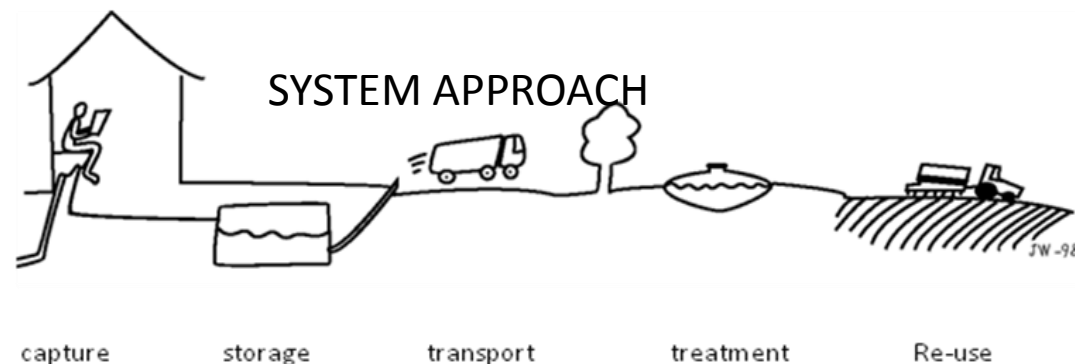
### Capturing topics such as:

- Planning process
- Stakeholder engagement and ownership
- Policy and regulatory framework
- Capacity and resources
- Certification and quality ensurance
- Monitoring



### Examples:

- South Africa
- Brazil
- Philippines
- Burkina Faso
- Sweden
- ...



# Social



## ***Capturing topics such as:***

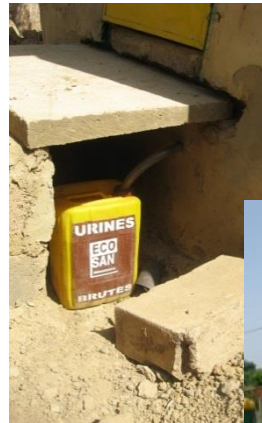
- Capacity development (e.g. awareness, local capacity)
- Participation (e.g. intervention models, community organisation)
- Gender and equity
- Cultural acceptance
- Socio-economic context (e.g. capacity and willingness to pay)



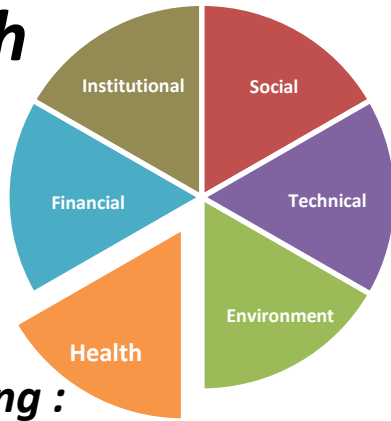


# Technical

*Diverse set of solutions for resource utilization*

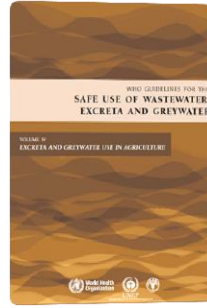


# Health

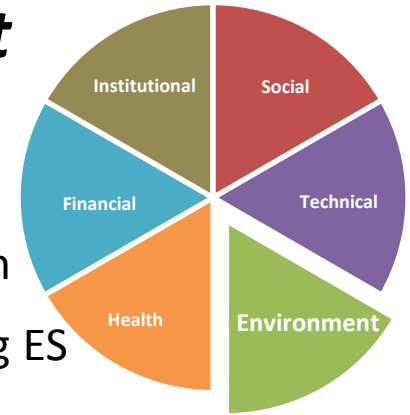


## Capturing :

- Integrated WASH approach
- Reuse guidelines
- Sanitation Safety Planning
- **Potential cases: Jordan**



# Environment

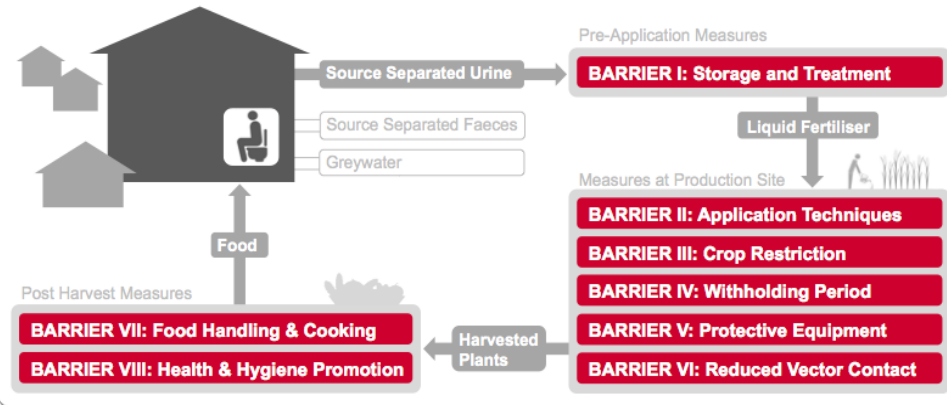


## Capturing topics such as:

- Environmental protection
- Protecting and enhancing ES
  - Natural treatment capacity
  - Ground water recharge
  - Creation of new habitats (e.g. constructed wetlands)
- **Potential cases: Namibia, Egypt, Philippines, Sweden,...**



