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

Sector based Training Package-

Trainer Handbook

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GREEN ECONOMY & BLUE ECONOMY

The idea of a **green economy** stems from the 2006 'Stern Report', which proposes an economic analysis assessing the environmental and macroeconomic impact of recent climate change and denouncing the negative impact on global GDP. Associated with this is the growing concern over the depletion of fossil fuels with the reaching of so-called peak oil and the price of crude oil surpassing USD 147 per barrel in July 2008, thus worsening the global energy problem. Further weighing on the precarious environmental picture are analyses on the exploitation of the planet's renewable resources, which in recent years have proposed an annual world consumption that exceeds the planet's capacity to renew itself, inevitably eroding available stocks.

The green economy is characterized from the outset as a new development model that counteracts the 'black' 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. As a solution, this analysis proposes economic, legislative, technological and public education measures that can reduce the consumption of energy, waste, natural resources (water, food, fuels, metals, etc.) and environmental damage by promoting the use of renewable energy sources.) and environmental damage while promoting a model of sustainable development through increased energy and production efficiency that in turn leads to a decrease in foreign dependence, the reduction of greenhouse gas emissions, and the reduction of local and global pollution, including electromagnetic pollution, all the way to the establishment of a truly sustainable economy on a global and lasting scale using mainly renewable resources (such as biomass, wind energy, solar energy, hydropower), the promotion/adoption of energy efficiency measures, and the deepest possible recycling of all kinds of domestic or industrial waste, avoiding waste of resources as much as possible. It is therefore a highly optimized model of the current market economy, at least in its original intentions.

The **Blue economy goes one step** further by envisaging a global economy model dedicated to creating a sustainable ecosystem by transforming previously wasted substances into profitable commodities. It represents a development of the green economy: while the latter envisages a reduction of CO_2 within an acceptable limit, the blue economy envisages zero CO_2 emissions and like the green economy is concerned with using energy from renewable sources and creating "sustainable" products. The goal of the blue economy is not to invest more in environmental protection but, thanks to innovations in all sectors of the economy that use substances that already exist in nature, to make fewer investments, create more jobs and earn more revenue. The blue economy is based on the development of physical principles, using scientific techniques such as biomimicry, a still little-known field that is based on the study and imitation of the characteristics of living species to find new production techniques and improve existing ones.

One example comes from Professor Jorge Reynolds, inventor of a new pacemaker without batteries, which are difficult to recycle. Thanks to his knowledge of how living organisms function in relation to the environment, he found a way to make the pacemaker work with body temperature and pressure generated by the voice. The blue economy, to achieve the goal of environmentally sustainable growth, therefore, relies on innovation, understood as change generated by knowledge sharing.

The blue economy is a concept that can also be addressed to the sustainable management of marine resources and fisheries. Numerous examples come from Sicily, which is committed, together with other Mediterranean countries, to creating a unique District, a system of responsibility and concrete participation of all the actors of the fishing and agro-industry in a production that respects the environment and can enhance the resources of the coastal territory, based on dialogue and collaboration. The European Commission defines it as 'All economic activities related to oceans, seas and coasts. It covers a wide range of interconnected established and emerging sectors'; it is a term widely used around the world with three related but distinct meanings: the overall contribution of oceans to economies, the need to address the environmental and ecological sustainability of oceans, and the ocean economy as a growth opportunity for both developed and developing countries. A related term is **Blue Growth**, which means 'supporting the growth of the maritime sector in a sustainable manner'. The term is adopted by the European Union as an integrated maritime policy to achieve the objectives of the Europe 2020 strategy.

Blue Justice is a critical approach that examines how coastal communities and small-scale fisheries are affected by the blue economy and the 'blue growth' initiatives undertaken by global institutions and governments to promote sustainable ocean development. The blue economy is also rooted in the green economy and the UN Sustainable Development Goals. Blue Justice recognises the historical rights of small-scale fishing communities to marine and inland resources and coastal space; in some cases, communities have used these resources for thousands of years. Therefore, as a concept, it seeks to investigate the pressures on small-scale fisheries from other ocean uses promoted in the blue economy and blue growth programmes, including industrial fishing, coastal and marine tourism, aquaculture, and energy production, and how they may undermine the rights and welfare of small-scale fisheries and their communities.

