

The Circular Economy



INNOVATION FOR CHANGE

New drivers for tomorrow's forestry

INSTITUTE OF CHARTERED FORESTERS
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Industrialised bio-based systems (agricultural, fibre and food) are linear and extractive

Current industrial agricultural/food design is based on *a linear* approach:

Take-Make-Dispose



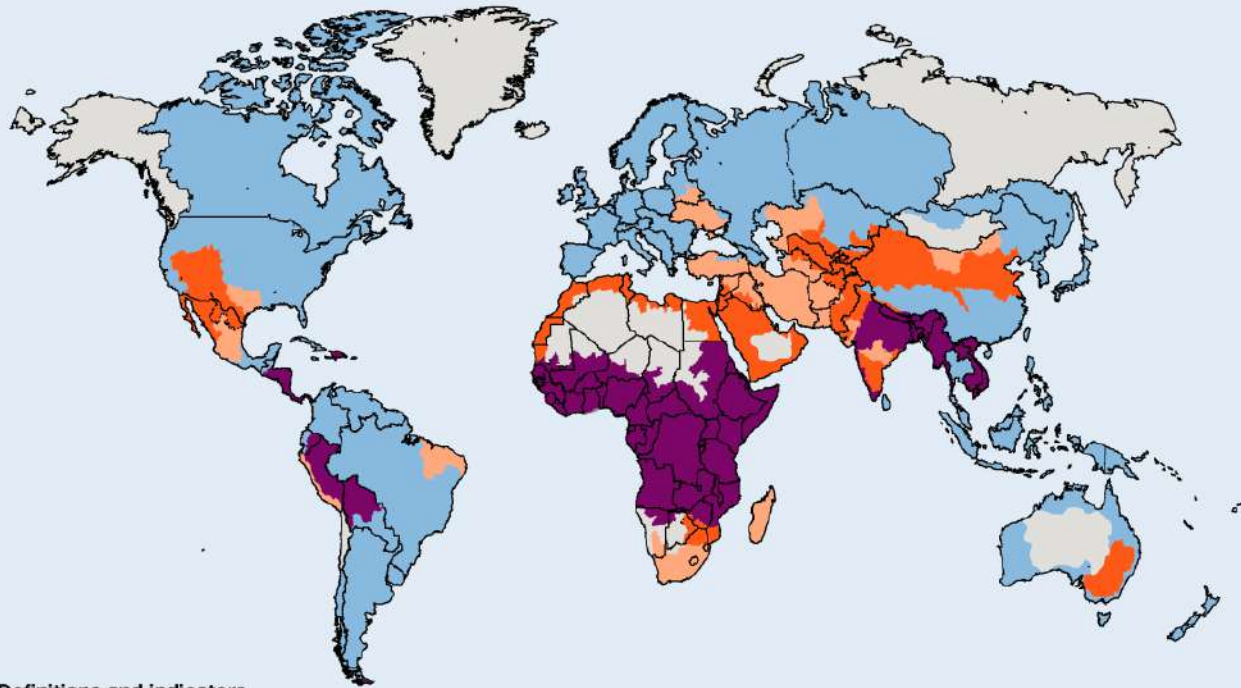
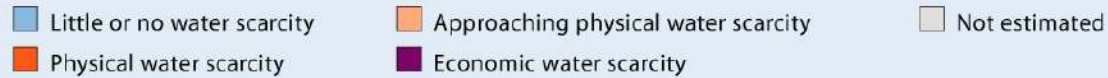
§ **Depleting planetary sources**, i.e., running out of materials, clean water and non-renewable energy sources

§ **Running out of planetary sinks** for emissions and pollution (which adversely affects human health and causes degradation and destruction of natural habitat for other species)

Water is also a material: often scarce

map 2

Areas of physical and economic water scarcity



Definitions and indicators

- *Little or no water scarcity.* Abundant water resources relative to use, with less than 25% of water from rivers withdrawn for human purposes.
- *Physical water scarcity (water resources development is approaching or has exceeded sustainable limits).* More than 75% of river flows are withdrawn for agriculture, industry, and domestic purposes (accounting for recycling of return flows). This definition—relating water availability to water demand—implies that dry areas are not necessarily water scarce.
- *Approaching physical water scarcity.* More than 60% of river flows are withdrawn. These basins will experience physical water scarcity in the near future.
- *Economic water scarcity (human, institutional, and financial capital limit access to water even though water in nature is available locally to meet human demands).* Water resources are abundant relative to water use, with less than 25% of water from rivers withdrawn for human purposes, but malnutrition exists.