## Multi Barrier Approach

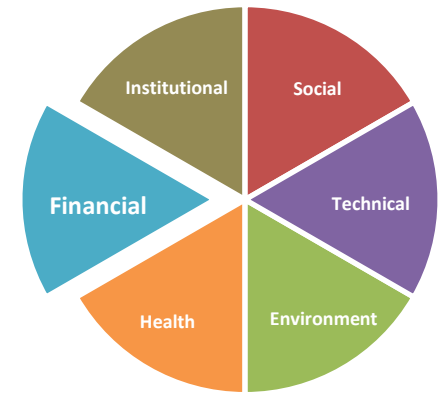




# Financial

## ***Capturing topics such as:***

- Financial models
- Cost-Benefit Analyses  
(e.g. costs for doing nothing – in health impacts and environmental degradation)
- Sanitation as a Business

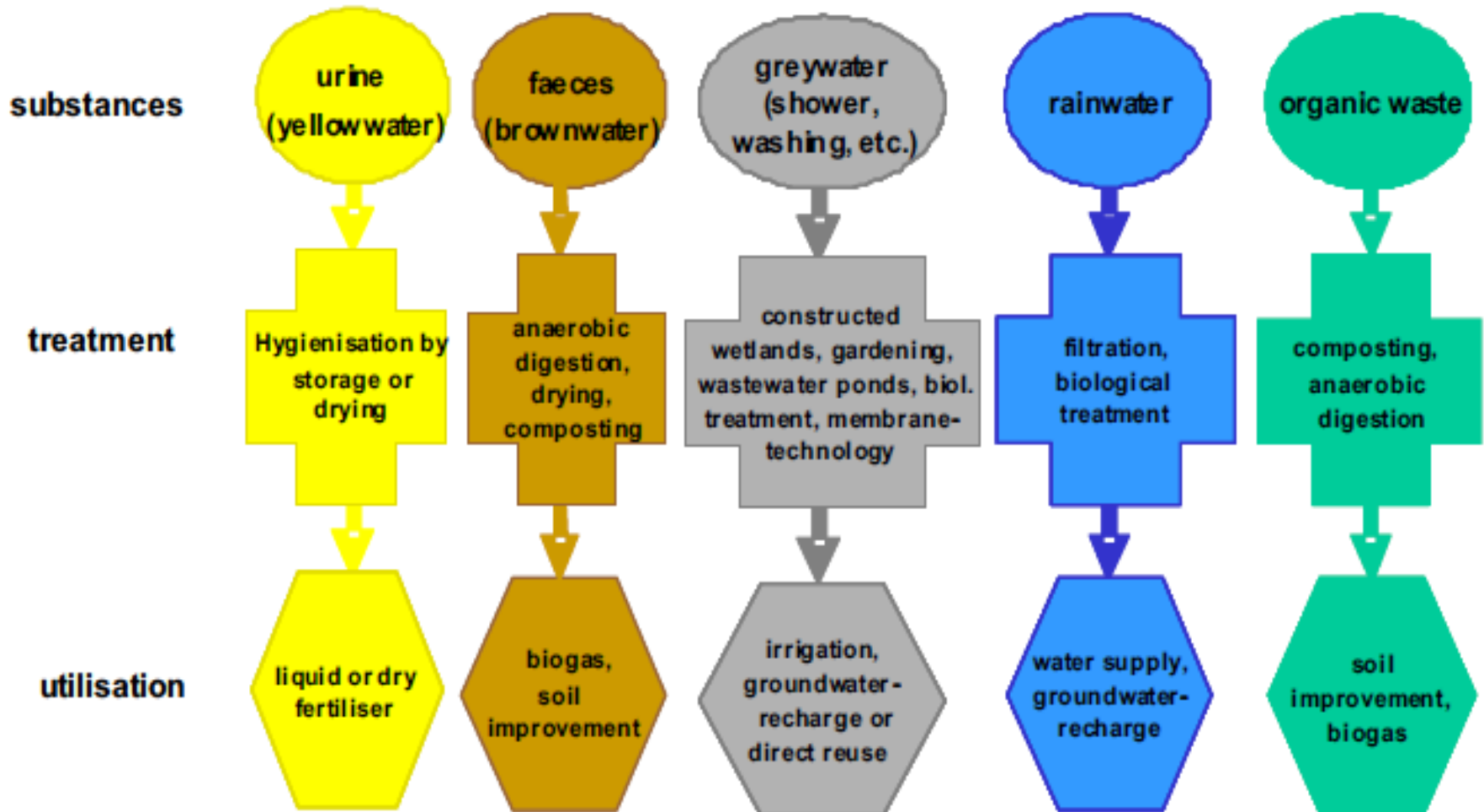


## ***Potential cases:***

- *Jamaica*
- *South Africa*
- *India*
- ...

