Mediterranean Youth, NEETs and Women Advancing Skills, Employment and Awareness in the Blue and Green Economy (MYSEA)

Sector based Training Package-

Student Handbook

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Module 1: Green Economy

According to UNEP (United Nations Environment Program) green economy is an economy that "*results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities*."

A 2016 publication from the EAA (European Environment Agency) can refer to:

- Sectors (e.g. energy)
- Topics (e.g. pollution)
- Principles (e.g. polluter pays)
- Policies (e.g. Economic Instruments)

A closely related green economy aspect is the efficient use of natural resources. Other important aspects that are in constant development are:

- Environmental Impact Assessment (EIA)
- Strategic Impact Assessment (SIA)
- Corporate Social Responsibility (CSR)
- Life-Cycle Analysis (LCA)
- Finance
- Trade
- Tourism

A pathway to sustainable development

A green economy can be seen as a pathway to sustainable development, which is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. In a green economy, the environment is a determining factor of economic production, value, stability, and long-term prosperity, as a source of growth and a spur to innovation.

What does a green economy look like?

Taking into account the aforementioned applications we can conclude that a green economy is one that:

- Aims at sustainable development
- Strives for growth without endangering the environment
- Reduces environmental hazards and ecological scarcities
- Shares many similarities with ecological economics but focuses more on political applications.

In addition, according to UNEP "to be green, an economy must not only be efficient, but also fair. Fairness implies recognizing global and country level equity dimensions, particularly in assuring a Just Transition to an economy that is low-carbon, resource-efficient, and socially inclusive."

The green economy is characterized from the outset as a new development model that counteracts the '*brown*' economic model based on fossil fuels (such as coal, oil and natural gas) by drawing on the knowledge of various ecological economies that address the interdependence between the human economy and the natural ecosystem by immediately considering the adverse effect of economic activity on climate change and recent global warming.

A Green Economy is part of sustainable development, a way to achieve a resource-efficient, socially inclusive and environmentally sustainable world. It is an economy that responds to the issues of climate change, the need for "*closed-loop systems*," meaning for example that we can reuse and recycle through the life cycle of products, and also redesign these products in order to minimize waste and pollutants and other environmental impacts from their production to their use and end of life.

Renewable Energy

Renewable Energy is collected from resources that are continually replenished in nature without human intervention are considered renewable energy. This includes sources such as sunlight, moving water, wind, and heat from the earth. It is important to note that not all renewable resources are sustainable. Biomass sources (plant-based materials used as fuel to produce heat and/or electricity) are one such example. Examples of such biomass resources include wood, and agricultural products. The reason these are not considered sustainable is that their rate of exploitation exceeds their natural rate of replenishment.

Wind Energy Parks

Wind Energy Parks are groups of wind turbines occupying the same location for the purpose of producing electrical energy through the power of wind. There are:

A. Horizontal-axis turbines: they are the most prevalent type of wind turbine. They regularly have three large, thin blades. Some units have just two blades. They are very comparable in appearance to an airplane propeller.

B. Vertical-axis turbines: they are typically a newer technology than their horizontal-axis equivalents. Their blades are smaller and wider. They are not like airplane propellers; instead, their shape matches the electric mixer beaters.

Wind Energy Advantages

1. Wind Power is Economical: Wind is one of the cheapest viable energy sources today. Wind energy alleviates the price volatility that fuel prices contribute to traditional energy sources since electricity from wind farms is exchanged at a fixed price over a long period of time (typically more than 20 years) and its fuel (wind) is free.

2. It's a clean fuel Source: unlike fossil fuels and gasses, wind energy does not pollute the air. Acid rain, greenhouse gasses, and smog are not caused by the pollutants that wind turbines release into the atmosphere.

3. Wind Energy offers Employment: According to the Wind Vision Report, the wind sector can support more than 600,000 positions in installation, maintenance, manufacturing, and supporting services by 2050.

4. Sustainable: the Earth's rotation, the irregularities on its surface, and the atmosphere's heating by the sun all contribute to the production of winds. As long as the sun is out and the wind is blowing, the energy produced may be used to transmit power across the grid.

5. Wind Turbines can be constructed on existing farms: The rural economies where the majority of the best wind locations are found greatly benefit from this. Since the wind turbines only use a small percentage of the land, farmers and ranchers may continue to operate the area. Landowners receive additional money from wind power plant operators who pay a farmer or rancher a rent fee for the usage of their property.

Solar Energy Parks

The Solar Energy parks are large-scale groups of solar panels that gather energy from the sun for the purpose of generating electrical energy.

Solar Energy Technology

Photovoltaic Power (PV) Station

PV stations are grid-connected systems of solar panels which use solar power to generate electrical energy on a large scale. These systems are made up of solar panels that convert light directly to electricity. Currently, PV stations remain the most popular way for collecting solar power on the public utility scale.

Concentrated Solar Thermal (CST) System

Unlike the Photovoltaic (PV) power system, which uses solar power to generate electrical energy from light, the Concentrated Solar fields use lenses and mirrors to concentrate the solar power, and convert the generated heat into thermal and electrical energy. In order for this to happen a CST is made of two parts: one that collects solar energy and converts it to heat, and the other that converts the heat energy to electricity.

Solar Energy Advantages

1. Environmental Benefits: solar energy doesn't produce gases which pollute air and water, and it does NOT create noise, which makes it suitable for rural areas.
2. Highly Renewable
3. Water Waste Prevention
4. Money Waste Prevention
5. Water Gain opportunities
6. Low maintenance: Solar panels don't need lots of time to be cleaned or repaired. Of course, you'd want to ensure a professional check-up every so often, in order to confirm that the panels are providing the expected energy.
7. Improving grid security: solar systems work as power centers for the grid. As a result, the grid security is improved and accidents like grid overload are less likely to cause a blackout.
8. Installation flexibility
9. High-Demand Solution: the grid security is improved and accidents like grid overload are less likely to cause a blackout.
10. Store the extra power

Green Building

Green buildings represent architectural constructions whose building process and structure are environmentally responsible and resource efficient. Green building practices can serve a variety of purposes and are often categorized into multi-faceted designs and approaches that are beneficial for both communities and businesses. Both policy professionals and the building industry have categorized green building principles to help guide future development and design. The five principles of green building practices have been established that are organized around the life cycle performance of green buildings. An integrated and comprehensive approach, the principles encompass each of the green building phases, including construction, operation, maintenance, and decommissioning.

Sustainable Transport

Sustainable transport refers to ways of transportation that are sustainable in terms of their social and environmental impacts. We can identify best practices related to major principles of sustainable transportation these includes Car free developments, Clean vehicles, Transit Oriented Developments (TODs), Promoting pedestrians and cyclists, Optimization of road network, Developing public spaces in city center , Parking management for sustainable transportation, and Traffic calming.

The main idea of these eight principles is proposed on the basis of eight major principles suggested by Institute for Transportation and Development Policy (ITDP) for sustainable transportation i.e. Walk, Cycle, Connect, Transit, Mix, Densify, Compact, and Shift.

Blue Economy

According to the UN Blue Economy "comprises a range of economic sectors and related policies that together determine whether the use of ocean resources is sustainable. An important challenge of the blue economy is to understand and better manage the many aspects of oceanic sustainability, ranging from sustainable fisheries to ecosystem health to preventing pollution.

Secondly, the blue economy challenges us to realize that the sustainable management of ocean resources will require collaboration across borders and sectors through a variety of partnerships, and on a scale that has not been previously achieved. This is a tall order, particularly for Small Island Developing States (SIDS) and Least Developed Countries (LDCs) who face significant limitations ".

Similarly to green economy, the definition of Blue Economy somewhat varies among organizations. Generally, when talking about a sustainable development strategy for coastal resources, Blue Economy is typically employed in the context of international development:

- Fisheries
- Aquaculture
- Marine farming
- Maritime transport
- Coastal renewable energy
- Marine ecosystem services
- Seabed mining
- Coastal, marine, and maritime tourism

Waves as Renewable Energy

- Waves are Constantly Moving
- Waves provide a more consistent power source compared to wind or solar. The reason being that, unlike wind and solar, waves are constantly moving and therefore they can produce energy 24/7.With the appropriate equipment, wave energy can be converted into electricity and added to an electric utility power grid
- An Enormous Energy Potential
- Waves are More Predictable
- Ocean Waves are Closer to Demand

Women and the Ocean

Focusing on the interlinkage between the SDG14 and SDG 5 (gender equality and the empowerment of women and girls) a panel of experts advocated for increasing women's participation and leadership at all levels.

With women critically under-represented in the field of ocean actions, particularly in decision-making roles in ocean science, policy-making, and blue economy, the panel called for more action and a radical change in society.

Strategies and planning of policy objectives

Identifying strategies to successfully support the accomplishment of environmental goals is one of the most significant and challenging matters for climate policies. But policies are not written in a vacuum. They are always related and influenced by factors in other (often similar) fields of interest.

Recently established research shows that one such factor for climate policies and environmental goals is sustainable development. In 2015 the United Nations established what is known as the 17 Sustainable Development Goals (SDGs). What the research suggests is that some of those goals demonstrate a strong correlation to the achievement of environmental policy objectives:

- Goal 1 No poverty: *"End poverty in all its forms everywhere".*
- Goal 4 Quality Education: *"Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all".*
- Goal 3 Good health and well-being: *"Ensure healthy lives and promote well-being for all at all ages".*
- Goal 8 Decent work and economic growth: *"Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all".*
- Goal 15 Life on Land: *"Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss ".*
- Goal 17 Partnership for the goals: *"Strengthen the means of implementation and revitalize the global partnership for sustainable development".*

Among the mentioned goals one has the highest impact on environmental policy implementation, namely Education.

Understanding which SDGs have the most impact on environmental goals can help you decide which sectors of development may benefit the most from environmental policies.

Let's now talk about how to approach developing a policy strategy.

Policy strategy elements

The structure and content of a policy strategy are as unique to your organization as the development process. Some components you may consider including are:

Organizational mission and vision: It is helpful to articulate your organization's mission and vision at the beginning of your policy strategy so that the reader can get a sense of how the component parts of the strategy align with them.

Context and purpose: This section should articulate the landscape within which your organization is working.

Why does your organization exist? What problem(s) is your organization addressing? What evidence exists to support your claims? These guiding questions should help develop a narrative around the context within which you are undertaking your work. This should then help set up the purpose of your policy strategy. What issues are you trying to address through your policy strategy?

Policy goals

A key part of your policy strategy is outlining your policy goals. You don't need to have lots of goals in order to justify a policy, as long as they are SMART. This means that each goal is:

- **S**pecific – no vague language, describe its exact purpose and objectives.
- **M**easurable – this means that you need to make the goal quantifiable, find the right metrics and use them to demonstrate the importance and desired impact in numbers.
- **A**chievable – a goal needs to be realistic; present how the policy goal fits and works in accordance to the environment – this includes your environmental, economic, organizational and social context.
- **R**elated – remember that each goal needs to make sense in the context of your overall strategy, so make sure to describe how it is connected to your other goals. And if you notice that a goal doesn't seem to fit the strategy, that's good – this is the time you should take to tweak it and make sure that it does.
- **T**ime-bound – one of the main differences between a goal and wishful thinking is time – make sure to calculate your best estimate for when you'd like to see your goal achieved and set a time frame as a universal guide in your description.

Green Growth Best Practices & Sectors

Green growth strategies play vital roles in unlocking synergies between economic growth, environmental protection, and poverty reduction and enabling a transition to an inclusive green economy. Even if the state of the environment is globally deteriorating, in the last 60 years, there have been some positive global environmental changes. For examples: removing lead from petrol helped improve air quality and has had a positive impact on young people's' health; recycling quotas in Europe and other places have encouraged waste sorting and collection systems so that fewer items are thrown away, removing ozone-depleting substances has had a positive impact, reducing the thinning

of the ozone layer. These examples, **which need to be scaled up**, show that we can recognize risk, collaborate and develop new strategies that can change technology, industry behavior and products, to benefit our environment and pave the way to a green economy.

ILO and the European Centre for the Development of Vocational Training (CEDEFOP) identified key requirements for developing a green economy:

• Environmental awareness as an integral part of education and training; • Effective cooperation between government and civil society;

• Decentralizing resources to enhance local impact;

• Prioritizing skills and classroom training; and

• Improving training and incentives for the workforce.

The transition to a green economy may mean alterations to the types of jobs that are available or that existing jobs may require new knowledge and application of current skills in new ways, as new working methods are introduced. This will involve some sectors reducing employment, while others increase employment.