WASTE MANAGEMENT

Waste management *refers to the set of policies, procedures or methodologies aimed at managing the entire waste process, from its generation to its final destination, thus involving the phase of collection, transport, treatment (disposal or recycling) up to the reuse of waste materials, usually produced by human activity, in an attempt to reduce their effects on human health and impact on the natural environment*.

The various EU waste management interventions over the past decade culminated in the Waste Framework Directive 2008/98/EC, later amended by **EU Directive 2018/851**. This provision clarifies basic concepts such as the definitions of prevention, re-use, recycling, disposal, and waste, and establishes a legal framework for waste treatment in the European Union, designed to protect both humans and the environment, emphasizing the importance of appropriate waste prevention, re-use and recycling techniques.

Key elements of this directive are:

A. the ***principle of minimizing negative impacts*** on the environment and human health in the treatment of waste, which allows, through a proper management policy, to reduce both raw material withdrawals and the use of the natural heritage as a collector of final waste;
B. the ***polluter pays principle or extended producer responsibility*** (EPR);
C. the ***waste hierarchy principle,*** which makes explicit that the solutions that can be adopted in waste management are:
    - prevention of waste production.
    - re-use.
    - recycling (including composting) and other recovery methods such as burning waste in incinerators to generate energy, (see the dedicated section below);
    - disposal in landfills, the cheapest method but also the worst for the environment and health. A proper waste policy must operate according to a scale of priorities, abandoning the last rungs, represented by disposal and energy recovery, in favour of the first, i.e., reuse and reduction of production, at the top. In this sense, all alternatives are valid in dealing with waste, but those 'placed higher' are to be preferred and, consequently, encouraged by virtue of the better environmental outcome they entail.
D. the ***principles of proximity and self-sufficiency, which are*** designed to oblige each community to take responsibility for the waste it produces, to prevent some European or non-European territory, in an unfavorable economic situation, from becoming a dumping ground for other states. In this case, it is not only a question of waste but, more generally, of environmental pollution since the more developed countries tend to offload their environmental problems onto others, typically those in the global south, importing '***environmental sustainability***' from the latter.

In this regard, Directive 2008/98/EC requires each Member State to ensure the implementation of waste management plans, which, supplemented by a prevention program, must contain:

- type, quantity and source of waste generated within the national territory and forecasts of waste streams.

- general management policies.
- Information on collection, disposal, and recovery systems, including assessments of future establishment of new facilities or closure of existing ones.

EU Directive 2018/851 amends the above provision with the aim of strengthening the maximization of recycling and reuse of waste, reflecting the EU goal of moving towards a circular economy. EU countries must favor sustainable production and consumption patterns, by encouraging the study and use of products that are durable, reusable, and repairable or can be upgraded, and focus on products containing raw materials, to progressively move away from the consumerism model, which encourages the purchase of more and more goods and services.

The objectives pursued by European legislation include:

- the reduction of global *per capita* food waste in retail and food losses along production and supply chains by 50 per cent by 2030.
- the reduction of the content of hazardous substances in materials and products.
- the interruption of waste production flowing into the sea.
- recycling of at least 55% of municipal waste by 2025, at least 60% by 2030 and 65% by 2035.
- the establishment, by 1 January 2025, of separate collection of textiles and hazardous waste generated by households.
- ensuring that, by 31 December 2023, bio-waste is collected separately or recycled at source.

According to statistics for 2017, waste management methods vary between Member States. In particular:

A. In Eastern and Southern European countries, landfill is still the most widely used method:
   - Malta, Cyprus and Greece landfill more than 80% of their waste;
   - Bulgaria, Croatia, Slovakia and Romania more than 60%;
   - Spain and Portugal account for about 50 per cent.
B. France, Ireland, Slovenia, Italy and Luxembourg dispose of about one third of their waste in landfills, but also use incinerators and recycle more than 40% of household waste;
C. Countries such as Belgium, the Netherlands, Sweden, Denmark, Finland and, above all, Germany, and Austria, manage municipal waste through the use of incinerators and recycling methods to the extent that landfilling is almost non-existent.