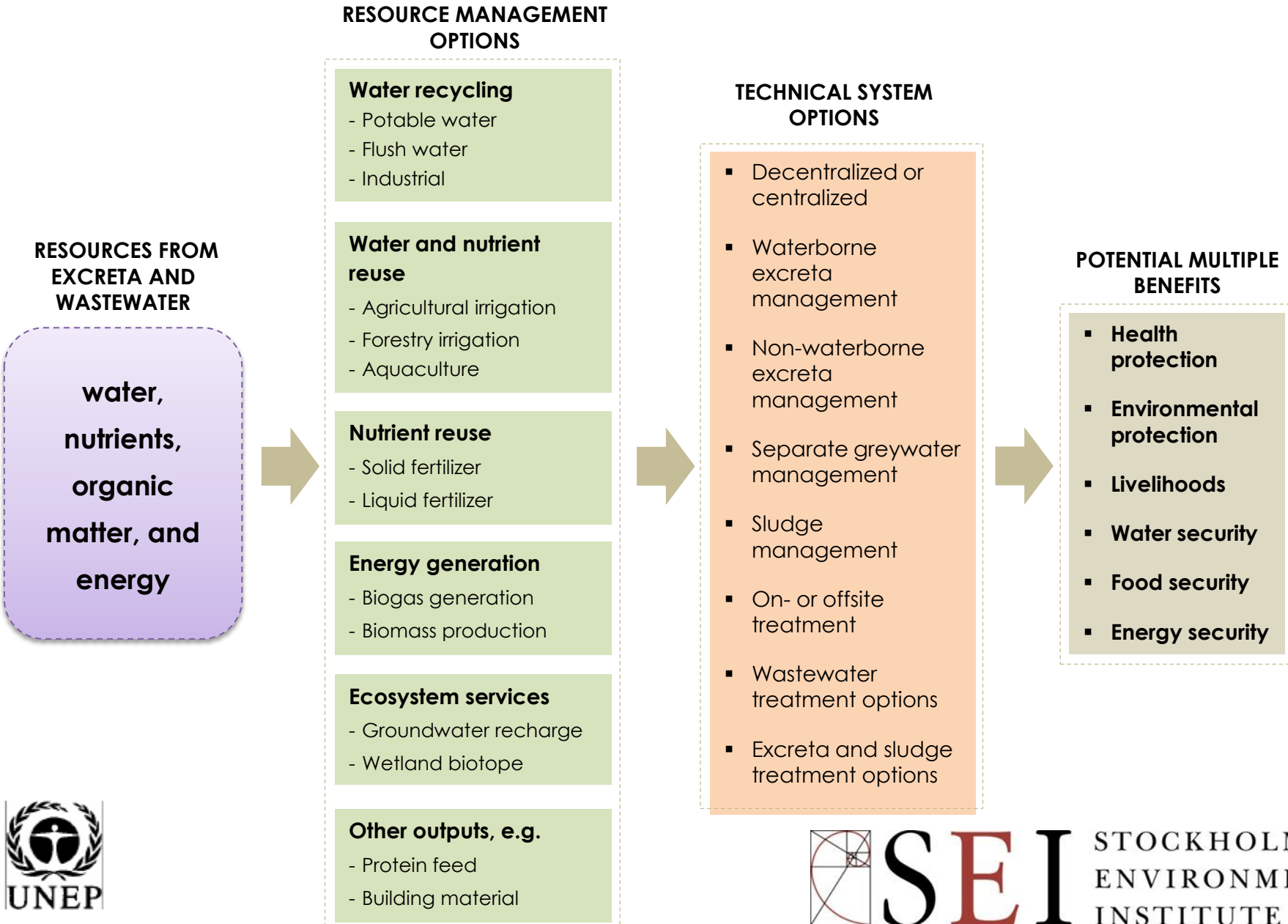


# Using the EcoSan approach.....



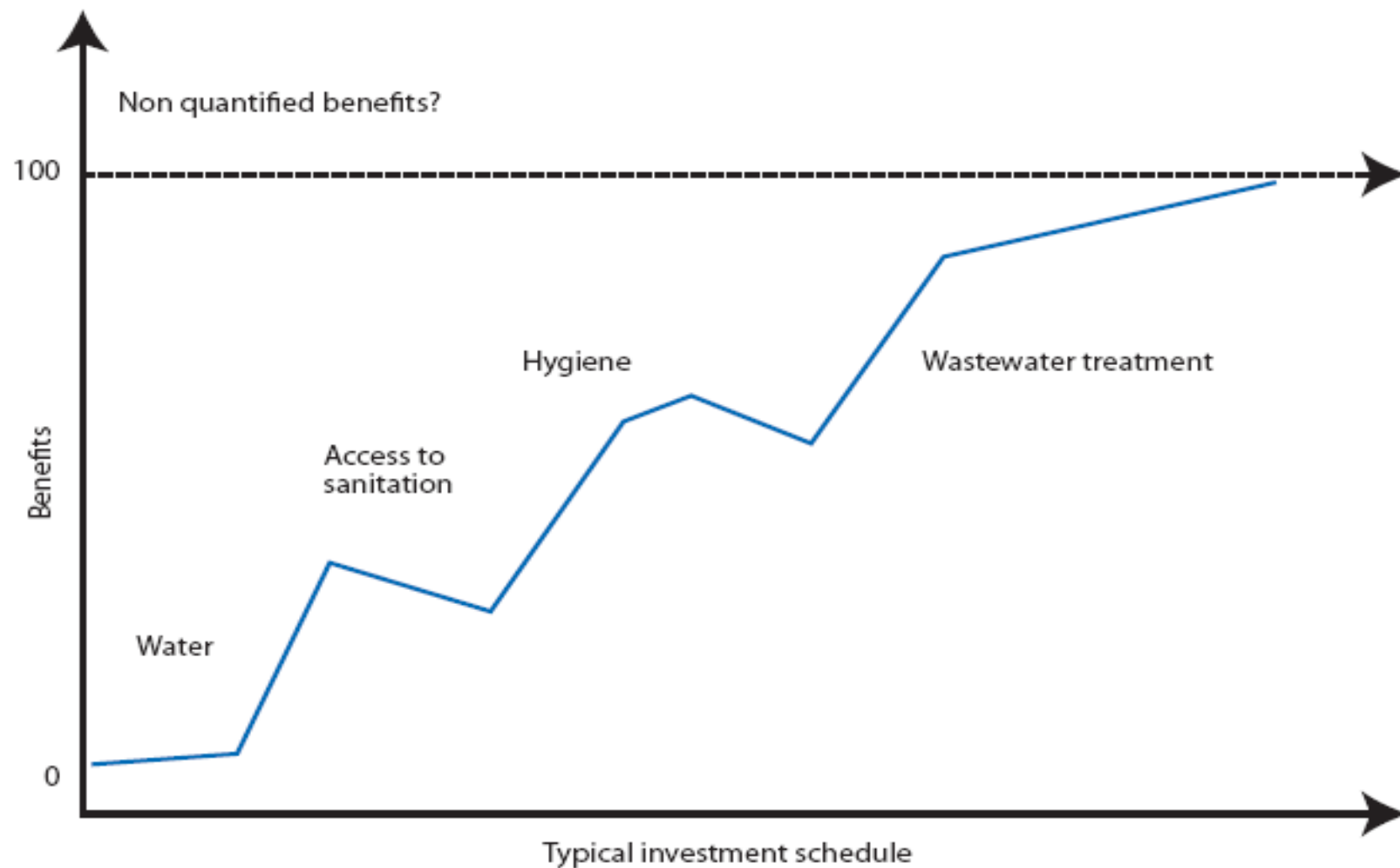
Waste segregation and possible utilization options. (UNESCO/IHP & GTZ, 2006)