Module 2: Agri Food Chain

According to the NACE classification-"nomenclature statistique des activités économiques dans la Communauté européenne", Agri Food Chain (AFC) includes the following broad sections:

Section A – "Agriculture, forestry, and fishing"

Section C – "Manufacturing"

Section G – "Wholesale and retail trade"

Section H – "Transportation and storage"

Section I – "Accommodation and food service activities"

This is to say that in addition to the farm sectors, there're also others involved in the AFC, such as packaging, transportation, and all economic and non-economic food-related activities and services. This means that there's a lot more to consider from the point of sustainability.

Biologically Integrated Farming Systems (BIFS)

Some examples of biological and cultural practices promoted in BIFS projects include:

Cover cropping

This means growing plants (called cover crops) that are meant not for harvest, but for covering the soil and as a result protecting it. They may grow between season harvests (including winter) and manage soil erosion, soil fertility, soil quality, water, weeds, pests, diseases, biodiversity and wildlife in the agroecosystem.

Crop residue

These are the materials that remain after a crop. There're two major types:

- Field residues (leaves, stems, seed pods) are valuable in tilling, watering, and erosion prevention.
- Process residues (seeds, husks, molasses, roots, bagasse) can be used as animal fodder, fertilizers, and soil amendment.

Habitat planting

Growing certain plants and flowers can encourage animal species to find their dwelling within your farm. As a result, you control both pests' population, and avoid using as much pesticides on your crops for the same reason.

Organic farming

Organic farming (also known as "ecological farming", "biological farming" or "organic agriculture") is an agricultural system that uses fertilizers of organic origin.

According to The International Federation of Organic Agriculture Movements (IFOAM - Organics International) *"Organic agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved..."*

Following this definition, there are 9 major agricultural practices and techniques which can be considered essential:

Fallow

As a result of ongoing agriculture, the soil can lose its fertility. In order for the land to restore its natural fertility, it is periodically left fallow for a period of time.

Crop Rotation

This process is used to either prevent the land from being left fallow or to shorten the time it is left fallow. The plants most often used in crop rotation are leguminous plants because they naturally fix atmospheric nitrogen.

Mixed Cropping

In this method, two or three crops are grown simultaneously – in doing so, each crop can partially replenish the nutrients used by the other crops. The percentage of crops that must be combined varies depending on the techniques used and the demands of the region.

Two-Cropping Agriculture

In this practice, two crops are grown in alternation over the course of a year. It is common in regions with sufficient rainfall or irrigation infrastructure. Typically, leguminous crops are the preferred second crop, because of their ability to fix atmospheric nitrogen.

Multi-cropping Agriculture

In this method, three crops are typically grown in a year. This strategy is popular in areas with access to early-maturing crop types and appropriate water management practices.

Relay Cropping

This practice refers to the process of sowing a new crop while an older crop is still present on the field and ripening.

Crop-Productivity

This refers to the amount of production of crop per hectare or per worker. Per worker productivity is higher in the areas of extensive agriculture. Per hectare productivity is higher in the areas of intensive agriculture.

Agricultural Efficiency

This is about answering the following equation/question: What is the maximum amount of crop produced in a minimum amount of time, and at what price is it sold?

Crop Intensity

This refers to the land's optimal agricultural usage i.e., how many crops can be obtained within a year and with what quality.

Gardening Basics

Start strong

Oftentimes we think that the only way to start gardening is with seeds. In reality, it may be easier to start with small, already sprouted plants. This may be a great solution if you are completely new to gardening or seeds are in limited supply where you are.

Location

Gardening is like real estate – it's all about location. If you are starting an outside garden, make sure that it is within your regular sight. The same applies if you are starting inside – in doing so you will remember to take care of your plants. In addition, positioning is crucial as it is inherently related to lighting and moisture, so let's talk about these next.

Light

Most edible plants, including many vegetables, herbs, and fruits, need at least 6 hours of sun in order to thrive. Similarly, in-house plants need the sun to keep their water balance checked.

Water

Keeping your plants may be trickier than it seems. This is because you want to keep your plants watered well, but you also don't want to get them drowned. Too much water can cause water to get stagnant, which may result in your plants getting sick or infected. This is why you want a good balance between water and light. To make matters easier, consider putting your indoor plants or starting your garden near a water source.

Soil

Starting with the right soil is essential. Research the best type of soil your plant requires and supplemented with nutrient-rich, well-drained soil. Also, keep in mind that your soil mix depends on whether or not you are planting directly in the ground or in pots. Certain soil manufacturers provide soil mixes that accommodate plants to better thrive in pots by accommodating for under- or overwatering.

Containers

Whether you're planting inside or outside, space is always important. Even if you are planting out-doors, you may not have the necessary natural soil conditions to do so – this is when you need to remember that you can plant in pots and containers outside as well.

Plants

As much as you may love certain things, you should only select and grow the ones for which you can match the necessary growing conditions. This includes sun requirements, heat tolerance, space for their root systems – this means both within the soil, but also outside if the plants are climbers or creepers. Do your homework and pick the varieties that will grow well where you live and in the space you have.

Zone hardiness

A “hardiness zone” describes the coldest place a plant can grow. As you can probably already guess, this can tell you what plants you can grow in your conditions and which you cannot. A higher zone number means a warmer climate.

Frost dates

Another thing to consider is when to plant your flora. Doing so either to early or too late can kill your plants. Therefore, you need to get acquainted with the average frost date for the region where you live. This also applies for indoor plants, whenever you are deciding to put them out for the spring-summer season or bring them in for the autumn-winter season. This is why, no matter the seasonal range and accompanying climate change in your region, it is always a good idea to identify the last spring date for your area and plan your planting accordingly.

Add mulch

Mulch is a layer of usually organic material with which you cover the surface around or on top the bases of your plants. It is used to control weeds, retain moisture and regulate temperature. Consider applying a layer of mulch that's 2 to 3 inches deep. You can use straw, shredded leaves, pine straw, or some other locally available materials. Alternatively, you can look for ready solutions that you can buy.

Feed regularly

Plant food contains essential elements such as nitrogen, phosphate, and potassium. Whether your plants are in a small greenhouse or in pots inside your home, these nutrients are essential for renewing the soil and assisting plants in developing strong roots. A month after planting you can consider adding plant-food-solutions to further enhance your gardening results.

Controlling Plant Diseases

Site selection

A home garden location has to be well light and have good drainage. Excessive soil moisture may induce illnesses of the roots and crowns, this is why you want to avoid wet, poorly drained soils. Direct sunlight is also important – in addition to all other benefits for a plant, it also allows unnecessary water to evaporate from the plant.

Crop rotation

Avoid planting vegetables of the same family in the same area in consecutive years. Planting vegetables from the same family continuously increases the risk of pathogens. For optimal results, you can grow the same or closely related plants only once every 3 to 5 years. In doing so, you are starving out most of the pathogens that cause stem and leaf diseases.

Diseases Free Seed and Transplants

You may think that it is a good idea to save seeds from one year to the following – this is not the case. Many plant diseases are seed-born – that's why it is better to use fresh seeds and always examine the seedlings before purchasing and starting a crop.

Use Resistant Varieties

The most efficient way of controlling vegetable diseases is to use resistant varieties. This is why it is worthwhile to go the extra step and buy resistant varieties when they are available. Usually, seed catalogs have the resistant traits of the various vegetable varieties listed.

Planting Date Management

Following the recommended planting dates for a particular vegetable can have a strong positive effect against plant diseases.

Trap Crops

Trap crops can limit aphid damage and help reduce the incidence of virus diseases. A few rows of a trap crop (e.g., rye or corn) around your vegetable garden will cause aphids to feed there first, and possibly loosen the virus they may carry.

Proper Spacing and Trellising

Staking or trellising prevents soil contact with the foliage and fruit, reducing the incidence of diseases such as fruit rots. Staking and trellising discourages the growth of pathogens, and promotes foliage drying by preventing soil contact with the foliage and fruit. This is why you want to space your plants properly, allowing air circulation and growth.

Use a Mulch Layer

Mulching prevents soil from splashing onto plants and also fruit from touching the bare ground. This will help to conserve soil moisture, prevent rots on mature fruit and reduce weed infestations.

Proper Fertilization

Proper pH prevents blossom end rot, encourages healthy growth of fruits and vegetables, and prevents vegetables. For this, make sure to test the soil anywhere from 3 to 6 months before the growing season. Then, follow the nutrient supply recommendations and adjust the soil pH to the respective requirements.

Weed Free Garden

Weed control is essential for preventing numerous insect-transmitted viruses. Weeds can serve as carriers for these viruses and infect homegrown vegetables. Good weed control increases air movement and decreases conditions that promote the development of disease (i.e., excessive moisture).

Avoid Tobacco When Working in the Garden

If you use tobacco, make sure to properly wash your hands before handling any plants. In doing so, you may prevent the transmission of the tobacco mosaic virus – a disease that may affect many different types of vegetables, especially solanaceous plants (nightshade family plants like tomatoes and peppers).

Soil solarization

Soil solarization is a chemical-free way of controlling pathogenic microorganisms (i.e., nematodes, bacteria, fungi). Soil solarization involves tilling the garden and then covering the areas with a clear plastic tarp for 6 to 8 weeks. The best time to solarize soil is June through August, when temperatures are at their hottest, as the process requires intense solar heat to be effective.

Sanitation

After harvest, remove and destroy plant material. Remove diseased plants, plant residue, and weeds in and around the vegetable garden to reduce the occurrence of some diseases. Plow the soil to help break down debris that may harbor nematodes, fungi, and bacteria.

Pesticide Use

Pesticides should be the very last form of defense used by home gardeners. Consider pesticides only once all other disease control options have been exhausted.

Irrigation (Watering) Strategies

Irrigation is the agricultural process of watering, by applying controlled amounts of water to a land. It helps to grow agricultural crops, maintain landscapes, and revegetate disturbed soils in dry areas and during periods of less than average rainfall.

There are many different types of irrigation systems, depending on how the water is distributed throughout the field – here are some common types:

Surface irrigation
Water is distributed over and across land by gravity rather than a motorized pump.

Localized irrigation
Water is distributed through a low pressure piped network, applied to each plant.

Drip irrigation
A localized type of watering where the water is delivered near or at the root of plants. Evaporation and runoff are minimized.

Sprinkler irrigation
Water is distributed by overhead high-pressure sprinklers or guns. The sprinklers are placed in a central location in the field or put on moving platforms.

Center pivot irrigation
A system of sprinklers move on wheeled towers and move in a circular pattern to distribute the water. This system is common in flat areas.

Lateral move irrigation
Water is distributed through a series of pipes, each with a wheel and a set of sprinklers. The sprinklers are rotated either by hand or with a purpose-built mechanism.

The sprinklers move a certain distance across the field and then need to have the water hose reconnected for the next distance. This system tends to be less expensive but requires more labor than others.

Sub-irrigation
Water is distributed across land by raising the water table, through a system of pumping stations, canals, gates, and ditches. This type of irrigation is most effective in areas with high water tables.

Manual irrigation
Water is distributed across land through manual labor and watering cans. This system is very labor intensive.

Composting

Compost, also known as composted soil, is the result of the bio-oxidation and humification of a mixture of organic matter (such as pruning residues, kitchen waste, manure, slurry or garden waste such as leaves and mown grass) by macro- and micro-organisms under special conditions: the presence of oxygen and the balance of the chemical elements of the matter involved in the transformation.

Once produced, compost can be used as a soil conditioner, which is then destined for agronomic or floricultural uses. Its use, with the addition of organic matter, improves soil structure and the availability of nutrients (phosphorus and nitrogen compounds). As a biological activator, it also increases the biodiversity of microflora.

Basic principles of composting

To have a good compost, one must remember that it is the *decomposing organisms* in the soil that produce it and the optimal conditions are:

- Nutrients - a mixture of carbonaceous matter (brown-hard-dry) and nitrogenous matter (green-soft-wet)
- Moisture - a nitrogenous (wet) matter and possibly rainwater or water brought in by hand
- Air - infiltrating through the porosity produced by the presence of the (hard) carbonaceous structuring substances.