Source: International Water Management Institute analysis done for the Comprehensive Assessment of Water Management in Agriculture using the Watersim model; chapter 2.

Source: Comprehensive Assessment of Water Management in Agriculture, 2007.
Summary available at:
http://www.fao.org/nr/water/docs/Summary_SynthesisBook.pdf

Fossil water



Fossil water



Fossil phosphate



Societe Nouvelle des Phosphates de Togo,
2007-12-02

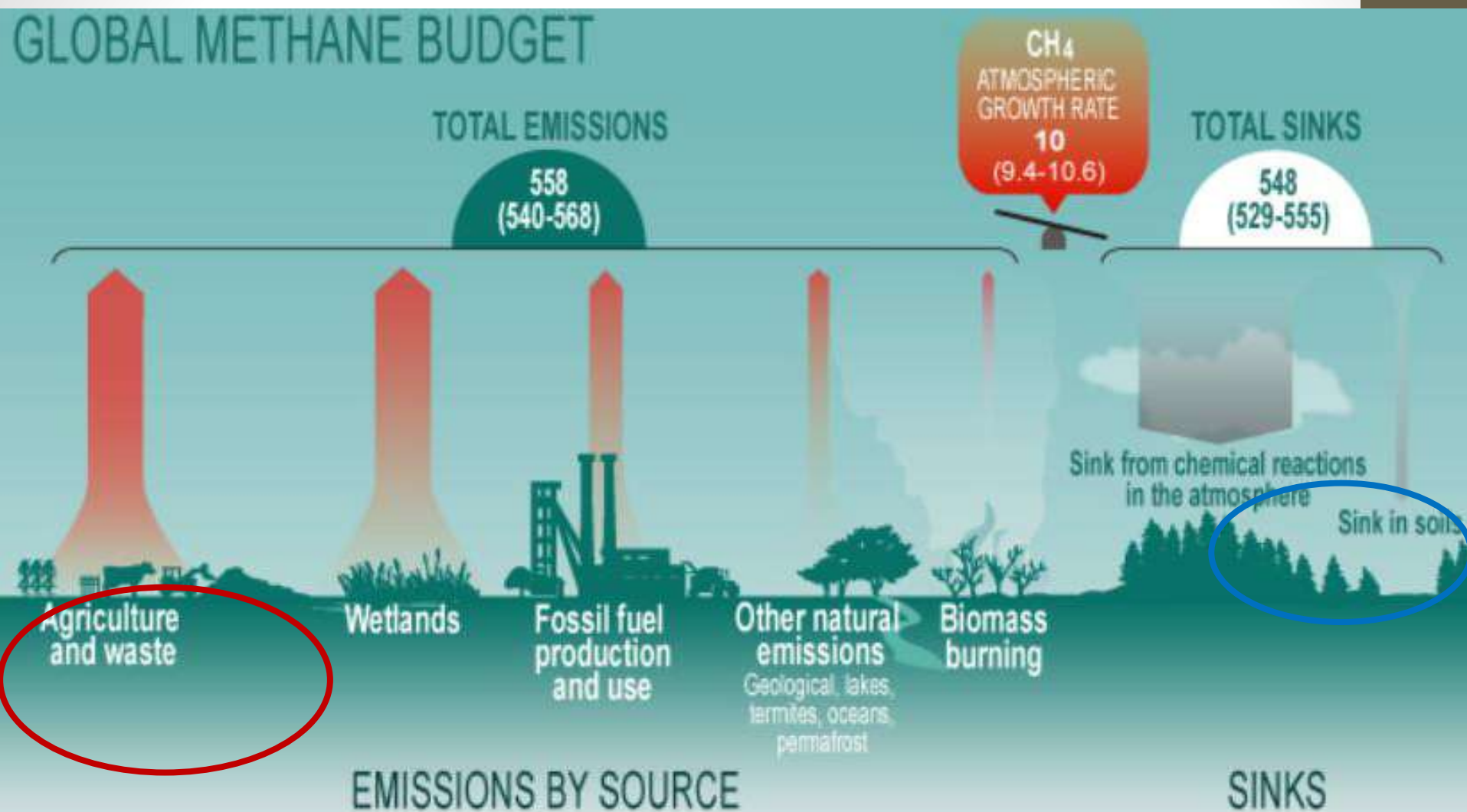
The problem of sinks

§ Many materials that we use to produce food contain chemical substances that are **hazardous** (dangerous) to human health and the environment.

§ Unfortunately, these substances get released into the environmental compartments (soil, water and air).

§ The releases occur deliberately and accidentally, in production, during use, or from **waste disposal sites**.

Agri-food systems are source of GHG emissions



A lot of food is thrown away uneaten

Into the Trash It Goes

A federal study found that 96.4 billion pounds of edible food was wasted by U.S. retailers, food service businesses and consumers in 1995 — about **1 pound of waste per day** for every adult and child in the nation at that time. That doesn't count food lost on farms and by processors and wholesalers.

For a family of four people, that amounted to about **122 pounds of food thrown out each month** in grocery stores, restaurants, cafeterias and homes. Here is a depiction of that family's monthly share, the sum of waste in eight different food groups as detailed in the study.