# Shifting focus from waste removal to resource recovery





# Benefits of investing in water and sanitation



Source: OECD (2011), *Benefits of Investing in Water and Sanitation: an OECD Perspective*, OECD, Paris.

# Benefits for local communities & Society

## **Wastewater**

- Provides a source of income to farmers
- Alternative fertiliser and irrigation source from domestic WW
- Recycling of local water and nutrient sources
- Reduction of energy consumption requirements for the production of artificial fertilizer
- Opportunities to reduce costs for conventional WW treatment (investment, operation, disposal)
- Supporting compliance with environmental legislation

## **Biomass**

- Increase in soil organic matter content and soil fertility
- Increased income from improved biomass yields due to irrigation and fertilization
- Opportunities to produce renewable biomass for local heat and power generation
- Supporting local economy by establishing local biomass supply chains
- It contribute to reducing dependency upon fossil fuels
- Getting green areas

# Benefits for other sectors?

**Energy sector:** both wastewater (sludge) and the biomass can be an efficient and renewable source of energy,

•**Water sector:**

- Reducing freshwater withdrawal
- Contributing to groundwater recharge
- Improving water quality

•**Economy:**

- the implementation of this integrated agro-forestry land-use system, particularly on larger scale, can furthermore **create income** and **job opportunities** for many people at a local level.