Compostable organic residues

- **Nitrogenous waste:** vegetable waste, garden waste (hedge clippings, lawn grass, etc.), green leaves, household waste (wet fraction), limiting residues of animal origin and mixing them well with those of vegetable origin.
- **Carbonaceous waste:** branches from pruning (better if they are shredded with a bio-shredder, otherwise they will be poorly attackable by the micro-organisms - increasing the 'attackable' surface area increases the speed of composting), dry leaves, straw (carefully keep these materials aside and mix them in with the nitrogenous waste that is produced from day to day.
- **Paper:** avoid printed paper (even though newspapers today no longer contain toxic substances) and, above all, avoid glossy paper!
- **Cardboard:** pieces of cardboard can also serve as shelter for earthworms.
- **100% natural fabrics:** pieces of wool, cotton, etc.
- Coffee grounds, tea filters, egg shells, dried fruit shells.
- Biodegradable bedding of herbivorous animals .

Types of composting

Industrial composting

Industrial composting allows optimal control of the process conditions (humidity, oxygenation, temperature, etc.) and the presence of any pollutants in the raw material (e.g. heavy metal residues and various aggregates) or pathogenic microorganisms for agriculture is eliminated through further mechanical separation and biological treatments respectively.

Other commonly exploited compostable biomasses are sewage sludge and waste from the care and maintenance of green areas (green compost). The **quality compost** obtained from the separate collection of organic waste through an industrial process can thus be conveniently exploited in agriculture, taking advantage of a natural fertilizer and avoiding the use of chemical fertilizers in the open field.

Community composting

In terms of size, community composting is somewhere between industrial and household composting. It is carried out through small plants used to accelerate the natural composting process of organic waste. These plants are used to serve a few dozen to a few hundred households (families) or the needs of a canteen, hotel or other producer of organic waste.

In home and community composting, at least two or three times a year, the material must be turned over to reactivate the composting process. The maturation time of the compost varies depending on the climatic conditions and the type of product to be obtained. Compost of mediocre quality cannot be easily utilised, can cause unpleasant odors and be the cause of major cost overruns. It is therefore essential that the composting process is well respected and followed.

The composting process takes place in two stages:

- Active phase - this first phase is characterized by a high level of activity of the microorganisms, which, by means of hydrolysis, degrade the most easily degradable organic fractions. The duration of this phase is a few weeks.

- Ripening phase - this second phase is where the more recalcitrant (i.e. less degradable) fraction is concentrated and subsequently humidified. The duration of this phase is longer than the first and lasts more than 2-3 months.

Home composting

Home composting is a procedure used to manage the organic fraction present in municipal solid waste produced in the home (mainly of food origin). To practice it, it is sufficient to have a patch of garden, preferably sunny, in which to accumulate food waste from the kitchen and those from the vegetable garden/garden. In some cases, a compost bin is used, a container that promotes oxygenation and conserves heat during the winter.

It is also possible to compost without a composter, in a heap or in a hole in the ground, but the results will be slower and of lower quality. Here's what the process requires:

- You will need at least two pits - one in use, and the other at rest, each rotating for 6 months.

- When the first one is full, you put it to rest, empty the second one and make it the active one.

- A 50 x 50 cm hole, 40 cm deep, can suffice for 6 months at the rate of one 10-liter bucket per week of kitchen waste, plus the mowing of a small lawn.

- In order to live and reproduce, the microorganisms also need a favorable temperature, so the composter, or pit, must be closed and sufficiently insulated from the outside environment.

- Rain and cold weather lower the temperature of the material, and thus slow down the process. In this sense the pit works better than the heap, as it is insulated on 5 sides (as well as having a more discreet visual impact).

- Although it is possible to introduce meat and fish waste, excess is generally discouraged as decomposing animal proteins release an unpleasant smell and may attract rats or other unwanted animals.

Soilless and Hydroponic Crops

Even the common potted plants that we keep on our balcony at home are an above-ground crop.

It must therefore be made clear that soilless crops can be subdivided into crops on substrate and crops without substrate or on liquid medium. In the former, the roots sink into a substrate of a different type (organic, inorganic or artificial) that is constantly moistened with nutrient solution, in the latter the root system is immersed directly into the nutrient solution.

Hydroponic cultivation falls into the latter category. Hydroponic agriculture (from the Greek ὕδωρ hýdor, water + πόνος pónos, work), or hydroponics refers to one of the techniques of above-ground cultivation: the soil is replaced by an inert substrate (expanded clay, perlite, vermiculite, coconut fiber, rockwool, zeolite, etc.) and the plant is irrigated with a nutrient solution composed of water and the (mostly inorganic) compounds required to provide all the elements necessary for normal mineral nutrition.

In this particular type of cultivation, the growth of the plant and its root system takes place outside the soil, which is replaced by an inert substrate, usually composed of expanded clay, perlite, vermiculite, rockwool, zeolite, coconut fiber, and other natural fibers. At the same time, the irrigation and growth of the plant is entrusted to a nutritive solution composed of water and inorganic compounds, necessary to supply all the substances required for plant growth.

The role of soil

The role of soil in relation to plants can basically be traced back to three functions:

- **Physical-mechanical**: the soil enables the anchoring of plants by protecting the root system from atmospheric agents that may interfere with its vitality (atmospheric humidity, lighting, insolation).

- **Trophic**: the soil is the physical environment that under natural conditions provides the plant with almost all the mineral elements it needs through root uptake. Only carbon and oxygen are taken up by carbonic nutrition, taking carbon dioxide from the air through the stomatal openings in the leaves.

- **Ecological**: the rhizosphere is the part of the soil biocenosis that has more or less direct relationships with the plant root system. These relationships are the result of a complex system of antagonisms and synergisms. Among the antagonisms are interactions with phytophages, parasites, phytopathogens, agents of allelopathy, or, more simply, competition with other plants occupying the same ecological niche. Synergisms include interactions with mutualistic symbionts and agents of stimulation.

Control parameters

Compared to conventional techniques, hydroponics shows significant advantages as contact with soil pathogens (in particular nematodes, agents of basal rot and trichomycosis) is eliminated at the source.

There are four essential control parameters:

- **pH:** this is fundamental for maintaining the solubility of elements and optimizing the exchange processes between the roots and the nutrient solution. A pH

deviating from the optimal range worsens the nutritional status of plants due to chemical or physiological immobilization of one or more mineral elements.

- **Electrical conductivity:** a low conductivity is related to an excessive dilution of the solution, so the plants are in a condition of deficient mineral nutrition. An excessively high conductivity is correlated to a high concentration of the solution and an excessively high osmotic tension (in absolute value): within the critical thresholds the plants show suffering and consume energy resources to overcome the osmotic potential to the detriment of the productive yield, beyond the critical thresholds the root uptake stops resulting in withering or wilting.

- **Flow rate, timing and dispensing cycles:** these are the parameters by which mineral nutrition is controlled overall through the replacement of the solution in contact with the roots. Excessively frequent dispensing and too high volumes (in relation to flow rate and duration of dispensing) increase economic and environmental costs as excess solution is lost through drainage unless the system is equipped with a system to recycle excess solution. Thinning out and too low volumes reduce production yields because the nutritional state of the plants is not optimal.

- **Chemical composition of the solution:** this is the parameter used to check the nutritional balance of the plants compared to the various nutrients, the antagonism ratios between potassium and alkaline earth metals, and the solubility of the various salts. Since plants require different fertilizer ratios depending on the species, type of production and quantitative/qualitative yield ratio, the composition of the solution is crucial in achieving the objectives. Fertilizers with high water solubility must be used to prepare solutions. The preparation must respect a priority in the sequence starting with the less soluble salts, and fertilizers using two mother solutions are preferable, keeping the less soluble salts separate from the more soluble ones. For certain trace elements, chelating formulations are preferred.

How it works

Above-ground cultivation is essentially based on a reduction of the variables at play and, above all, of mutual interference by replacing the soil with a physical environment in which parameters are easier to control. In the case of hydroponic cultivation, the conceptual solution takes the form of the following four points:

- **The 'protective function'** of the roots against weathering is performed by an inert and tendentially aseptic solid substrate. The substrate has no anchoring function. The plant does not need to expand its root system because the anchoring function is lost and it finds the water and mineral salts it needs in the immediate vicinity, and the roots must be almost in contact with the atmosphere to avoid root asphyxia phenomena. In some hydroponic growing techniques, the substrate is therefore entirely replaced by a thin liquid film in which the roots develop.

- **The 'anchoring function'** is replaced, if necessary, by a system of wires that keep the plants suspended, i.e., the anchoring of the plant is ensured by attaching its aerial apparatus to a suspension system.

- **The 'trophic function'** of the soil is fully replaced by the supply of a nutrient solution by means of a fertigation system, in which irrigation water is used as a carrier of mineral salts. The substrate must be chemically inert in order to avoid

interference of chemical factors (e.g. ion exchange and pH) with the parameters controlled by fertigation.

- **The 'ecological function'** of the soil is completely canceled out by hydroponics. Since the prerequisites for the creation of a favorable biocenosis do not exist, the substrate that replaces the soil is completely inert from a biological point of view, and the medium only accommodates the roots of the cultivated plants.

Soilless cultivation has clear advantages in environmental situations where the substrate is not in a condition to grow the crop optimally. This type of cultivation also has lower use of water to obtain the same result, approximately one tenth compared to growing in soil, making this system particularly useful in those environmental situations where water scarcity makes it difficult or even impossible to grow vegetables. The environmental aspect should not be underestimated, since the use of fertilizers is targeted and there is no dispersion in the soil; the use of herbicides is absent, while the use of pesticides is decidedly reduced.

At present, organic fertilizers are commercially available that make it possible, using a hydroponic system, to obtain an organic product (but not certified according to Regulation (EC) No 834/2007).

In terms of quality, the product shows uniformity of size and characteristics as well as consistent organoleptic qualities throughout production, qualities demanded by organized distribution from fruit and vegetable producers.

The Agri-food Sector

The well-being of the agrifood sector is connected to the well-being of humankind. **Multiple UN Sustainable Development Goals** (**SDGs**) - "*Zero Hunger*", "*Good Health and Well-Being*" and "*Ensure sustainable consumption and production patterns*" - are directly linked to the global food system.

These SDGs are the blueprint for achieving a better and more sustainable future for all. round 39% of the world's adult population is overweight and 39 million children under the age of 5 were overweight or obese in 2020 (WHO).

Almost 3.1 billion people could not afford a healthy diet in 2020 which was 112 million more than in 2019, reflecting the inflation in consumer food prices stemming from the economic impacts of the COVID-19 pandemic and the measures put in place to contain it (FAO).

Almost 20% of the total food produced each year is lost or wasted in the EU. This accounts for 88 million tonnes or 173 kg/per person of food wasted with an estimated cost of 143 billion.

Food waste is also responsible for about 10% of global greenhouse gas emissions.

According to EIT Food, preventing food loss and food waste at scale, would offset huge amounts of environmental damage and biodiversity loss as well as increase the accessibility of food for food insecure populations.

Furthermore, according to the European Commission food consumption is the main driver of negative environmental impacts generated by households in the EU, followed by housing (especially space heating) and mobility (particularly the use of private cars).

The food supply chain is a major source of jobs and economic activity. People are employed in producing, preparing, processing, packaging, storing, transporting and selling. According to the European Commission the farming and food sectors together provide nearly 40 million jobs in the EU.

Agricultural businesses are unique in the sense that they depend more on the weather and climate than many other sectors and that there is an "inevitable time gap" between consumer demand and farmers being able to supply.

<u>Other challenges:</u>

- Greener and smarter solutions transition from businesses is expensive and not without its risks for the businesses;
- Access to financial resources and pricing and payment conditions;
- Scale of production and workforce skills;
- Brain drain in the rural areas;
- Missing cooperation culture, and unwillingness to network and involve external partners in the company's processes.

The Short Food Supply Chain

A short food supply chain (SFSC), as defined by the EU, is a supply chain involving a limited number of economic operators, committed to cooperation, local economic development, and maintaining close geographical and social relations between food producers, processors and consumers.

- Direct sales from the farmer to the end-consumer (on-farm, farmers' markets, internet deliveries).
- Box delivery schemes,
- 'Pick your own' and community-supported agriculture (CSA), where consumers financially support local growers by purchasing a 'subscription' to their fresh produce for a particular growing season.

The main products typically traded in a SFSC are fresh seasonal fruit and vegetables, followed by animal products (mainly meat, fresh and prepared) and dairy products as well as beverages.