Source: United States Department of Agriculture; Census Bureau

BILL MARSH AND KARI HASKELL/THE NEW YORK TIMES; PHOTOGRAPH BY TONY CENCOLA/THE NEW YORK TIMES

Almost 45 million tonnes of food is thrown away uneaten in USA annually. Source: Martin, A., Into the Trash It Goes, *New York Times*, 18 May 2008

The Circular Economy



Biological materials



Technical materials

Vision #2
Regenerative agriculture/forestry



Farming/ collection*



Mining/materials manufacturing

Soil restoration



Biosphere

Biochemical feedstock

Materials/parts manufacturer

Product manufacturer

Retail/service provider



Recycle



Biogas



Anaerobic digestion/ composting†

Cascades



Collection



Collection



Maintain



Reuse/ redistribute



Refurbish/ remanufacture

Extraction of biochemical feedstock†

Energy recovery



Landfill

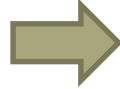


Leakage (to be minimised)

Vision #1
Bio-based economies

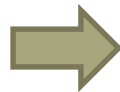
Two approaches to design metabolisms

Approach 1
Take back system
(closed loops)



Research on business models, supply chain management/OR, and contractual design/theory, the theory of the firm

Approach 2
Networks in the
metabolisms



Research on inter-firm collaborations (dynamic capabilities, knowledge governance)