•**Food security:**

- Aquaculture
- livestock
- Crops

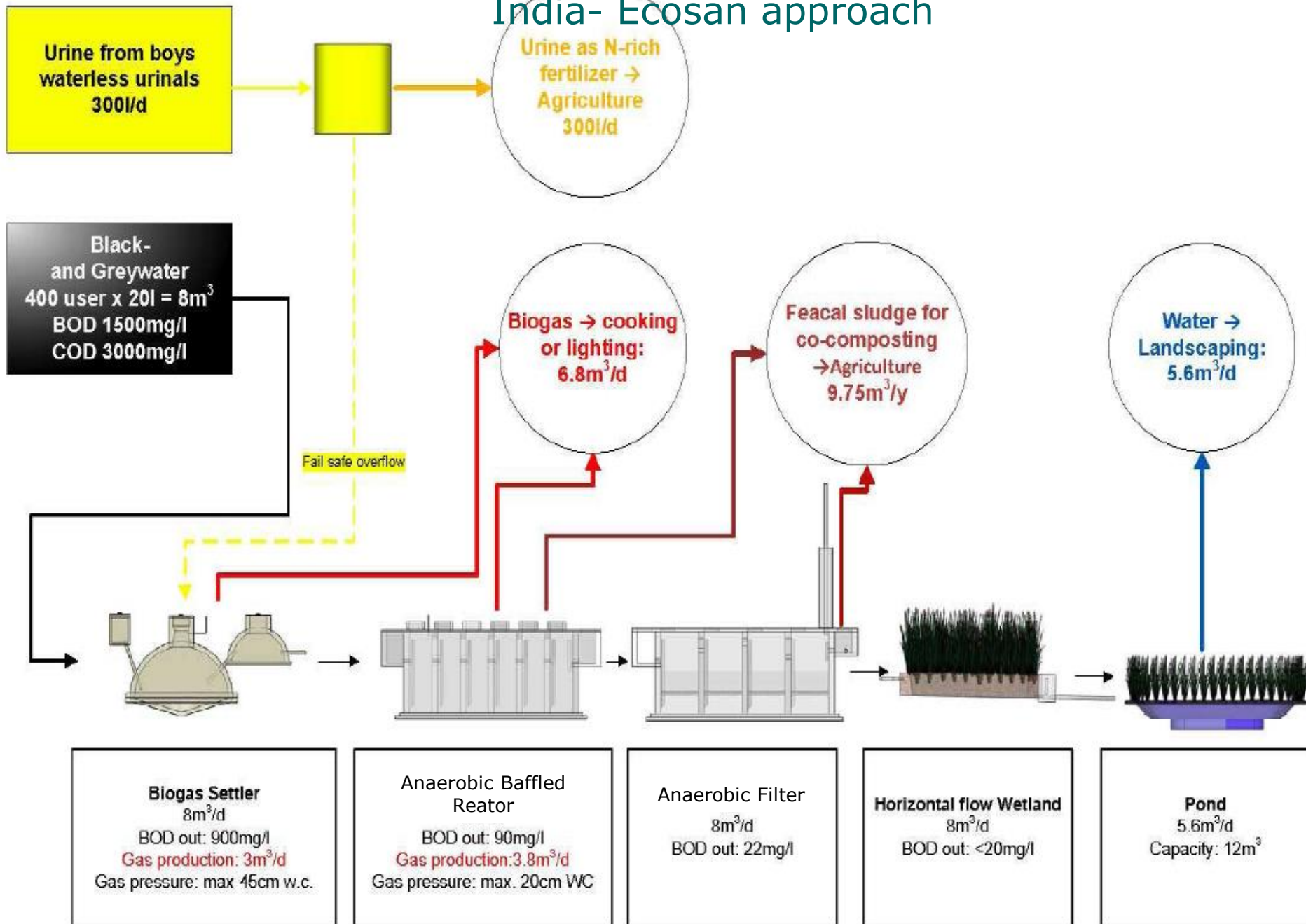
•**Health sector:**

- Reducing WW related diseases

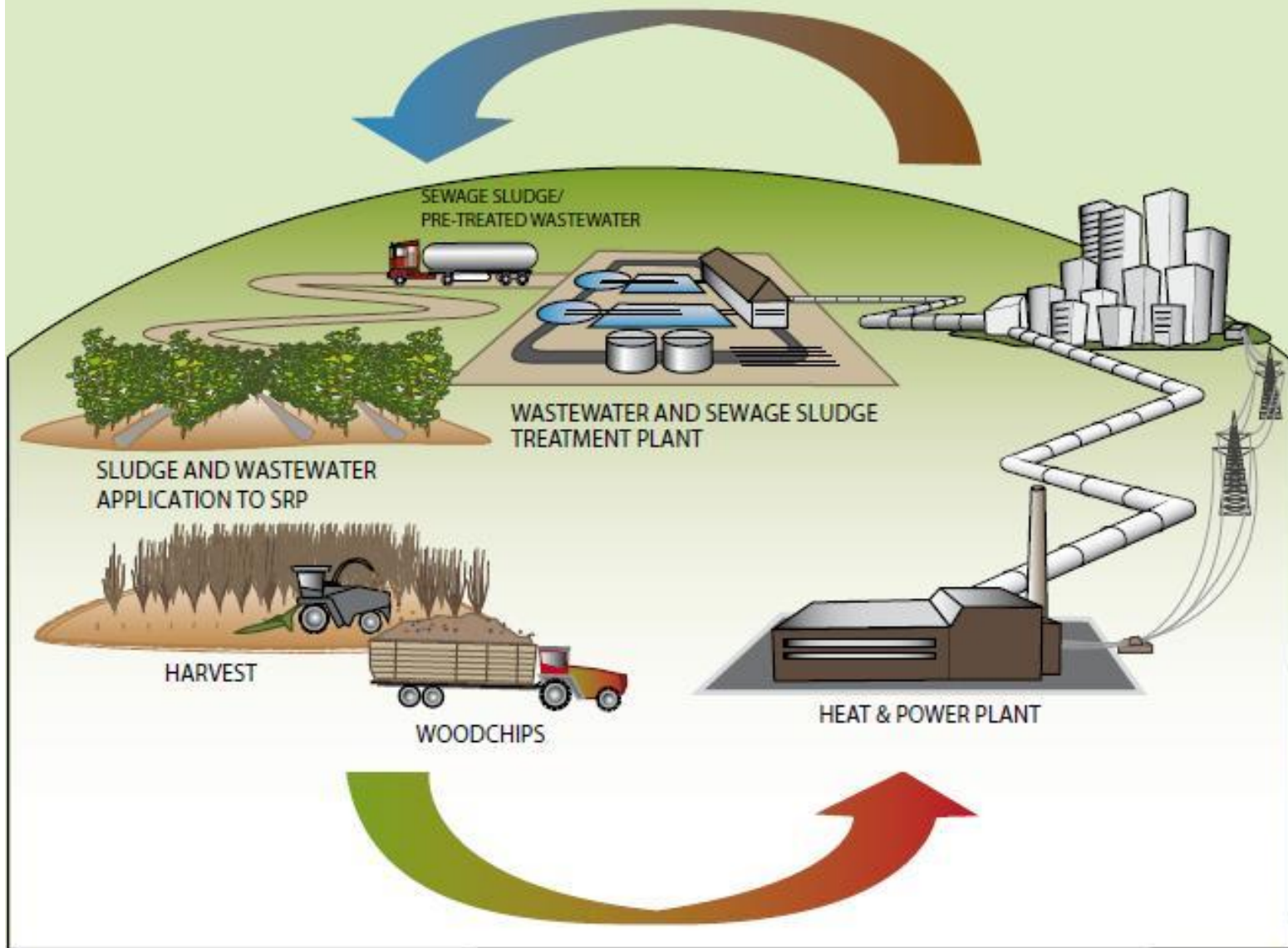
•**Forest**



# Decentralized Wastewater Management at Adarsh College – India- Ecosan approach



# COMBINED BIOMASS PRODUCTION AND WASTEWATER PURIFICATION AS AN INTEGRATED LAND-USE SYSTEM



Schematic of the *short rotation plantation*. Source: EUBIA ([n.y.](#))