The value of forestry and fishing production

Forestry

Nearly one-third of the global population depends on forest goods and services to provide food, woodfuel, building materials, medicines, employment and income. Cooking is a primary means to ensure proper nutrient absorption, and globally 2.4 billion people make use of woodfuel for cooking and for sterilizing water. Forest's role in the maintenance of biodiversity as a "gene pool" for food crops helps to secure the diversity needed to promote adequate quality of diets. Forests' contributions to food security and nutrition is based on:

- Keeping healthy forests is essential to provide the sustainable ecosystem services that are required for food security and nutrition.
- Improved land governance combined with institutional and tenure reforms as well as political will are necessary to reduce the current rate of forest degradation and increase the contribution of forest resources to food security and nutrition.
- Forest policies need to ensure that food security and nutrition objectives are integrated into forest management practices.
- Secure forest tenure, community-based forestry, agroforestry, adapted forest management practices, small and medium-sized enterprises and capacity development are some of the measures that can significantly enhance the contribution of forests to food security and nutrition.

Fisheries

One of the main challenges of Fisheries is creating a balance between maximizing the social and economic potential of the fisheries industry while protecting the integrity and quality of the country's marine and coastal ecosystems and addressing transformation in the sector. Unsustainable fishing practices threaten marine wildlife as well as the livelihoods and food supply of many vulnerable populations. These threats manifest

through overfishing; illegal, unreported and unregulated fishing; bycatch (incidental capture); destructive habitat impacts; poor governance and regulatory systems; human rights and labor abuses; and reductions in food security.

Opportunities and challenges in aquaculture

Aquaculture fish convert more of their feed into body mass than terrestrial animals. the production of 1 kg of beef (resp. pork and fish) protein requires 61 kg (resp. 38 kg and 13 kg) of grain. Moreover, aquatic animal production systems also have a lower carbon footprint per kilogram of output compared with other terrestrial animal production systems. Nitrogen and phosphorous emissions from aquaculture production systems are much lower compared to beef and pork production systems though they are slightly higher than those of poultry.

Yet from a food security and nutrition perspective, debate continues on whether it would not be preferable to use such fish directly for human consumption instead as for fishmeal, especially as 'lower grade' but nutritious fish could be consumed by food insecure people, instead of being used to feed fish consumed by wealthier consumers.

Gender, along with intersectional factors (such as economic class, ethnic group, age or religion), Is a key determinant of the many different ways by which fisheries and aquaculture affect food security and nutrition outcomes, availability, access, stability and diet adequacy, for the population groups directly involved in fish production and supply chains, but also beyond.

Food Processing

Even in ancient times, both primary (e.g., drying, milling, oil extraction) and secondary processing (i.e., when products of primary processing are formulated and manufactured into processed foods) were employed to convert produce into safe and palatable foods and to extend shelf life. Food processing also creates important opportunities for generating income and employment for communities. Processed foods are an integral part of today's diet and a significant contributor to food and nutrition security.

Sustainable Food Processing

The Sustainable Food Processing group focuses on a system oriented approach in food production via the consideration of the total value chain including emerging needs in society and their environmental, economic and social impact:

- high-pressure processing, pulsed electric field (PEF), pulsed lights, cold atmospheric plasma,
- microwave, ohmic heating, and ultrasound, high-pressure assisted sterilization,
- PEF-supported sterilization processes,
- drying rates for foods or minimizing excess sludge production during wastewater treatment,
- alternative PEF-assisted process developments for the energy intensive beet sugar processing.

Nanotechnological innovations in the food and agriculture

Nanotechnology is one of the most important tools in modern agriculture, and agri-food nanotechnology is anticipated to become a driving economic force in the near future. Agri-food themes focus on sustainability and protection of agriculturally produced foods, including crops for human consumption and animal feeding. Nanotechnological innovations include encapsulated ingredients that provide protection of sensitive bioactives(e.g., omega-3 fatty acids, vitamins) and increased nutrient delivery, nanomaterials for controlled delivery of anti-microbials, smart sensors for improved food safety management, and nanocomposites for improving barrier properties of packaging materials.

Strategies for improving the sustainability of food systems

Resource management:

- manage food and water scarcity;
- reduce waste, retain, and recover/reuse nutrients within the food chain;
- generate a worldwide compendium of indigenous and traditional raw materials, processing, and preparation methods.

Sustainable processing and improved food delivery

- develop sustainable, efficient, and responsible food packaging, storage, transportation, and delivery systems;
- exploit alternative energy sources and biosystem-based production/processing;
- build sustainable practices into food preparation and processing;
- create flexible, scalable, and appropriate urban food processing, preparation, delivery, and consumption models;
- develop food processes based on PAN (preferences, acceptance, and nutritional needs).

influencing behavior and developing consumer trust:

- encourage sustainable and responsible processing, preparation, and consumption of foods;
- improve transparency and gain consumer trust by providing consumers unbiased information.

Integration along the food value chain:

- reevaluate existing food chains and improve integration along the food supply chain to improve sustainability;

- create a systems approach for the agricultural food chain;
- promote digital transformation and development of a “precision” food chain;
- expand interdisciplinary and intradisciplinary food research and development; and involve multiple stakeholders from agriculture, nutrition, trade, government, and consumer organizations.

Module 3: Waste Management

Circular Economy

The Circular Economy is closely related to the Green Economy.

Research from 2017 explores and describes Circular Economy as "*a regenerative system in which resource input and waste, emission, and energy leakage are minimized by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling* ".

The 3R Concept

Following this definition, it is easy to understand how and why circular economy is used interchangeably with the "3R Concept" in waste management – Reduce, Reuse, Recycle.

Here are a few tips to get you started with each.

Reduce – this is related to simply creating less waste. In doing so you are stopping the problem at the source.

The easiest way to do so is to start looking around and identify items that you can substitute with such that you can use repeatedly, like reusable bags for your groceries, reusable bottles for water and beverages, and reusable boxes for lunch and other meals.

Reuse – this is related to expanding the boundaries of what we described in the previous R. Here reusing may be related to giving away that which you are not using anymore or even repurposing an item for different use. In doing so you are expanding its usefulness and servitude.

Example activities include selling and sharing clothes, children's toys, and any other items that don't serve you anymore and have been gathering dust for the past year and even more.

Recycle – at this point, many people have an intuitive understanding of what recycling means. This is the transmutation of items discarded as waste into new materials and products, with the goal of furthering what we already have instead of more natural, virgin resources.

Of course, waste management and each mentioned concept go way beyond the basics we've just outlined.

For this reason, let us now explore some of these in greater depth.

Definition of waste

Defining waste is more important than one may think. While from a personal point of view this may seem nonessential, it is crucial from the perspectives of government and legislation. A clear understanding of what is and what is not waste, makes it easier to assess the environmental and health risks that may come from different products – this in turn, makes waste management possible.

So, what is waste? Gathered from various official definitions, waste is:

- A substance, object or material
- No longer suited for its intended use
- Directed for recycling or reuse
- Intended to be disposed of or
- Required to be disposed of by law

Classification of waste

Classification of waste depends greatly on national regulations and legislation. That said, most types of classification usually follow one (or a combination) of concepts that use specific questions as a starting point. For example:

- "Who or what generated the waste"
- "What is it made of?"
- "Who handles this type of waste?"
- "How dangerous is it"

Examples of waste classification

Source of Origin

This concept classifies waste by answering "Who or what generated the waste?" For example:

- Construction and demolition (concrete, wood, etc.)
- Household and commercial (municipal solid waste, medical, tires, etc.)
- Agriculture and forestry (organic, pesticides, fertilizers, etc.)
- Wastewater treatment (sewage sludge, chemicals, solid waste, etc.)
- Industry (textile, plastics, chemicals, nuclear, etc.)

- Mining (mine water, waste rock, chemicals, etc.)

Level of Risk

This concept classifies waste by answering "How dangerous is it?" For example:

Non-hazardous waste
Also called "solid waste", represents all types of waste that haven't been classified as hazardous. Solid wastes are products that we often associate with recycling and consider for repurposing: paper, plastic, glass, metal, organic, etc.

Hazardous waste

This type of waste has been generally classified as harmful (either to the environment or to human health). Hazardous waste can also be collected and recycled, but the processes related to that are very different from those associated with non-hazardous waste.

The main characteristics of hazardous waste are toxicity (ingestion or absorption), ignitability (flammable), corrosivity and reactivity (explosiveness or toxic gas release). Examples include:

E-Waste – generally characterized as hazardous because of toxic components. Includes:

- Batteries
- Computers
- Phones

Medical waste – hazardous because it can be toxic, and infectious, containing harmful microorganisms and bacteria. It includes:

- Pharmaceuticals
- Bodily fluids
- Body parts
- Bandages
- Chemicals

Radioactive waste – hazardous because it includes radioactive materials. Handling and managing this type of waste is significantly different from others.

Recyclable, Biodegradable & Compostable Waste

Recyclable

Products that can be collected and reprocessed to produce new items are called “recyclable” products. Common recyclable materials are paper, cardboard, plastic, glass, aluminium, and electronic waste. Just like other eco-friendly practices, recycling aims at diverting waste from landfills.

Identifying Recyclable Products

Most simple paper and plastic products are marked with the universal recycling symbol. However, any complex electrical goods (mobile phones, computers, printers, etc.) can be recycled as well. Some products can be disassembled, and their parts can be recycled, while products like batteries, paints and fertilizers can be further processed to reduce the environmental impact of their disposal.

Biodegradable

'Biodegradable' products are the ones that break down into carbon dioxide, water and biomass within a reasonable amount of time in the natural environment.

However, the term 'biodegradable' has no legal enforcement or definition which leads to manufacturers using it very loosely.

Biodegradability is highly sought in cleaning agents. While conventional cleaning agents usually emit hazardous phosphates and volatile organic compounds (VOCs) when they degrade, biodegradable cleaning solutions do not.

Identifying Biodegradable Products

Biodegradable goods feature a leafy triangle shape on the back of their packaging. This sign is different from the conventional continuous arrow triangle found on recyclable objects. In addition, products have various levels of biodegradability.

Disposing of Biodegradable Products

Biodegradable can be disposed of in your garbage. However, it is essential to highlight that landfills lack the microorganisms and oxygen required for waste to biodegrade in a timely manner. For this reason, it is important to consider minimizing your use of biodegradable items and consider recyclable or compostable alternatives.

Compostable

“Compostable” products are biodegradable bodies that also release valuable nutrients into the soil, enhancing the growth of trees and plants. The most popular composters are industrial; however, personal compostable containers are gaining popularity and finding a place in people’s gardens.

Compostable products are commonly made out of PLA (Polylactic acid), vegetable starch or bagasse (sugarcane fiber). From an eco-friendly perspective, products labeled “compostable” are to be preferred over others that may be labeled “biodegradable.” Compostable products degrade within several months and produce no toxic residues.

Identifying Compostable Products

Compostable products are indicated as “compostable” with a label. (usually found on the bottom or the handle of an item). A product can be labeled as “compostable” only if it is

fully compostable – this requires the item to be certified as such and the evaluation is usually carried out by a third-party company.

That said, it is extremely important to pay attention to the actual text since there are numerous labels that may want you either to believe that the product is compostable or simply indicate that the product is of different nature. Such labels include "biodegradable".

Disposing of Compostable Products

From a personal standpoint, the process of dealing with compostable products is pretty straightforward - you place the products in your compost collection containers, and they get picked up. Items generally decay in 30-120 days, depending on the product size and material. This happens in an industrial composter – for this, a city must have a composting facility.

Alternatively, you can use a home composter in your backyard – keep in mind that in this case, it will take longer for the products to degrade.

If you don't have access to a compost facility or a home composter, your last resort solution would be to dispose of your compostable products in the garbage. The reason being is that compostable items are NOT recyclable yet – if you put compostables into your recycling you will only contaminate the process.

Guide to Recycling and use of Biodegradable and Eco Sustainable Plastics and Products

There are several types of plastic that are considered common. Here they are:

1. **PE (Polyethylene)**
   Collectively, this is the most common type of plastic worldwide. It is classified into three types:

   - **HDPE (High-Density Polyethylene)**

     Considered NOT biodegradable as the process takes a very long time.

     It is recyclable. Also, it can be reused and repurposed utility are limited

     - Milk bottles
     - Shampoo bottles
     - Chemical containers
     - Toys
     - Buckets

   - **LDPE (Low-Density Polyethylene)**

     Considered NOT biodegradable as the process takes a very long time.

     It is not always recyclable – this depends on the regional recycling institutions.

     Its reuse and repurposing utility are limited.