Waste generation has long been regarded as an inevitable and unavoidable by-product of economic activity and growth, but thanks to modern technology and careful management practices, this cyclical link can be broken. In February 2021, the European Parliament voted on a new action plan, calling for additional measures to achieve a zero-carbon, toxic-free and fully circular economy by 2050.

Italy has in some ways been a forerunner in Europe in reducing the effects of waste on nature and the environment by saving and recovering natural resources from it (e.g., precious metals from WEEE) and reducing the production of waste itself by optimizing its management cycle. The Unirima 2021 report provides a snapshot of Italy's success in paper recycling with 87.3% (the EU average is 73.9%), exceeding the European target 15 years earlier: a historic vocation that points to PNRR resources to modernize plants and further improve

The transposition of the European Union's environmental directives, which have brought about numerous changes to the waste management system, has led to the need for a radical

reorganization of state and territorial competences, including the assignment to the regions of the function of identifying, based on objective environmental criteria, areas that are not suitable for the location of disposal and recovery plants, which are still lacking, especially in central and southern Italy. In addition, there was also a need to define national criteria and strategic guidelines.

In this regard, in implementation of **EU Directives 2018/851 and 2018/852**, Legislative Decree No. 116 of 3 September 2020, Article 198-bis, established the National Waste Management Programme, by the Ministry of the Environment and with the technical support of ISPRA (Istituto Superiore per la Protezione e la Ricerca Ambientale). The purpose of this Programme is to define the strategies, criteria and objectives to which the Regions and Provinces must adhere when drawing up regional waste management plans, which must be consistent with the national plan. The latter will then be subject to SEA (Strategic Environmental Assessment), in perfect coherence with what has been ruled by the Court of Justice of the European Union (C 305-2018).

Legislative Decree 116/2020, like the directives it implements, is clear in defining the rules for calculating recycling targets. In particular, the legislation provides that the weight of recycled municipal waste is calculated as the weight of waste that, after undergoing the various control operations aimed at ensuring high quality recycling, is sent to the actual recycling phase, during which this waste is processed to obtain new products, materials, or substances. In a nutshell, as a rule, the weight of the recycled municipal waste is measured at the point of actual recycling. As an exception, the weight of the recycled municipal waste can also be measured at the output, after sorting operations, under two conditions:

E. that such output waste is subsequently recycled.
F. that the weight of materials or substances that are removed by subsequent operations, prior to the actual recycling operation, is not included in the weight of the waste defined as recycled.

In addition, starting in 2020, various decrees have been issued by the Ministry of Ecological Transition regulating EoW (End of Waste) for street sweeping waste, end-of-life tyres, packaging and packaging waste, paper, and cardboard, and finally, last June, for Construction and Demolition waste/materials. This is a legal framework concerning the termination of waste status at the end of a recovery process. Thus, EoW refers to the process that allows a waste to return to its useful role as a product. EoW does not refer to the result, but rather to the pathway that will lead to that conclusion according to the criteria regulated by Art. 6 of Directive 2000/98/EC and implemented by Legislative Decree 152/2006 (Testo Unico Ambientale -TUA - or Environment Code), now amended by Legislative Decree 116/2020 and subsequent amendments. Art. 205-bis of the latter provision clarifies that it is at the point of entry into the industrial cycle that the recycling target will be measured, since it is in this circumstance that the existence of a market for such EoW is demonstrated. In Italy alone, this market represents about 7 tons of collected material each year, urban and industrial.

For Italy, in fact, the EoW does not represent an absolute innovation, since a similar logic already existed in the Italian legal system: the system of Secondary Raw Materials (MPS), established by the Ministerial Decree of 5 February 1998. The EoW for paper and cardboard, therefore, is in continuity with the MPS discipline, updating it to the EU discipline. In particular, a waste ceases to be a waste when it undergoes recovery operations and meets the following requirements:

1. the substance or object is intended to be used for specific purposes.
2. there is a market or demand for that substance or object.

3. the substance or object meets the technical requirements (UNI norms) and complies with the regulations and standards applicable to products.
4. the use of the substance or object will not lead to overall negative impacts on the environment or human health.