# Non-waterborne excreta management:

- Urine diverting dry toilets
- Central collection and treatment
- Reuse in crop



*El Alto, Bolivia*

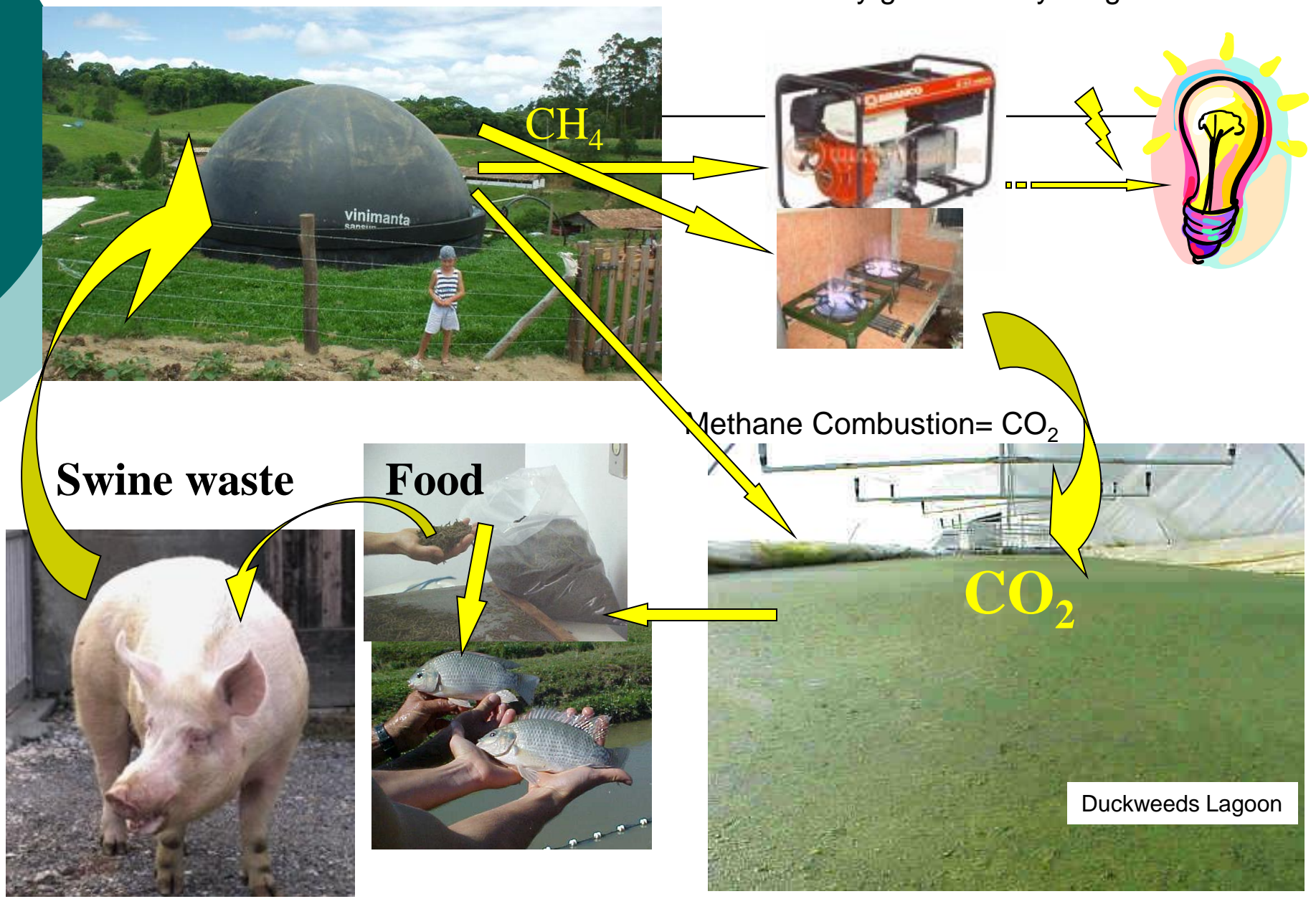


NODO DE CONOCIMIENTO EN SANEAMIENTO SOSTENIBLE DESCENTRALIZADO



# Swineculture and Water - Brazil

Electricity generator by Biogas

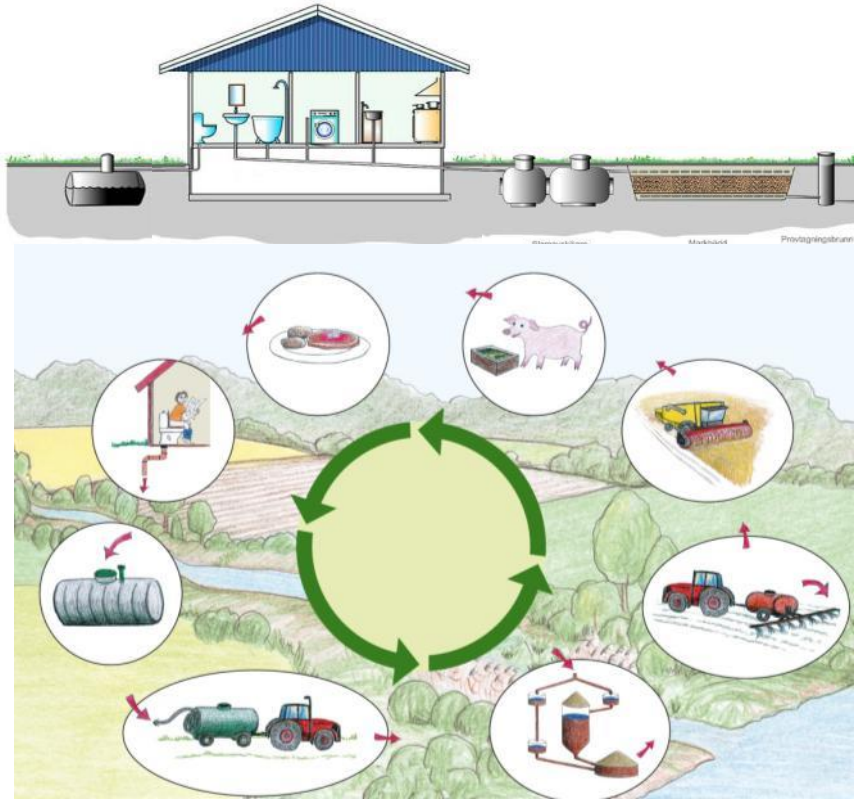


# Niger: use of duckweed (*Lemna* spp.) in WW treatment and fodder production

1. to clean water in stabilisation providing high quality of effluent,
2. harvesting of duckweed for use as:
  - a feed for on-site aquaculture
  - animal feed) provides additional income generation for the system.
3. use of treated water for irrigating additional plants such as Moringa and Leptadenia adds to the financial stability of the agro sanitary system.

→ Water hyacinth (already there!) within the Niger River could also offer other perspectives

**Decentralized wastewater management:  
Low-flush vacuum toilets – Wet-composting and urea  
treatment – Reuse in (energy) crop**



Södertälje Municipality, Sweden





## Protein production from waste products:



### Potentials for wastewater sludge and excreta management



### Black Soldier Fly



- Dry Mass Reduction 60-80%
- 1 kg DM prepupae per 10 kg waste
- Inactivation of bact pathogens (*Salmonella* spp.)
- Pre-pupae
  - 40% protein
  - 30% fat
- Self-harvesting
- High protein production
- Greatly reduced waste amount
- Inactivation of some critical bacterial pathogens
- Reduced need for land application of fertiliser