     - Garbage bin liners
     - Plastic bags
     - Films and sheets
     - Landscape timber
     - Bubble wraps
     - Beverage cups
     - Postal Envelopes

   - **LLDPE (Linear Low-Density Polyethylene)**

     Considered NOT biodegradable as the process takes a very long time.

     It is not always recyclable – this depends on the regional recycling institutions.

     Its reuse and repurposing utility are limited

     - Salad bags
     - Cheese wraps

- Protective food films (bread, meat)

2. PET or PETE (Polyethylene Terephthalate)

This kind of plastic is one of the most prevalent types. It is commonly used for food packaging, usually transparent, lightweight, and fabrics (e.g., polyester). It is usually transparent, lightweight and durable.

Clear PET is fully recyclable however, black packaging PET is not yet recyclable.

Health advocates advise NOT to reuse PET products. In addition, it may have some repurposing utility. Examples include:

- Beverage bottles
- Food jars (jelly, peanut butter, etc.)
- Food bottles (dressings like ketchup, mayonnaise, mustard)

3. PVC or Vinyl (Polyvinyl Chloride)

This plastic is harder and more resistant to weathering and chemicals, and it doesn't conduct electricity. These qualities make it a preferred material for building, construction and high-tech application.

It is also impermeable to germs and easily disinfected – because of that, it is often used in health-care equipment and single-use applications that reduce infections. The latter is important, because PVC is also the most dangerous type of plastic to our health, as it leaches toxins through the entirety of its lifecycle.

PVC isn't recyclable, neither is it biodegradable. However, it can be reused or repurposed to create other products. Examples include:

- Credit cards
- Plumbing pipes
- Medical bags
- Medical tubing
- Oxygen masks

4. PP (Polypropylene)

This plastic is more durable, flexible enough and more heat resistant than some others. Because of that, it is usually found in food packaging and storing products, as well as items that are meant to be reheated.

Polypropylene is recyclable, but it is not biodegradable. However, it can be reused or repurposed to create other products. Examples include:

- Food containers
- Straws
- Bottle caps

- Prescription bottles

5. PS or Styrofoam (Polystyrene)

This plastic is rigid, offers very good insulation and is low-cost. For these reasons, it is one of the more preferred materials in the food and construction industries. It is, however, similar to PVC in a way that can be harmful to human health, as it can easily leach toxins that can be absorbed by food.

Polystyrene is recyclable, but it is considered non-biodegradable, as the process takes too. Health professionals advise against reusing it however, the material can be repurposed. Examples include:

- Takeout food containers
- Egg cartons
- Cutlery
- Cups
- Shipping packaging
- Product packaging
- Building insulation

6. Other

The purpose of this category is to encompass any other type of plastic, which doesn't belong to any of the aforementioned types. This is supposedly reflected in its code, and it usually means that this particular type of plastic is non-recyclable (yet). Examples include:

- Eyeglasses
- Clear plastic cutlery
- Baby bottles
- Sport bottles
- Electronics

Landfills

Green economy and sustainable development are continuous endeavors - the final destination for lots of waste is still landfills. This doesn't mean that landfills aren't elaborate and something that is also under the umbrella of continuous improvement and worth understanding.

What is a landfill?

A landfill site is an area of land that has been specifically engineered to allow for the deposition of waste onto and into it.

What is the difference between a landfill and a dump?

A landfill is a government-regulated place where waste is treated, monitored and properly layered. A dump is most often an illegal site where people take their trash that is unregulated and poses a risk to the environment.

What Are the 4 Types of Landfills?

There are currently three standard landfill types – each designed to accept and handle specific types of waste. In addition, there is a fourth, currently emerging, type of landfill that allows for the controlled disposal of organic materials.

1. Municipal Solid Waste Landfills

If you throw it out in a garbage can, chances are that your trash ends up in a municipal solid waste (MSW) landfill. These sites are typically what come to mind when you think about a landfill.

2. Industrial Waste Landfills

If it sounds like this landfill is self-explanatory, that's because it is. An industrial waste landfill is where industrial waste is disposed of.

Items often brought to industrial landfills include:

- Concrete
- Lumber
- Asphalt
- Gypsum
- Metal
- Bricks
- Building components (doors, countertops, cabinets, etc.)

3. Hazardous Waste Landfills

For important reasons, hazardous waste landfills are the most closely regulated and structured landfills. They are specifically designed to hold hazardous wastes in a way that virtually eliminates the chance of them being released into the environment.

Some of the design requirements for hazardous waste landfills include:

- Double liners
- Double leachate collection and removal systems
- Leak detection systems
- Run on, runoff and wind dispersal controls
- Construction quality assurance programs

4. Green Waste Landfills

Many municipalities are starting to offer a place for organic materials to naturally decompose. These composting sites are on the rise because most standard landfills and transfer stations are not as accepting of organic materials like fruits, vegetables, and, in particular, yard waste disposal.

Since these landfills are still not officially sanctioned by the EPA, some transfer stations will accept it, others only partially or not at all – it all depends on your local municipality.

- Common types of green waste include:
- Mulch
- Weeds
- Leaves
- Tree branches
- Biodegradable food waste
- Flowers and grass trimmings

Typical Anatomy of a Landfill

Technologies used in most landfills are similar, however, the exact sequence and type of materials may differ from site to site depending on design, location, climate and underlying geology. That said, here are the most common elements of a landfill:

Protective Cover

1. COVER VEGETATION

   As sections of the landfill are finished, native grasses and shrubs are planted, and the grounds are kept open. The vegetation is visually appealing and helps to keep the underlying soils from eroding.

2. TOP SOIL

   Top soil promotes and sustains plant growth by retaining moisture and supplying nutrients.

3. PROTECTIVE COVER SOIL

   The protective cover soil shields the landfill cap system while also retaining moisture to maintain the covering vegetation.

Composite Cap System

1. DRAINAGE LAYER

   A geonet, which is a layer of sand or gravel or a thick plastic mesh, drains excess water from the protective cover soil to improve stability. It also helps with preventing water penetration through the landfill cap system. To separate solid particles from liquid, a geotextile fabric similar to felt may be placed on top of the drainage layer. This keeps the drainage layer from becoming clogged.

2. GEOMEMBRANE

   A thick layer of plastic forms a cap, keeping excess precipitation out of the dump and preventing leachate. This layer also keeps landfill gas from escaping, reducing odours.

3. COMPACTED CLAY

   When the landfill reaches the authorized height, compacted clay is laid over the rubbish to form a cap. This layer keeps excess precipitation from entering the landfill and creating leachate, as well as preventing landfill gas from escaping and causing smells.

Working Landfill

1. DAILY COVER

   At the end of each working day, the waste is covered with six to twelve inches of soil or other acceptable material. This daily treatment lowers smells, stops litter from spreading, and deters scavengers.

2. WASTE REDUCTION

   In order to reduce the amount of space that waste takes up, it is compacted within layers. This practice also lowers odors, keeps litter from spreading, and discourages scavengers.

Leachate Collection System

The liquid that has penetrated into the landfill is called leachate. Precipitation is the primary source of leachate, with natural waste decomposition playing a small role. The leachate collecting system captures leachate from the landfill so that it may be treated

or disposed of properly. Such leachate collecting system is made up of the following parts:

1. LEACHATE COLLECTION LAYER

   A geonet is a layer made of either sand, gravel or a strong plastic mesh that catches leachate and allows it to drain to the leachate collection pipe system with the help of gravity.

2. FILTER GEOTEXTILE

   To separate solid particles from liquid, a felt-like geotextile fabric may be placed on top of the leachate collecting pipe system. This keeps the piping system from clogging.

3. LEACHATE COLLECTION PIPE SYSTEM

   With the help of perforated pipes and a gravel bed as a base, leachate is transported to specifically created low spots called sumps. Pumps located inside the sumps mechanically extract the leachate from the landfill and then carry it to the leachate management facilities for treatment or another suitable means of disposal.

Composite Liner System

1. GEOMEMBRANE

   A thick plastic layer forms a liner that prevents leachate from leaving the landfill and entering the environment. This geomembrane is usually made using high-density polyethene or HDPE. This special type of plastic is extremely resistant and impermeable to the chemicals that might be in the leachate. This layer also helps to prevent the escape of landfill gas.

2. COMPACTED CLAY

   This clay serves as an extra barrier to stop both leachate and landfill gas from escaping and entering the environment. It is located directly below the geomembrane.

3. PREPARED SUBGRADE

   Before starting construction on the landfill, the native soils beneath it are prepped as necessary.

Zero waste strategy for green supply chain management (GSCM)

"Zero waste is the conservation of all resources by means of responsible production, consumption, reuse, and recovery of products, packaging, and materials without burning, and with no discharges to land, water, or air that threaten the environment or human health."

Zero Waste International Alliance (ZWIA)

A zero-waste supply chain embraces a redesign of the resource lifecycle, evaluating every step to ensure that each product is reused or recycled. A Zero-waste strategies emphasize overall waste prevention and seek to change the way materials flow through the entirety of the production pipeline.

Waste-to-Energy plants burn household and similar waste that could not be prevented or recycled. From this incineration process the plants recover energy. This can be in the form of steam, electricity or hot water. The electricity is fed into the grid and distributed to the end-users; the hot water, depending on local infrastructure can be sent to a nearby district heating (or cooling) network to heat (or cool) homes, hospitals, offices etc., and the steam can be used by the nearby industry in their production processes. Waste-to-Energy is a hygienic method of treating waste, reducing its volume by about 90%.

Modern European Waste-to-Energy plants are clean and safe, meeting the most strict emission limit values placed on any industry set out in the EU Industrial Emissions Directive.

- It turns the non-recyclable waste into secure energy and valuable raw materials in an environmentally safe manner.

Waste-to-Energy helps reach the targets set in the **EU Landfill Directive** that aims to reduce the amount of waste being landfilled (Benefits of diverting waste from landfills).

Waste-to-Energy and **Recycling** are complementary waste treatment methods in integrated waste management systems. Household and similar waste should be sorted at source and the clean materials should be sent to high quality recycling. The remaining waste, that cannot be recycled in a technically or economically viable way, should be used to generate energy.

- It keeps the circle clean by dealing with unwanted components in the material cycles (act as a pollutant sink, fulfilling a hygienic task for the society).

Is Waste-to-Energy helping or hindering climate protection?

1 - Substituting fossil fuels with a partly renewable alternative. Residual waste is a local and secure source of energy that can work. It has a key role to play in phasing out fossil fuels and decarbonizing the electricity and heat sector, especially where district heating and cooling infrastructures are in place.

2 - Reducing methane emissions by diverting waste from landfill. A recent UN Report suggests that the waste sector offers the largest potential in Europe for mitigating methane emissions and that methane mitigation is arguably the strategy with the greatest potential to decrease global warming over the next 20 years.

To put this into perspective, over a 100-year period, the global warming potential of methane is 28 times higher than that of CO2. ; over a mere 20-year period this figure soars to 86 times higher.

3 - Recycling metals and minerals from bottom ash that is left over from the incineration process.

Identifying effective levers that enable products to contribute to the transition to a circular economy, requires analysis of the complex and non-linear relationships between many economic system drivers:

(1) shifting from product-based to service-based business models

(2) making additive manufacturing and the Internet of things work for product circularity

(3) aligning policy instruments throughout a product's life-cycle.

Learning to identify and observe key mechanisms, as well as landscape, regime and niche trends relevant to product circularity, is a key asset in developing the knowledge base on the circular economy.

It enables the design of more appropriate ways to monitor the transition, and to take action that has a higher probability of leading to change in the right direction.

Module 4: Supply Chain Management

You now have a better understanding of what different environmental economies stand for, plus some of the foundational types of waste and sustainable solutions. Next, we are going to explore how all these things can be brought together and optimized in a supply chain.

What is a (sustainable) supply chain?

A supply chain is the network of all the people, businesses, resources, tasks, and technological advancements involved in the production and distribution of a good.

An entire supply chain, from the distribution of raw materials from the supplier to the producer to the final delivery to the customer, is included.

Naturally, a supply chain is considered sustainable when it completely integrates ethical conduct and environmental awareness into a profitable and competitive paradigm.

In the following pages, you will find a step-by-step guide that outlines all the major points that sustainable supply chain management has to take into account.

Step 1 | Mapping the supply chain

In order to make adjustments to a supply chain, you need to see what happens and where it happens. That's why, before anything else, you want to make a map with your supply chain where you can see the connections between activities.

What should your supply chain map include?

1. **Process**

   A supply-chain map can include 2 types of processes:

   - Upstream production processes, which describe the activities related to gathering all raw materials for creating a product (but not the creation of the product).