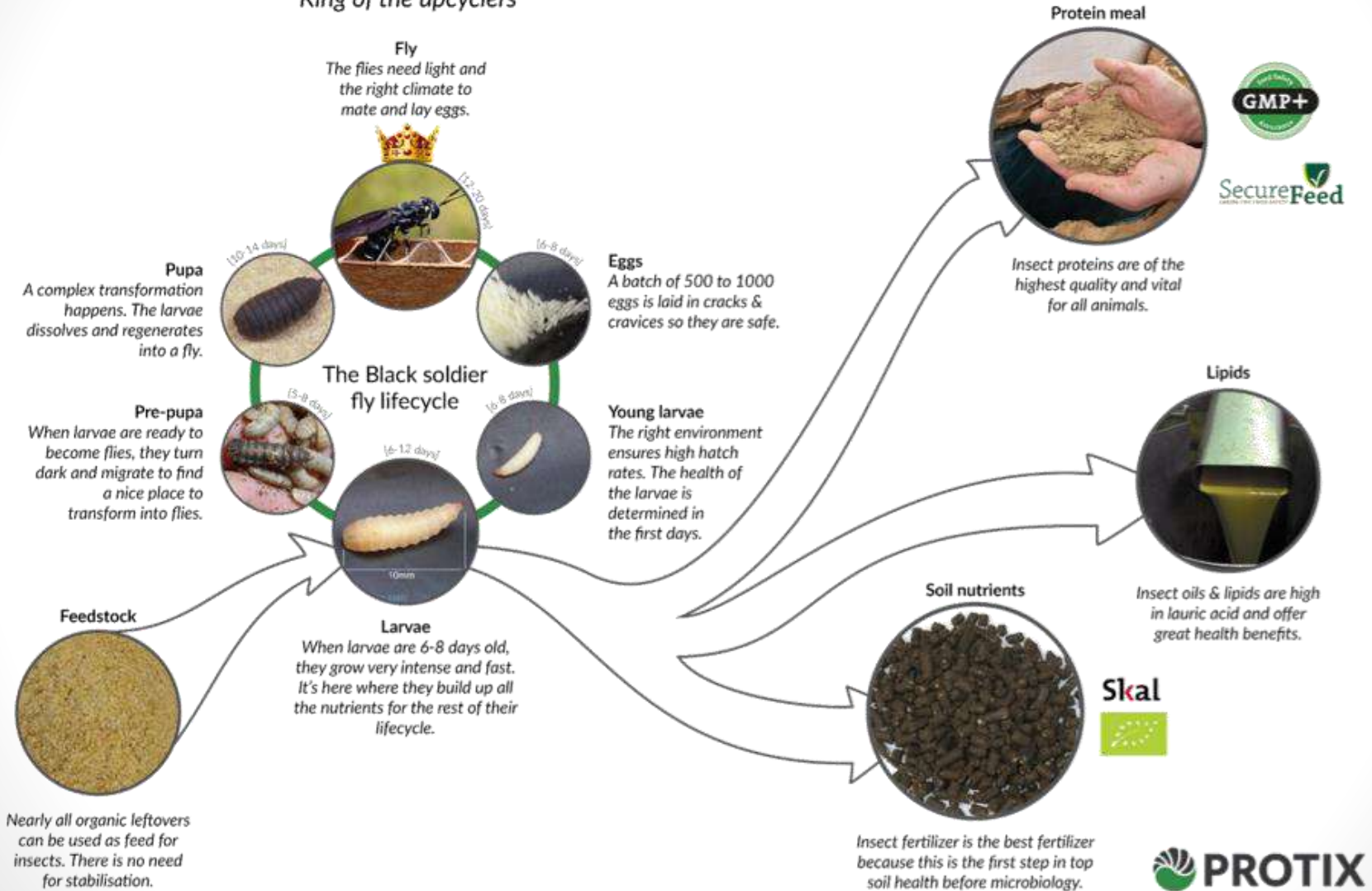
Approach 1: Closed loop/Closed circle

- Closed loop recovery
 - The reverse channel supplies high quality (recovered) products, components and materials to the forward channel thereby reducing the need for virgin sourcing and production. We refer to this as **closed-loop recovery**.
 - **To maximize substitution, the recovered items must re-enter the original supply chain** (Krikke 2011).

Krikke, H (2011). Impact of closed-loop network configurations on carbon footprints: A case study in copiers, *Resources, Conservation and Recycling*. 55, 1196-1205

Circular economy models in agribusiness (approach 1)