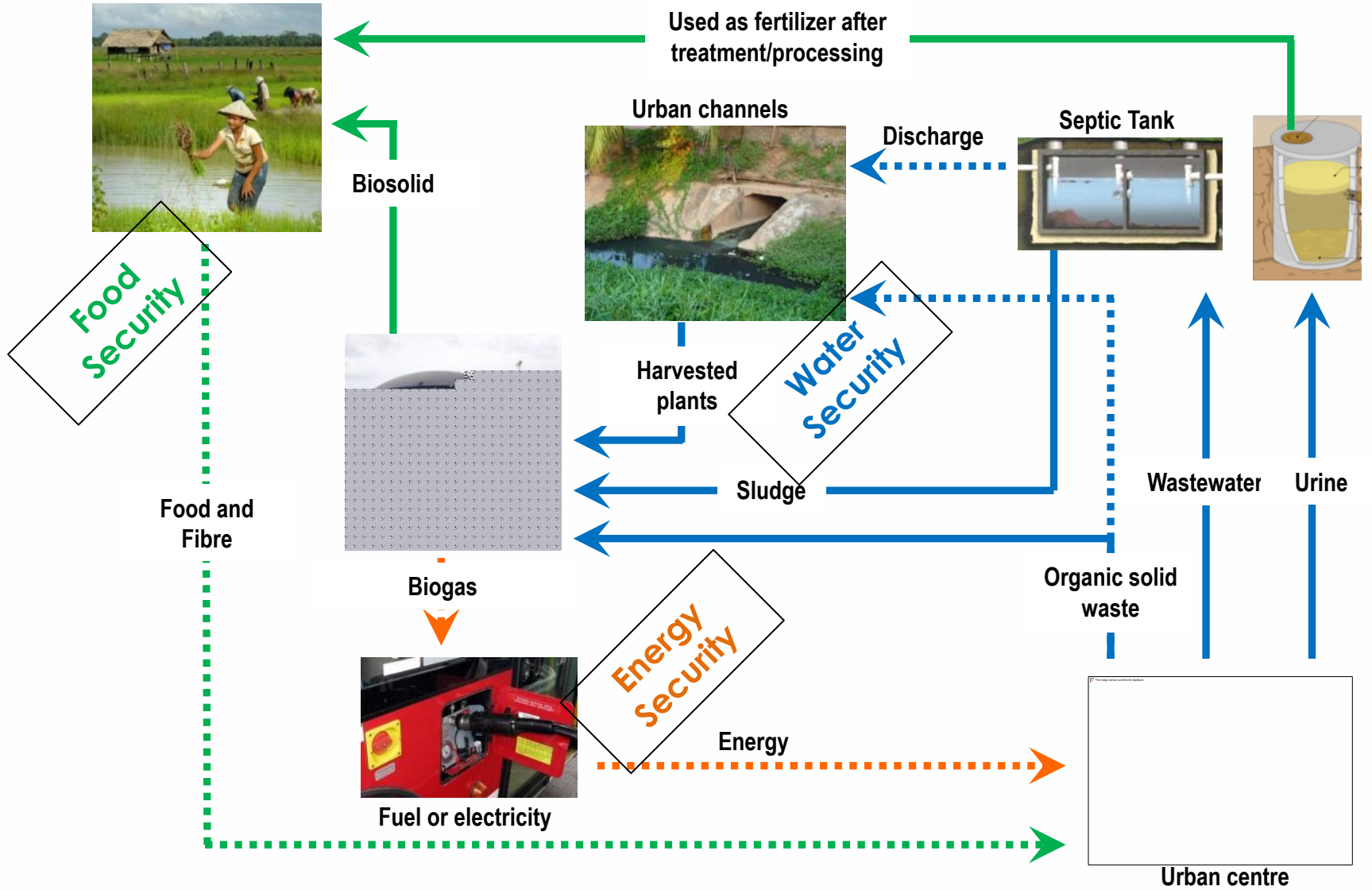


**Projects in Uganda, South Africa, USA, Sweden..**

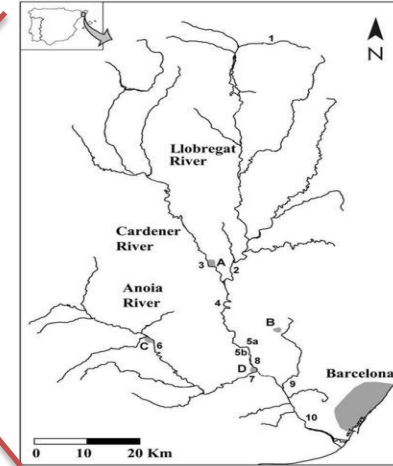


# Making wealth from waste-Resource based management

Concept example from Vientiane, Laos



# Example - Llobregat River Basin



Barcelona city  
1,619,337 inhabitants

Area: 4,948 km<sup>2</sup>  
Length: 156.5 km

# Example - Llobregat River Basin

## ENDEMIC WATER SHORTAGES:

The Llobregat River is the main source of irrigation water providing in normal conditions  $1.5 \text{ m}^3/\text{s}$ . In shortage periods is reduced to  $0.8 \text{ m}^3/\text{s}$ .

During drought conditions, the extraction of the Llobregat aquifers exceeds the natural recharge.

El Prat de Llobregat and Sant Feliu de Llobregat WWTPs had tertiary treatment.

Royal Decree 1620/2007 establishes the legal framework for the reuse of regenerated water.

Severe drought 2007-2008

# Example - Llobregat River Basin

## VOLUNTARY INTERSECTORIAL WATER TRANSFER

- Integrated Water Resources Management.
- Farmers release freshwater and cities provide reclaimed water. WIN-WIN STRATEGY.
- The use of reclaimed water for irrigation purposes prevents a deflection of river water which can be used for domestic water supply and for environmental purposes.
- Cheapest alternative to guarantee the water availability for irrigation and domestic purposes and also to improve the water quality.



# Example - Llobregat River Basin

## MULTI-PURPOSE USE OF RECLAIMED WATER:

	El Prat de Llobregat WWTP (hm <sup>3</sup> /yr)	Sant Feliu de Llobregat WWTP (hm <sup>3</sup> /yr)
Agriculture	13.09	7.36
River stream flow	10.37	-
Wetlands	6.31	-
Seawater barrier	0.91	-
Municipalities	-	0.11
Recreation	-	0.37
Industry	5.48	-
Total	36.2	7.84

Source: Cazorra et al., (2008) and Catalonian Water Reuse Program (2009).

# Example - Llobregat River Basin

## ALTERNATIVES:

- Sea water desalination: 0.45 to 1.0 EUR/m<sup>3</sup>
- **INTERSECTORAL WATER TRANSFER: 0.34 EUR/m<sup>3</sup>**

El Prat de Llobregat area	5 245 000 EUR/yr for 13 hm <sup>3</sup> /yr