   - Downstream production processes, which describe the activities related to how the collected raw materials are treated and transformed into the final product, including distribution, wholesaling and retailing.

2. **Chain**

   Each process should include both direct supplier activities and sub-supplier activities.

   - If the process describes upstream production in the engineering sector, this will describe the activities related to gathering the natural resources necessary for manufacturing certain parts.

   - If the process describes downstream production in the engineering sector, this will describe the activities related to the actual manufacturing of these parts.

3. **Aspects**

   Each activity can have a positive and/or negative impact on people and the environment This will give you the perspective on things that need your attention. Those effects (both positive and negative) are called "aspects" – put those in the map as well. For example:

   - Emission of air pollutants

   - Heat dissipation

   - Cold dissipation

   - Substance release

   - Soil enrichment

4. **Impact**

Once you have your aspects mapped, describe their impact as well (i.e., the aspect describes "what" is the result of a given process in your chain, while the impact describes "how" the process influences the surrounding environment). For example:

- Water pollution (aspect) can lead to severe health issues (impact)

- Air pollution (aspect) can lead to supply disruption after exceeding limit values for air pollution prevention (impact).

How to choose what to map?

Mapping your supply chain may feel overwhelming at first, that's why you need to have a strategy – here's a set of steps to help you get going until you find your own rhythm.

1. Prioritize

Consider which processes and activities you map first. Here are some criteria to help you start:

- Procurement costs on products and services

- Sales volumes of products and services

- Raw materials and components when working with lots of similar products.

2. Categorize

One of the most influential factors in a supply-chain is location. Put together your activities based on the locations of suppliers and sub-suppliers. You may find that some of them are positioned in a way that would allow them to batch and deliver goods more productively and environmentally-friendly.

3. Analyze

If you are working with direct suppliers of parts, then you are also working with suppliers of raw materials, just indirectly. This is why it is always a winning strategy to do research and gather information on sub-suppliers i.e. - the activities and supply chains that go beyond your own direct suppliers. These may include raw material extraction, as well as raw material processing companies. Extending your research may allow you to get direct access to materials and services that seemed off-limits before, which may lead to lower production costs; shorter, more direct supply chains, and as a result - less risk of negative impact on the environment.

4. Collecting information

With all previous steps described, the two big questions are "where to start gathering all this information" and "what questions to ask". Here are some suggestions about that.

FIND INFORMATION

There are two ways to go about gathering what you need:

- Internal – check in with people within your own organization who can provide you with what is already available for both the supply structure and each supplier (both direct and sub-suppliers) Consider the people work in:
    - Acquisition
    - Development
    - Quality assurance
- External – similar to the organization you work for, all other companies should have their supply chains mapped, so consider reaching out and asking them to provide you with it. If they don't have their supply chains mapped, offer to work on it together.

  Industry associations and initiatives are another great source of information. Consider reaching out and see what they can provide regarding supply chain standards for the industry.

GATHERING INFORMATION

Once you connect with the right people and institutions you need to know what to ask, here are some suggestions:

- What are the upstream/downstream steps in value creation (products, services)?
- Who are the suppliers (from direct suppliers all the way to raw material producers)?
- Which activities take place within the supply chain?
- Where do production and services originate?

Step 2 | Identifying impact, risk, and areas of action

Once you map your supply chain there are three sustainability areas that will require your attention:

- ✔ Compiling the company's sustainability aspects and impacts – this is a rather rough assessment of the effects that the company has on the environment.
- ✔ Assessing and prioritizing the company's sustainability risks – based on the aspects and impacts analysis the company grades and prioritizes the risks related to the environment, the people, and the company itself.
- ✔ Selecting the topics and areas of action – b ased on all previously done analysis the business puts together a plan for the implementation of a better, more sustainable supply chain process in the most important areas.

Let's take a look at each of these steps in greater detail.

1. Compiling sustainability aspects and impacts

Organize and prioritize all sustainability aspects and impacts

You've already outlined the aspects and impacts when you were mapping your supply chain. What you need to do now is put all aspects and impacts into a table.

This will then help you to perform a materiality analysis and prioritize aspects and impacts based on their potential sustainability effects.

Finding information for your materiality analysis

Just like everything else, there's a lot of information available for you to use – you just need to know where to look. Here's where you can start:

- YOUR ORGANIZATION – the people who you talked to about the supply chain map are the same people that can have information for the analysis as well. Consider talking to them directly. For more massive results, consider using surveys that would contain the same questions you'd otherwise ask face-to-face .
- INFORMATION EXCHANGE – see if you can gather that same information from direct suppliers and sub-suppliers as well. In return, offer the information that you already have about your own organization.
- WORK WITH THE INSTITUTIONS – reach out to NGOs, industry associations, research institutions and data centers, as these can too provide you with valuable information.
- LOOK AT THE DOCUMENTS – whether you find yourself limited and unable to get in touch with those institutions directly, there's no reason not go through the papers, research and other materials that they've published and find relevant information.

2. Assessing and prioritizing sustainability risks

Using the gathered information about sustainability aspects and impacts, you can evaluate the risks they may present for people and the environment and strive to act preventively.

Risk probability and magnitude

Risk assessment and prioritization are directly linked to two other concepts – risk probability and risk magnitude.

Assessing risk magnitude strives to answer the following two questions:

- What is affected?
- To what extent is it affected?

Assessing risk probability is also related to two main questions:

- What is the likelihood of this event or process to occur?
- What are the things that can increase or decrease the likelihood of this to occur?

Key risk factors

The number of factors that help you evaluate both the probability and magnitude of a given risk can be plenty. Whatever the case may be, the following are always a good idea to consider:

- INDUSTRY – each industry has its different risks and impacts. At the same time, the risks and impacts for each industry are well-known within its confines – make use of that next time you want to evaluate potential risks.
- SUPPLY CHAIN STRUCTURE – the value of supply chain mapping comes from the traceability and transparency that offers about everything along processes. Conversely, the lack of transparency and traceability can be the prerequisite of unknown risks, with both unknown probability and magnitude.
- COUNTRY – risk potential is great in those countries that either don't have the necessary sustainable laws or where those laws are not respected. Consider familiarizing yourself with the environmental legislations and human rights regarding sustainability in your country, as well as the countries of your suppliers.

Risk prioritization

One of the most popular and effective risk evaluation techniques is to ask all people involved in the risk evaluation process to provide their own assessment. The process is pretty straight forward:

- On a scale from 1 to 5 each person provides their own score of both Probability and Magnitude, for each risk that you've previously identified.

- Then, you add together the scores provided by participants for each identified risks, getting a total for both Probability and Magnitude.

- Based on the Probability and Magnitude of risks you can now compare them and decide which would require most attention.

Following these relatively simple processes you probably already realize that it is important who is involved and how the evaluation is conducted. Consider involving multiple subject matter experts, and make sure that each party provides their scores anonymously – this will ensure that no one gets influenced by the opinion of their peers (regardless of their expertise).

3. Selecting the topics and areas of action

Once you have your list of risks organized and prioritized you will need to identify which field of sustainability the top risks belong to – this will help you devise your action plan.

Lots of the described process is performed following certain standards, that are designed to make all work and processes much easier. If you are new to this line of work or looking for ways to fortify and organize some of the knowledge you already have, then exploring the standards in your industry would be of great help to you.

Step 3 | Analyzing gaps and deriving measures

Company goals are rarely related with starting something from complete zero. It is more often associated with closing the gap between what an organization is already doing and what it wants to accomplish further.

This is why, it is just as important to now analyze the current supply chain activities, as it was to set the right conditions for their development in the previous two steps. Here's where you can start.

Impact-based actions

Previously, we've looked at different aspects of impact that our supply chain can have on the environment and people. Now, let's talk about the measures (actions) that a company can follow to reduce negative impact and avoid risk. Since they can be both internal and external, here are some examples of both:

- The very first thing you can do is to have everyone in the organization periodically trained and updated on matters related to environmental responsibility and sustainability.

- Similarly, you can provide sustainability training offers for your suppliers and sub-suppliers.

- Stay updated on sustainability initiatives in your industry and join the ones you can. Also, you can invite your suppliers and sub-suppliers to do the same and participate together.

- Establish an auditing processes for direct suppliers and formulate a code of conduct that they need to comply to in their work with you.

- Make sure to always have risk related information actualized and record all sustainability-related data.

Prioritizing actions

Just as the popular saying goes "true change always starts from within", if all this whole process is very new to you, then the same holds true for sustainability performance. If sustainability performance is something very new to you, then it is better to focus on your internal supply chain questions first. Usually, those first areas of action include the following:

- Checking central business processes and setting up ongoing processes for sustainable supply chain management.

- Informing suppliers, defining requirements, and seeking self-assessment.

- Reviewing sustainability performance of suppliers.

- Developing suppliers (e.g., providing training).

- Disclosing information on the state of sustainability in the supply chain.

Step 4 | Adapting internal structures and processes

New and existing business processes within the company are set up or adjusted based on the results of the materiality analysis and the inventory. It is also necessary to provide the financial, human, and technical resources required to lay the internal foundations for sustainable supply chain management.

In order to achieve goals and implement measures within the company, competent employees and free resources are needed.

If supply chain management is aligned with sustainability issues, new links between different departments and employees can arise. Companies should promote internal exchange and, in cooperation with the colleagues involved, determine necessary procedures and responsibilities.

How to establish sustainable supply chain management in the company

Having a clear responsible figure or entity can make things much easier for the whole organization to learn and implement new sustainability changes. So, make sure that there's always someone for people to turn to for next steps and solutions. This could be an expert, a manager or team with extended knowledge in everything related to supply chain sustainability.

In addition, there could be people from other teams or departments that are not in charge of managing your new sustainable solutions, but they might be responsible for a specific part of their implementation.

For this reason, it is important for all people to establish strong relationships with those who are involved with the management of supply chain sustainability.

Remember that every organization is a collective of individuals – as such, it is valuable to consider what drives people and motivate them to continuously implement the sustainability solutions you have. Here are some solutions to consider:

- Use what you have.

  Adding sustainability to the existing rewards and sanctions systems is one solution.

- Get competitive.

  You can also go beyond that, by considering sustainability competitions where teams and individuals can participate.

- Aim for the high-score

  Pursuing good sustainability ratings or passing on positive customer or stakeholder feedback.

Step 5 | Formulating supplier requirements

Throughout this phase of the procedure, the organization develops a code of conduct. It outlines the process for creating and sending requirements to vendors. So the main topics of discussion are the code of conduct and how it may be applied to the supplier relationship.

The code of conduct should refer to both general and specific international standards and norms. It may also include local laws and regulations related to production – this can be particularly useful, as you won't have to come up with new rules for procedures that have already been established as such. It also helps with unifying the requirements for all suppliers.

International standards, especially in industry- and product-specific variants, simplify requirement formulation for suppliers. Which standards you are going to refer to in your code will depend on your industry. Here are some of general ones to consider the following consider:

- International Bill of Human Rights
- International Labour Organization (ILO) core labour standards
- UN Ten Principles of the Global Compact
- OECD Guidelines for Multinational Enterprises
- ILO Tripartite Declaration of Principles concerning Multinational Enterprises and Social Policy
- ISO 26000: Guideline for social responsibility
- UN Guiding Principles on Business and Human Rights
- OECD Convention on Combating Bribery of Foreign Public Officials in International Business Transactions/UN Convention against Corruption

Code structure

Codes of conduct are all similar in structure. They frequently consist of:

- **Introduction**

  It summarizes the mission statement and references relevant international standards. It may also specify the duties of the direct supplier, such as passing the code on to sub-suppliers and/or being willing to participate in audits.

- **Supplier requirements**

  These are often broken down into sectors such as environment, social, and governance. Any individual requirements can cross-reference valid standards (such as the ones already listed).

- **Supplier understanding and consent**

Suppliers confirm with their name and the signature of a representative that they have read and accepted the code.

Zero-Tolerance Range

Often standards present a range of actions or performances that the entity should aim not to exceed or fall under – that range is what we refer to as "tolerance".

That said, there are also standards for which any form of deviation is unacceptable – hence being called "zero-tolerance". Examples of such norms include child labor, human trafficking and deforestation of virgin forests. The previously listed standards can guide you as to which zero-tolerance norms apply to your industry.

It is important to make sure that your suppliers are well-acquainted with these, as well as the consequences that come from their infringement.