The TUA also includes significant innovations about responsibility for waste management. Article 188, under the heading 'Responsibility for waste management', provides that the initial producer or other holder of waste, if he does not treat it himself, is obliged to hand it over to an intermediary or trader, or to an entity or company, which carries out waste treatment operations or, again, to a waste collector, which may be public or private. In this case, the costs of waste management are borne by the initial producer of the waste, the holders at the time or the previous holders. The responsibility of the holder for the proper recovery or disposal is excluded in the case of delivery of waste to the public collection service and, likewise, in the case of delivery of waste to authorized persons for recovery or disposal, provided that the holder has received the waste identification form. Furthermore, in the case of delivery of waste to entities authorized for the operations of grouping, reconditioning and preliminary storage, the responsibility of the waste producers for the correct disposal is excluded on condition that the latter, in addition to the transport form, have received the certificate of disposal issued, in accordance with the model defined by decree of the Ministry of the Environment, by the owner of the facility performing the operations.

Italy also holds the record as regards the genesis of the first waste traceability system as in 2012 the nationwide experimentation of SISTRI (*Sistema di Tracciabilità dei Rifiuti* - Waste Traceability Control System), which was definitively repealed in 2018, took place. In order to ensure the collection and processing of environmental data relating to waste, the Ministry of the Environment, with the technical-operational support of the National Register of Environmental Managers, manages the National Electronic Register for waste traceability in compliance with Article 188-bis of Legislative Decree 152/2006, which, on the subject of waste traceability control, establishes that it must be guaranteed at all stages, from their production to their final destination and is divided into:

- a Master Data section, including the master data of the operators and information on the specific authorisations issued to them to carry out waste management activities;
- a Traceability section, including environmental data and route data from geolocation systems.

In addition to these novelties, there is also the confirmation of the Waste Register referred to in Article 189 of the TUA, pursuant to which 'anyone carrying out waste collection and transport activities on a professional basis, dealers and brokers of waste without holding possession, companies and entities carrying out waste recovery and disposal operations, Consortia established for the recovery and recycling of particular types of waste, as well as undertakings and entities that are initial producers of hazardous waste and undertakings and entities that are initial producers of non-hazardous waste, shall annually report to the territorially competent Chambers of Commerce, Industry, Crafts and Agriculture the quantities and qualitative characteristics of the waste subject to the aforesaid activities, of the materials produced as a result of the recovery activities, as well as the data relating to the authorisations and communications concerning the waste management activities. Exempt from this obligation are the farmers referred to in Article 2135 of the Civil Code with an annual turnover not exceeding Euro 8,000, the companies that collect and transport their own non-hazardous waste, referred to in Article 212, paragraph 8, as well as, for non-hazardous waste only, the companies and entities that are the initial producers that do not have more than ten employees. The Cadastre is aimed at ensuring a complete and constantly updated cognitive