Sant Feliu de Llobregat area	1 607 000 EUR/yr for 7.3 hm <sup>3</sup> /yr
Total annual cost	6 852 000 EUR/yr for 20.3 hm <sup>3</sup> /yr
<b>Average unit cost of water release</b>	<b>0.34 EUR/m<sup>3</sup></b>

- ✓ **The interserctoral water transfer represents the cheapest option.**

# Example - Llobregat River Basin

## ECONOMIC IMPACT OF THE USE OF RECLAIMED WATER FOR AGRICULTURE:

	Sant Feliu area (EUR/yr)	El Prat area (EUR/yr)	Total (EUR/yr)
<b>Pumping costs</b>	- 62 672	-321 177	- 383 849
<b>Fertilizing costs</b>	-10 419	- 30 017	- 40 436
<b>Sales revenue</b>	- 388 139	0	- 388 139
<b>Conveying reclaimed water</b>	208 390	120 066	328 456
<b>Change of farmers' income</b>	<b>252 840 (20%)</b>	<b>231 127 (5%)</b>	<b>483 967 (25%)</b>

Source: FAO (2010)

- The investment of one euro in the use of reclaimed water creates an income increase in agriculture of EUR 1.6 and EUR 1.9 at Sant Feliu and El Prat area respectively.

# Example - Llobregat River Basin

## ECONOMIC IMPACT AT WATERSHED LEVEL:

### ➤ Costs:

- **Water regeneration (additional cost to water treatment)**
- **Transport regenerated and released water**

### ➤ Benefits:

- **Increase in the income of the farmers**
- **City benefit (freshwater volume released by farmers multiplied by the domestic water price)**



# Example - Llobregat River Basin

## ECONOMIC IMPACT AT WATERSHED LEVEL:

	Sant Feliu area (EUR/yr)	El Prat area (EUR/yr)	Total (EUR/yr)
<b>Cost of additional treatment</b>	589 000	3 685 000	4 274 000
<b>Cost of conveying water and released freshwater</b>	1 018 000	1 550 000	2 568 000
<b>TOTAL COST OF WATER TRANSFER</b>	<b>1 607 000</b>	<b>5 245 000</b>	<b>6 852 000</b>
<b>Farmers' income increase</b>	253 000	231 000	484 000
<b>City benefit</b>	8 126 000	14 430 000	22 556 000
<b>TOTAL BENEFIT OF WATER TRANSFER</b>	<b>8 379 000</b>	<b>14 631 000</b>	<b>23 010 000</b>
<b>TOTAL NET BENEFIT OF WATER TRANSFER</b>	<b>6 772 000</b>	<b>9 386 000</b>	<b>16 158 000</b>



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**THANK YOU FOR YOUR ATTENTION**

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