Making the code of conduct binding

The company should make the requirements of the code of conduct a binding part of its relationship with direct suppliers. Here are some examples on how to do that:

- Require that your suppliers sign the code of conduct and commit to its implementation.
- Integrating the code of conduct in the very contract of the supplier.
- Consider making the supplier's contract binding in such a way that it requires sub-suppliers to comply to the code as well.
- Make the code accessible to all your employees and require the same from your suppliers:
    - Language barriers can be overcome by translating the code
    - Distribution can be overcome by making webinars or trainings that aim to familiarize everyone with the code's content
    - Keeping a copy of the code available in your database for everyone to reference can further facilitate commitment.

The code is the first and most fundamental measure that a company should establish. If accepted by all parties, it is the basis for understanding upon which a company bases its own and collaborative action, evaluates progress, and plans long-term cooperation.

Step 6 | Evaluating the sustainability performance of suppliers and building competencies

Once the formal compliance with your code of conduct and sustainability compliance measures have been signed, it is important to ensure that all agreed-upon rules and standards are also followed in practice.

This is why it is quintessential to continuously evaluate the performance of your suppliers, support them in their supplying capabilities and further develop your criteria for supplier selection and confirmation.

Here's how you can do each of these things.

Assessment strategies

SUPPLIER SELF-ASSESSMENT

Companies can easily use the supplier self-assessment to acquire a general overview of the supplier's strengths and shortcomings. By responding to a questionnaire, individuals may determine how much they satisfy the standards. Think about the following inquiries:

- Responsibility for sustainability management and compliance with certificates and standards
- Certification in environmental topics (such as EMAS, ISO 14001), labour standards (for example SA 8000)
- Adherence to non-certifiable standards (such as principles of the UN Global Compact or ISO 26000)
- Participation in multi-stakeholder and industry initiatives
- Internal sustainability-relevant measures and management processes that prevent negative impacts on the environment and society, for example by means of relevant indicators
- Results of the previous audits as well as information on the type, extent, and conductor of the audits
- Sub-supplier commitments, for example in the form of their own codes of conduct.

AUDITS

Audits go a step beyond the supplier's self-audit and represent an on-site evaluation and can be performed either by a representative of your own organization or by an external, third-party entity.

An audit is carried out on the basis of specific requirements recorded in audit reports. Naturally, these reports will be based on your code of conduct and/or other management system standards such as the EMAS.

No matter the specifics, an audit should include the following core components:

- Discussions with management: Corporate policy and implementation, use of management systems, salaries, working hours, et cetera.
- Discussions with employees: Possible topics include working conditions, resource use, gender equality, etc. Discussions should be carried out with a representative number of employees.
- Site inspections: Visually assessing the locations for visible violations.
- Document evaluation: Checking personnel files, documents on health and safety, information on working hours, data on emissions, material and energy consumption.

Supplier capability development

Whether an audit or self-assessment revealed a violation or space for improvement, an action plan must be made. The objectives and timeframe of corrective action plans should be precisely stated, and clear review indicators should be established. Keep in mind that this is only feasible if the supplier is open and willing to cooperate, and your business has the necessary influence. If this is not the case and the violations are severe, ending the business partnership and switching suppliers should be taken into consideration.

In order to assure a longer-lasting effect, any short-term adjustments might be paired with medium- and long-term ones. These are what they include:

- supplier education (on relevant sustainability standards and requirements)
- technical assistance with process improvement (for example for reducing emissions)
- putting supplier pilot initiatives into action (for example introducing environmental management systems)
- working with suppliers to conduct materiality evaluations.

Evaluation strategies

While supporting our suppliers in their sustainability endeavours, we should also keep our own development intact. This ensures that we are working with the right suppliers and we are holding both ourselves and our suppliers updated and accountable to the right standards.

Our own self-assessments and materiality analysis are what can tell us if we are working with the best suppliers for us – new and existing ones alike.

Furthermore, in addition to more standard supplier requirements like price, quality and time for delivery, you can add social and environmental standards that are aligned with your supply chain sustainability goals.

Step 7 | Reporting

This step is all about sharing information about everything you learn, do and further unravel regarding your sustainable supply chain management activities.

Who do you communicate that information to? Well, this is where we bring the process full circle, as the very people who were involved in planning and putting your sustainability efforts into motion would be the first interested to learn more about your progress in success i.e., your stakeholders.

Here are some existing indicators to consider:

- Number of pollutant tests
- Proportion of rejected products
- Average duration of supplier relationship

Of course, a company can change and adapt indicators to better fit your specific supply chain goals. Here are some resources to consider referring for identifying more specific, relevant measures:

- The Global Reporting Initiative (GRI) Sustainability Reporting Standards
- The German Sustainability Code (DNK)
- The Environmental, Social, and Governance (ESG) KPI (Key Performance Indicators) Catalogue of the European Federation of Financial Analysts Society.

Sample Strategies for Agri Supply Chains

Depending on the local circumstances and requirements variations of three general strategies apply for organizing agri-supply chains:

- **Chain differentiation**
- **Integral chain quality assurance**
- **Chain process realignment**

Chain Differentiation

Chain differentiation refers to setting up supply chains in order to respond to the demands of specific market segments. Emerging markets are continuously making new demands on food products and service, thus setting new demands on the suppliers of these products.

Consequently, the chains of production must differentiate in order to satisfy consumer demands.

Integral chain quality assurance

The quality and safety of food are becoming more and more important dictators of consumers' choice. Good Agricultural Practices and Integrated Pest Management are examples of such new standards.

Things that enable agro-industrial companies and retailers to assure the quality and safety of food include **Integral chain quality assurance** concepts as well as setting up **tracking** & **tracing** systems.

Chain process realignment

Markets are becoming increasingly competitive. As a result, chain reconfiguration and process re-engineering.

It becomes necessary to seek sources of competitive advantage which are based upon cost reduction, cycle time improvement, postponement of value-added and asset productivity gains and customer value driven initiatives.

4 Steps for Setting Up Agri Supply Chain Projects

Efforts to improve supply chain development should be based upon pilot projects that serve to identify and refine the most practical methods. A typical pilot project consists of a project cycle made up of four phases:

- **Orientation/Analysis**
- **Definition**
- **Implementation**
- **Monitoring and Evaluation**

1. Orientation/Analysis

The first step in a typical supply chain development project consists of an analysis of the problems in the chain, the identification of the players and the ambitions of these players.

Questions that should be answered in this phase include:

- Who are the players in the supply chain, what are their roles, competencies and relationships?
- Who will be the selected project partners?
- What are the stakeholder perceptions in terms of definitions and ambitions?
- What is the existing technology and what are the organizational drivers and needs?
- What are the quality categories and what are the existing quality monitoring systems?

2. Definition

The insights gained in the orientation phase have to be translated into strategies and an action plan. Questions that should be answered in this phase should be related to the project's:

- Goals
- Objectives
- Activities
- Risks
- Schedule and planning

- Budget and financial arrangements
- Partners specific contribution

3. Implementation

After mutual agreement upon the plan by all the stakeholders. The execution should take place in time and according schedule. Special attention is needed for knowledge transfer and training.

Within the supply chain partners have to become acquainted with new concepts like:

- Chain marketing
- Logistics
- Quality control
- Certification
- Tracking & Tracing

4. Monitoring and Evaluation

In this phase the implemented adaptations are finished and have to be evaluated. It involves the testing of the results of the project and the readjusting of phase 1 so that new challenges can be faced.

Monitoring

Ongoing monitoring also includes quantitative aspects and qualitative aspects. Quarterly financial reports can illustrate the economic progress of the program.

Questionnaires to be answered by the various stakeholders (project leader, research institutes, companies), can shed a light on matters like:

- Positive experiences in the project
- Reasons/factors that affected the project
- Grading of stakeholders performance on aspects like: vision on project goal, commitment to
- The project, openness to other project participants
- Most important lessons learned
- Commitment to future participation

Evaluation

Agri supply chains function within dynamic environments and ought to be responsive to new challenges, thus agri supply chain development should be considered as an ongoing cyclical process.

The evaluation phase should cover questions like:

- Have the set objectives and targets been reached?
- Have the results been achieved in time?
- Have the activities been carried out within the proposed budget constraints?
- If not, what was the reason for the deviation?
- Will the supply chain strategy be the same in the next 5 to 10 years?
- What kind of new challenges and problems do we face?

Reverse Logistics

Reverse logistics refers to supply chain management that delivers things back from customers to vendors or manufacturers. After a client receives a product, reverse logistics operations such as returns or recycling are required.

By converting waste into sales, reverse logistics add value and nurtures customer loyalty. Businesses reuse, recycle, and sell returns. Reverse logistics that works reduces distribution and storage expenses as well.

Following are a number of different types of reverse logistics, followed by specific steps and strategies to develop better reverse logistics.

Types of Reverse Logistics

The various types of reverse logistics are referred to as reverse logistics components. They take into consideration remanufacturing, packing, unsold items, and delivery concerns and concentrate on returns management and return policies and procedures (RPP). Some forms of reverse logistics include leasing, maintenance, and product retirement.

Returns Management

This procedure deals with consumer product returns or preventing returns from happening in the first place. Re-returning an item means doing so a second time. Re-returns can also happen when a seller rejects a return and sends the item back to the buyer without issuing a reimbursement.

Return policy and procedure (RPP)

The RPP of a corporation consists of the return rules that it discloses to customers. These policies must be clear and consistent. Employees should also adhere to them.

Remanufacturing or refurbishment

Remanufacturing, refurbishing, and reconditioning are all examples of reverse logistics management. These processes involve product repair, rebuilding, and reworking.

A process called cannibalization of parts refers to the practice of businesses recovering interchangeable, reusable components or resources from other goods. It entails disassembling, cleaning, and reassembling things to recondition them.

Packaging management

This type of reverse logistics focuses on the reuse of packing materials in order to reduce waste and disposal.

Unsold goods

This kind of reverse logistics is in control of returns of unsold products from retailers to manufacturers or distributors. These returns might be the consequence of poor sales, out-of-date merchandise, or a delivery refusal.

End-of-life (EOL)

When a product is no longer functioning or useful, it is deemed to be EOL. The item may no longer meet the consumer's needs or may be replaced with a better, more recent model. Manufacturers regularly recycle or dispose of end-of-life products. As a result of these, manufacturers and governments may experience environmental challenges.

Delivery failure

If a delivery fails, the products are returned to sorting facilities, from where they are delivered back to the facilities that they came from in the first place.

Rentals and leasing

The firm that owns the product has the option to resell, recycle, or redeploy equipment for the lease or rental agreement.

Repairs and maintenance

Some product agreements require consumers and corporations to maintain or repair equipment as needed. In certain cases, the company sells brand-new consumers on fixed, defective returned items.

5 Steps to Effective Reverse Logistics

1. **Finish the Return**

When a consumer signals that they want to return an item, the return process begins. This step should indicate the product's condition and authorize returns. This method also includes scheduling return shipments, approving refunds, and swapping defective products.

2. **Take care of returns**

When a returned item arrives at your location or the centralized processing center, inspect it to determine what type of return it is. Sort things into the following categories: repair, resale as new, resale as a return, recycle, scrap, or refurbish. (Note: If your reverse logistics are optimized, you should know where the things are going before they arrive.)

3. **Move the returns forward**

You may reduce your daily waste by delivering fixable items to the repair department.

4. **Repair**

After checking the returned item/equipment and assessing if it can be repaired, move it to the repair area. Sell any parts that can be sold if possible.

5. **Recycle**

Send any items or components that you are unable to repair, reuse, or sell to a local recycling center.

7 Strategies to Optimize Reverse Logistics

1. **Examine the relevant laws and agreements**

Examine and update your company's policy on returns and repairs. These rules must be exact and take into account the primary causes for returns and repairs. The return and repair policies of a company may set it apart from competitors.

2. **Collaborate with Vendors**

Working closely with suppliers may ensure that clients get a smooth, integrated experience rather than one that is difficult to navigate.

3. **Make use of data to simplify operations**

By collecting return data, you may learn about the possible causes of product returns. After that, you may make changes to your sales, product design, and forward logistics processes as needed.

4. **Track products forward and backwards**

When you link raw materials to finished items and client orders, you can track ingredients in case you need to manage recalls; instead of issuing them for the entire line, you may find the problem and issue recalls selectively.

5. **Centralize Return Centers**

With a centralized return center, you can more effectively sort things and choose the best course of action for each one. Businesses with a core may more efficiently select how to recoup product value. If your company lacks the resources to run a separate returns center, consider assigning a portion of your warehouse or factory to returns.