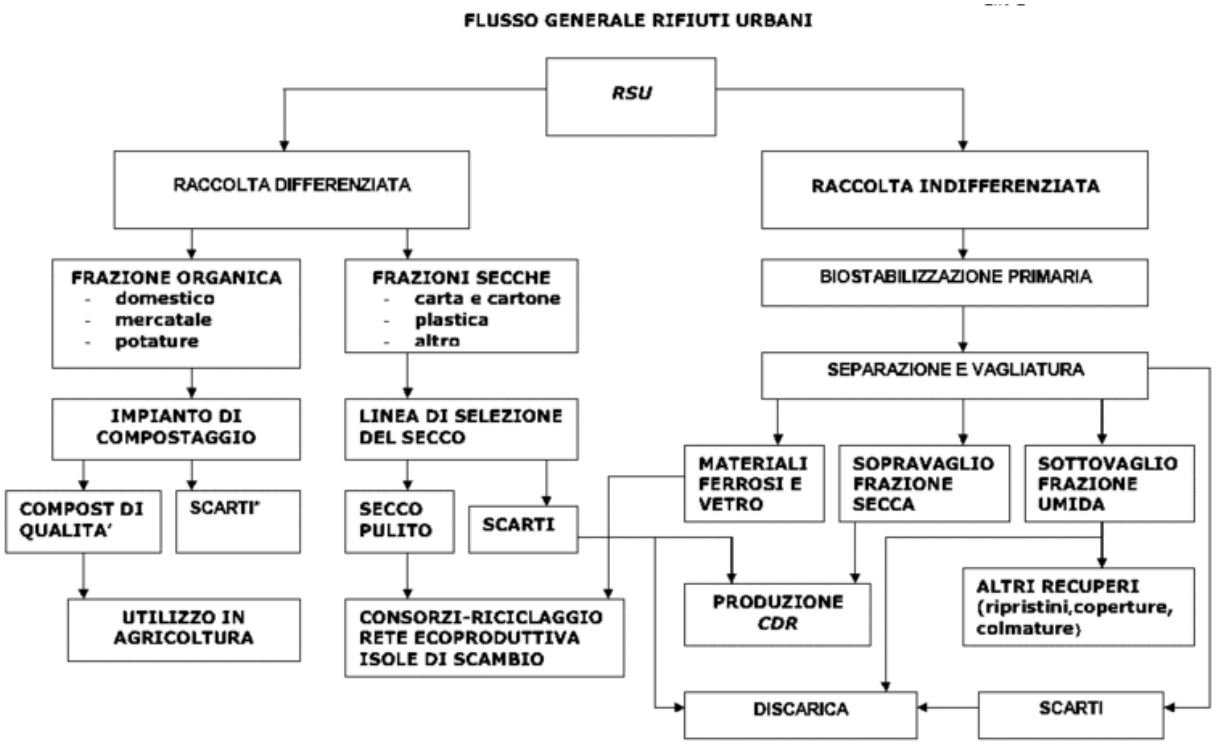
framework, also for the purposes of planning waste management activities, of the data collected by means of the traceability tools and is divided into a National Section, located in Rome at ISPRA, and into Regional Sections or those of the Autonomous Provinces of Trento and Bolzano, which are located at the corresponding Regional and Autonomous Provincial Agencies for the Protection of the Environment.

Another confirmation concerns the fulfilments concerning the keeping of waste loading and unloading registers referred to in Article 190 of Legislative Decree 152/2006, while some changes have been made about waste transport referred to in Article 193. In particular, the transport of waste must be accompanied by an identification form and the registers relating to the transport, integrated with these forms, must be kept for three years (instead of five) from the date of the last registration. Finally, pursuant to paragraph 7, "the form is replaced, for waste subject to transboundary shipments, by the documents provided for by the Community legislation referred to in Article 194, also with regard to the route covered on national territory. The Italian legislation on cross-border shipments of waste must be supplemented by that adopted by the European institutions by means of regulations having executive effect and bilateral agreements, as recently affirmed by the Criminal Court of Cassation in its judgment no. 1429 of 15 January 2020.

Having completed this dutiful regulatory preamble, it is imperative to analyze from a technical and operational point of view: ***waste treatment*** consists of the set of techniques aimed at ensuring that waste, whatever its fate, has minimal impact on the environment. It may involve solid, liquid or gaseous substances, with different methods and fields of research for each.

Waste treatment practices also vary depending on whether the producers are residential, industrial or commercial. The treatment of waste for residential and institutional users in metropolitan areas is usually the responsibility of the local government authorities, while its treatment for commercial and industrial users is usually the responsibility of the producer of the waste.

The following diagram summarizes the methods and chains for treating municipal solid waste according to current management policies in Italy.