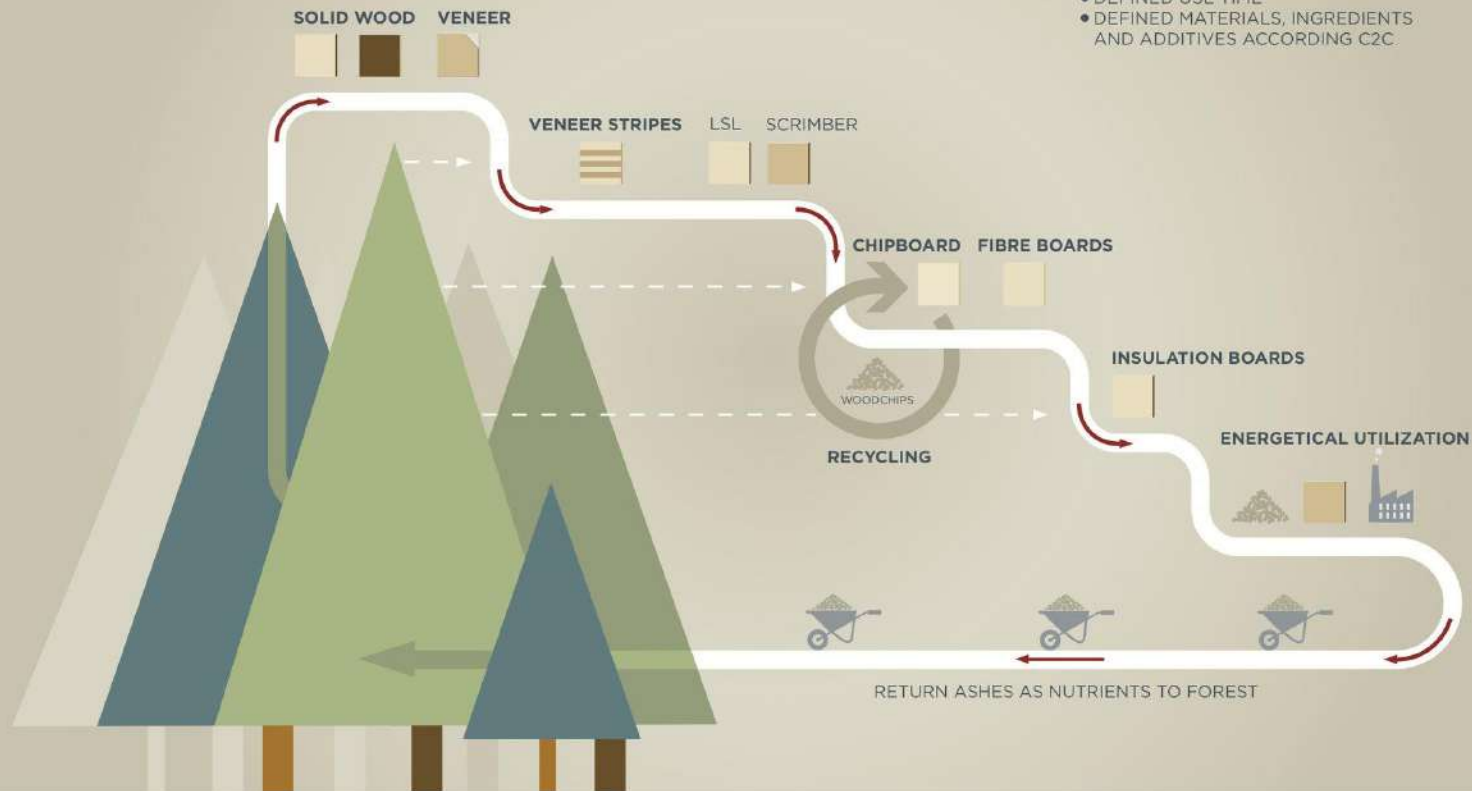
The BLACK SOLDIER FLY King of the upcyclers



Circular economy models in forest management and timber/wood production (approach 1)

WOOD CASCADE ACCORDING TO CRADLE TO CRADLE

- DEFINED PATHWAYS
- DEFINED USE TIME
- DEFINED MATERIALS, INGREDIENTS AND ADDITIVES ACCORDING C2C.



ORIGINAL EPEA-USED WITH PERMISSION

Approach 2: Metabolisms as Networks

- CE design enables the creation of wholly beneficial industrial systems driven by the synergistic pursuit of positive economic, environmental and social goals.
- CE defines a framework for designing products and industrial processes that turn materials into nutrients by enabling their perpetual flow within one of two distinct metabolisms: the biological metabolism and the technical metabolism (Braungart et. al 2007)

Braungart, M. McDonough, W. and Bollinger, A. (2007) 'Cradle-to-cradle design: creating healthy emissions – a strategy for eco-effective product and system design' *Journal of Cleaner Production*. 15, p.1337-1348

Circular economy models in agribusiness (approach 2)

Agripark metabolisms in Agriport A7 (The Netherlands)