6. **Examine Transportation and Logistics**

On a regular basis, go through the forward and reverse logistics and transportation methods. Examine the feasibility of integrating some of these processes with transportation. If your delivery drivers can pick up empty pallets as well as deliver full pallets, you can save trips, time, and money.

7. **Automate**

To help organize your firm, use cloud-based logistics solutions. A software solution, for example, may oversee refurbishment, track asset recovery, and provide business intelligence analysis.

Cold Chain

One of the most fundamental challenges for a company is to make sure that their food products remain at a safe temperature at all times.

As a result, every supply chain needs a parallel cold chain, ensuring that all food products are grown, processed, packaged, stored, transported, and then sold to remain at an appropriate temperature for the duration of their whole journey.

How the cold chain works

Most products must enter the cold chain as soon as they are harvested. This is done to maintain not only the good but also the natural life, quality and safety of the shelf.

This requires a minimum of two cold storage solutions that comply to the necessary temperature standards:

- An onsite cold storage
- A cold storage transport

The same applies for manufactured goods, like pharmaceuticals and processed goods. A significant proportion of manufacturers and retailers use the services of cold chain logistics providers specialists, which provide transport for their products and storage.

Some products go straight to export or to retail facilities still, but this doesn't dismiss the necessity for cold chain solutions (both for transport and storage). The same holds true for export, regional and local distribution, retail or home purchases. Each route and place where the goods need to reside requires a cold solution.

Big Data & Agriculture

To optimize reverse logistics, companies need cohesive strategies that account for speed, efficiency and cost. When taking action, consider policies, partners, data, capacity, logistics and transportation.

Big Data

Put simply, big data is larger, more complex data sets, especially from new data sources.

These data sets are so voluminous that traditional data processing software just can't manage them. But these massive volumes of data can be used to address business problems you wouldn't have been able to tackle before.

The Three Vs of Big Data

Volume

The amount of data matters. With big data, you'll have to process high volumes of low-density, unstructured data. This can be data of unknown value, such as Twitter data feeds, clickstreams on a web page or a mobile app, or sensor-enabled equipment. For some organizations, this might be tens of terabytes of data. For others, it may be hundreds of petabytes.

Velocity

Velocity is the fast rate at which data is received and (perhaps) acted on. Normally, the highest velocity of data streams directly into memory versus being written to disk. Some internet-enabled smart products operate in real time or near real time and will require real-time evaluation and action.

Variety

Variety refers to the many types of data that are available.

Traditional data types were structured and fit neatly in a relational database. With the rise of big data, data comes in new unstructured data types.

Unstructured and semi-structured data types, such as text, audio, and video, require additional preprocessing to derive meaning and support metadata.

Big Data on the Farm

Feeding a Growing Population

This is one of the key challenges that even governments are putting their heads together to solve. One way to achieve this is to increase the yield from existing farmlands.

Big data provides farmers granular data on rainfall patterns, water cycles, fertilizer requirements, and more. This enables them to make smart decisions, such as what crops to plant for better profitability and when to harvest. The right decisions ultimately

improve farm yields.

Using Pesticides Ethically

Administration of pesticides has been a contentious issue due to its side effects on the ecosystem.

Big data allows farmers to manage this better by recommending what pesticides to apply, when, and by how much.

By monitoring it closely, farmers can adhere to government regulations and avoid overuse of chemicals in food production. Moreover, this leads to increased profitability because crops don't get destroyed by weeds and insects.

Optimizing Farm Equipment

Companies like John Deere have integrated sensors in their farming equipment and deployed big data applications that will help better manage their fleet.

For large farms, this level of monitoring can be a lifesaver as it lets users know of tractor availability, service due dates, and fuel refill alerts. In essence, this optimizes usage and ensures the long-term health of farm equipment.

Managing Supply Chain Issues

McKinsey reports that a third of food produced for human consumption is lost or wasted every year.

A devastating fact since the industry struggles to bridge the gap between supply and demand.

To address this, food delivery cycles from producer to the market need to be reduced. Big data can help achieve supply chain efficiencies by tracking and optimizing delivery truck routes.

Internet of Things (IoT) & Agriculture

IoT is the abbreviated form of the Internet of Things.

IoT smart agriculture products are designed to help monitor crop fields using sensors and by automating irrigation systems. As a result, farmers and associated brands can easily monitor the field conditions from anywhere without any hassle.

IoT is a broad terminology given to every object that can relay information when connected to the network. Agriculture implements IoT through the use of robots, drones, sensors, and computer imaging integrated with analytical tools for getting insights and monitoring the farms. Placement of physical equipment on farms monitors and records data, which is then used to get valuable insights.

Weeding Robots

Since the industrial revolution in the 1800s, automation got more advanced to efficiently handle sophisticated tasks and increase production.

With increasing demands and shortage of labor across the globe, agriculture robots or commonly known as Agribots are starting to gain attention among farmers.

Recent advancements in sensors and AI technology that lets machines train on their surroundings have made agrobots more notable.

Machine Navigation

As remote-controlled toy cars are enabled with a controller, tractors and heavy plowing equipment can be run automatically from the comfort of home through GPS.

With advancements in IoT in Agricultural and machine learning, these tech-driven motors are enabling Advanced farming using IoT independently with features such as automatic obstacle detection.

Harvesting Robotics

Utilizing agribots to pick crops is solving the problem of labor shortages and can operate 24/7. These bots can work in greenhouses to aptly determine the stage of crops and harvest them at the right time.

Material Handling

Robots can perform dreaded manual labor tasks working alongside the labourers. They can lift heavy materials and perform tasks like plant spacing with high accuracy, therefore optimizing the space and plant quality and reducing production costs.

Drones

Agriculture is one of the major sectors to incorporate drones. Drones equipped with sensors and cameras are used for imaging, mapping, and surveying farms.

From the drone data, insights can be drawn regarding crop health, irrigation, spraying, planting, soil and field, plant counting, yield prediction, and much more.

Drones can either be scheduled for farm surveys (drone as a service) or can be bought and stored near farms where they can be recharged and maintained.

Remote Sensing

Sensors are devices sensitive to anomalies. Farmers can monitor the crops from the analytical dashboard and take action based on insights.

Remote sensing in agriculture is revolutionizing the way data is acquired from different nodes in a field.

Crop Monitoring

Sensors placed along the farms monitor the crops for changes in light, humidity, temperature, shape, and size. Any anomaly detected by the sensors is analyzed and the farmer is notified. Thus remote sensing can help prevent the spread of diseases and keep an eye on the growth of crops.

Weather Conditions

The data collected by sensors in terms of humidity, temperature, moisture precipitation, and dew detection helps in determining the weather pattern in farms so that cultivation is done for suitable crops.

Soil Quality

Soil health analysis helps in determining the nutrient value and drier areas of farms, soil drainage capacity, or acidity, which allows adjustment of the amount of water needed for irrigation and the opt most beneficial type of cultivation.

Computer Imaging

Computer imaging involves the use of sensor cameras installed at different corners of the farm or drones equipped with cameras to produce images that undergo digital image processing.

Digital image processing is the basic concept of processing an input image using computer algorithms.

Image processing views the images in different spectral intensities such as infrared, compares the images obtained over a period of time, and detects anomalies, thus analyzing limiting factors and helping a better management of farms.

Quality Control

Image processing combined with machine learning uses images from a database to compare with images of crops to determine the size, shape, color and growth therefore controlling the quality.

Sorting & Grading

Post harvest, computer imaging can increase accuracy and time-efficiency of sorting and grading agricultural and food products based on their size, texture, color and shape.

Irrigation Monitoring

Irrigation monitoring over a period of time helps in mapping irrigated lands. It also enables optimum irrigation scheduling based on soil moisture conditions, varying weather patterns, and plant physiological conditions.

Big Data & IoT in Agri Food

Technologies empower manufacturers to reduce costs, save time and ultimately become more profitable. Technology allows companies to capture data to identify potential risks and issues along their entire supply chain.

As a result, they can continually optimize their operations and function more efficiently and, therefore become more productive in the long run.

Production & Processing

By monitoring ingredients' temperatures, flow rates and distributions with the help of smart valves and actuators in the production stage, manufacturers can maximize their regulatory processes and product quality.

This technology is especially valuable for manufacturing plants with multiple product lines and thus need to initiate seamless, resource-efficient changeovers.

Inventory Management

Sensors allow for real-time tracking of products even when they are in storage.

IoT automation in warehouses allows food storage to be easily organized into zones to avoid issues that arise through poor handling or pests.

By using moving robots or ultrasonic systems, pests can be identified much more efficiently than if one relies merely on the human eye.

Data retrieved from pressure-sensitive sensors, food manufacturers can also track customers' behavioral trends and use this information to avoid shortages down the line. This is especially helpful with foods that are subject to seasonality, such as cocoa in the lead-up to Christmas.

Product Packaging & Delivery

Sensors are able to detect anything from degradation to damage, allowing manufacturers to develop measures to avoid these occurrences in the future.

Similarly, data points can help assess and optimize production line times, which may directly impact companies' abilities to fulfill orders and meet tight delivery deadlines.

Radio frequency identification (RFID) and GPS systems allow companies to monitor their products along the entire supply chain.

Trac eability & Transparency

Farm-to-table, farm-to-fork, farm-to-restaurant, farm-to-fridge – food producers and manufacturers begin tracking their food through the entire supply chain and proactively

communicate information about their ingredients to consumers.

Ensuring traceability of and maintaining transparency are critical in building consumer loyalty and trust – this includes:

- Raw materials
- Supplies
- Ingredients
- Final products

Food & Employee Safety

With the help of technology, food manufacturers can access and make use of real-time food safety data, such as carbon dioxide, heavy metals, humidity and temperature, or shipping times and storage conditions.

This is often classified as active cold chain management.

By identifying chemical and biochemical reactions at the point of harvest, during manufacturing and even transportation, some smart sensors and cloud-based predictive analytics can even identify pathogens along the supply chain and help mitigate their spread.

Human Resources & Mechanic Operations

Food safety is not just about food but also employee safety and safety.

By monitoring factors such as staff illness, food manufacturers can continually optimize their safety standards on-site.

Similarly, by harnessing predictive software to flag potential mechanical wear or damage before it occurs, downtime is reduced and unnecessary injuries are avoided.

Food Authenticity

Tech is proving its value in combating food fraud in the organic food industry as well.

By assigning any given product a digital identification mark, businesses are able to separate them from their counterfeit counterparts.

Examples of these product authenticity labels include simple QR codes and somewhat more complex micro-chips. Brands who harness these technologies may quickly find that they are highly beneficial in building consumer trust.

Resources

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Green economy initiatives

PARTNERSHIPS FOR THE SDGs

The link above consists of various initiatives that were collected either by Secretariat staff or uploaded directly into the database by member states, international organizations and major groups through the online form.

Empowering women to conserve our oceans

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ORACLE NetSuite, A Guide to Reverse Logistics: How it Works, Types, and Strategies (2021)

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Food and EU policy

EU's common agricultural policy (CAP)

The European agricultural guarantee fund (EAGF)

European agricultural fund for rural development (EAFRD)

EU Green Deal

Farm to Fork strategy

Biodiversity strategy for 2030

Relevant initiatives on the pan-European level:

• EIT Food is a large European food innovation initiative, supported by the European Institute of Innovation and Technology (EIT) under Horizon Europe, working to make the food system more sustainable, healthy and trusted and to illustrate the central position of the agrifood sector in Europe's industrial and innovation strategy.

• The European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI) is one of five European Innovation Partnerships launched in 2012. It aims to foster a competitive and sustainable agriculture and forestry sector. It bridges the gaps between research and practice in agriculture, forestry and agribusiness, and encourages sharing innovative ideas.

• The Smart Specialization Platform for Agri-Food orchestrates and supports the efforts of EU regions committed to work together for developing a pipeline of investment projects connected to agriculture and food.

• The European network for rural development acts as a hub of information on how rural development policy, programs, projects and other initiatives work in practice and how they can be improved to achieve more. The ENRD supports the effective implementation of EU countries' rural development programs by generating and sharing knowledge, as well as facilitating information exchange and cooperation across rural Europe.

• LEADER / Community Led Local Development (CLLD) is a "bottom-up" approach that has been used for 30 years, in which farmers, rural businesses, local organizations, public authorities and individuals from different sectors come together to form Local Action Groups to improve the potential of their areas.

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Applications of Big Data in Waste Management

IoTs in Food Manufacturing

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