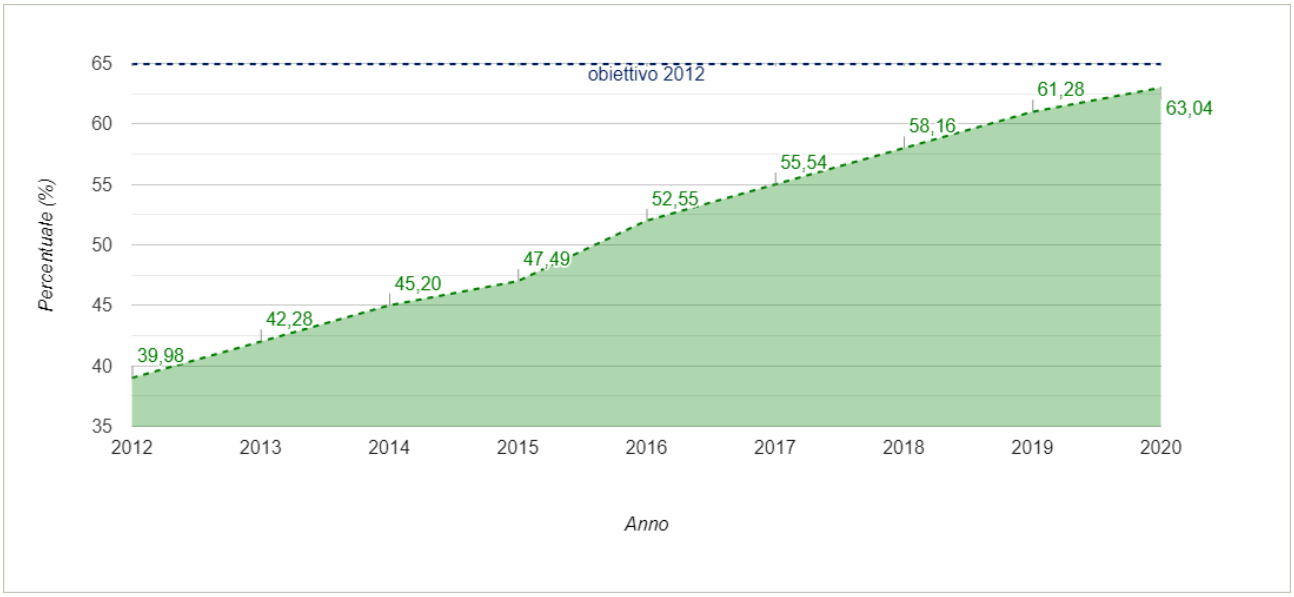
Of course, this is a theoretical scheme that is not always, not completely and not everywhere, implemented in the same way and above all is only one of the possible ways of waste management. Technical developments and/or different waste management directions and priorities may lead to substantial changes in the scheme, but it still provides an outline and the correct terminology on the subject.

Separately collected waste can basically be treated, depending on the type, by two procedures:

1. recycling, for dry fractions.
2. composting, for the wet fraction.