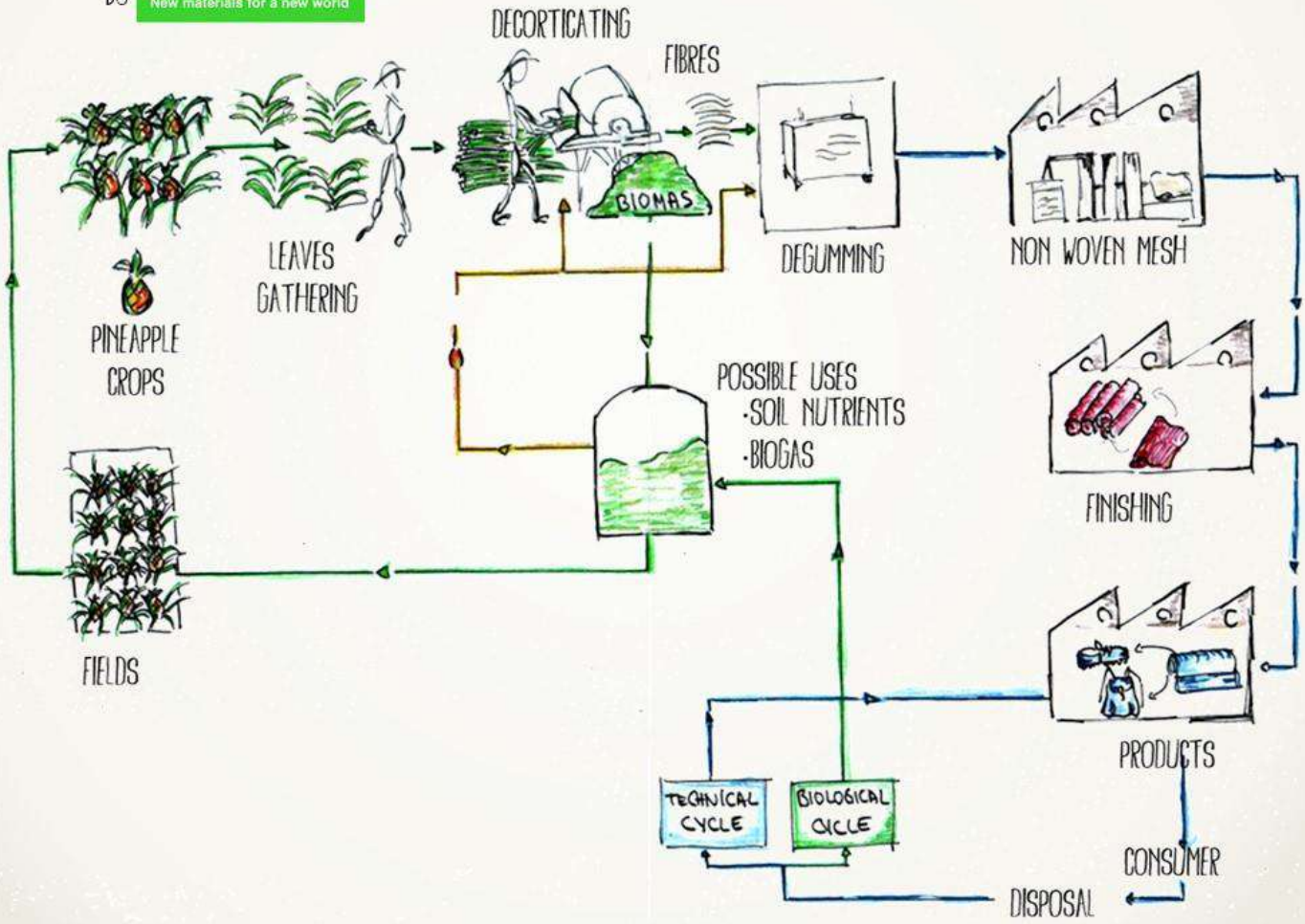


Circular economy models in fibre management (approach 2)



BY **ananas anam**
New materials for a new world

intended life cycle



Regenerative agriculture/forestry

The current global practice of regenerative agriculture/forestry is based on applied and scientific research carried out by several international communities:

Scaled-up systems and practices:

- organic farming

Niches

- permaculture, agroecology, agroforestry, ecological intensification, restoration ecology.

www.regenerativeagriculturefoundation.org