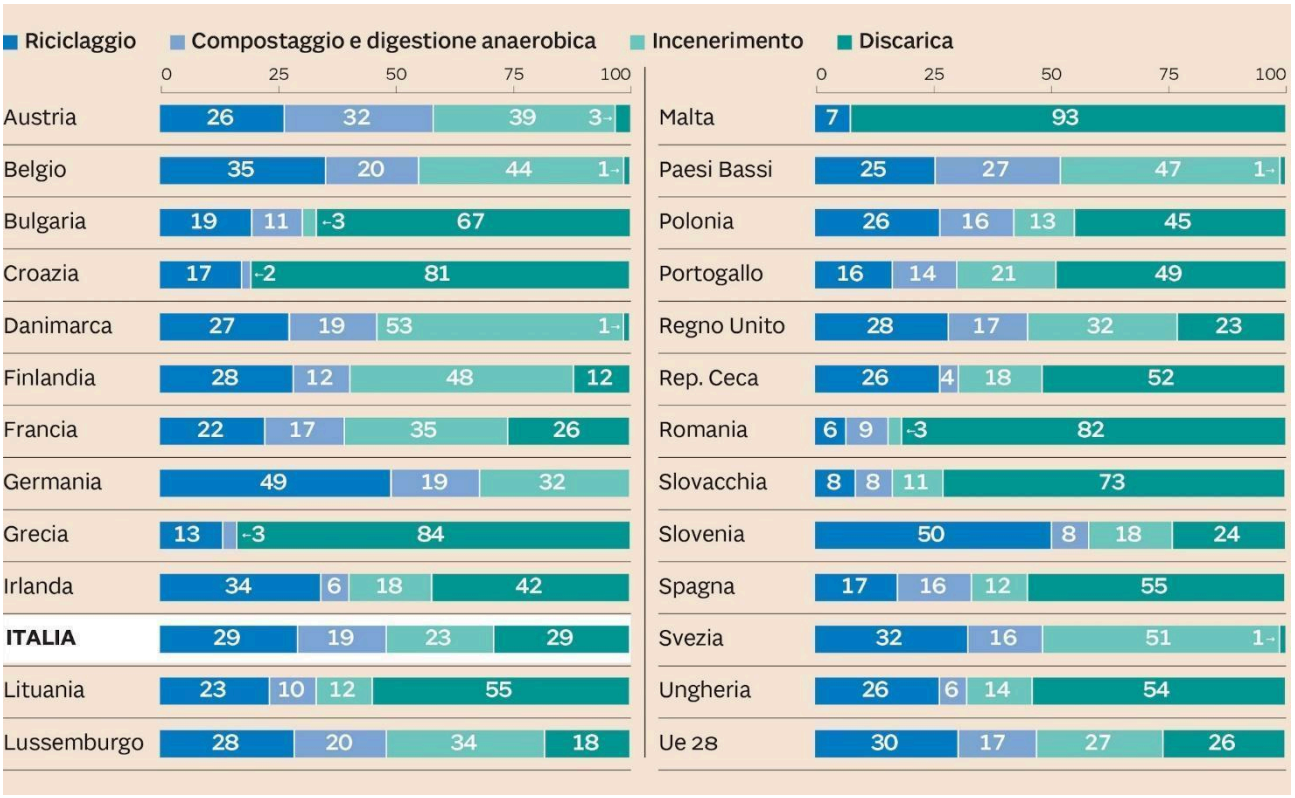
Recycling includes all organizational and technological strategies to reuse as raw materials waste materials otherwise destined for landfill or destructive disposal.

In Italy, the rate of separate collection is growing steadily but is still below potential.



Particularly efficient solutions such as separate door-to-door collection, where adopted, can significantly increase the percentage of recycled waste.

By way of comparison, consider that in Germany the separate collection rate already reached 56% nationwide in 2004.



2015 values per capita in some European countries. In percent (Source: Ispra elaborations on Eurostat data)

There are numerous materials that can be recycled: metals, paper, glass and plastics are some examples; there are, however, complexities associated with so-called 'multi-packed' materials (i.e. made up of several different materials) such as bottles of fruit juices or milk, as well as for complex objects (e.g. cars, household appliances, etc.): however, these are not insurmountable problems and can be solved with special technologies, some of which have already been adopted in Italy.

A particular case is plastic, which as is well known exists in many different types and can consist of many different materials (PET, PVC, polyethylene, etc.). These different materials have to be handled separately and therefore separated from each other: this greater complication has in the past made incineration more cost-effective than recycling. Today, however, special machines can automatically and quickly separate the different types of plastic even if they are collected in a single bin, so the adoption of these advanced technologies allows for profitable recycling.

Unfortunately, in some cases the plastic (usually the inferior ones) is still sent to incineration or worse to landfill.

The **composting of** the wet fraction is a biological technology used to treat the organic fraction of waste collected separately (also called wet waste) using a bio-oxidation process, transforming it into a quality agricultural soil improver to be used as a natural fertiliser: 100 kg of organic fraction yields a compost yield in the range of 30-40 kg. By means of anaerobic digestion, biogas is also obtained that can be burnt to produce electricity and heat; in this way it is possible to decrease the level of polluting emissions from the landfill and improve management, also taking advantage of the consequent decrease in volumes linked to the recycling of wet waste.

Composting differs from TMB in that it only treats wet waste and not mixed waste, although TMB may include a process like composting.

Waste collected separately is naturally much more difficult to process than waste collected separately. Three main routes can be followed:

1. **cold treatment,** i.e. separation and partial material recovery, biostabilization and landfilling;

   The purpose of cold treatment processes for undifferentiated or residual waste - i.e. the waste remaining after separate collection - is to recover a further proportion of recyclable materials, to reduce the volume of material for final disposal and to stabilize the waste in such a way that the formation of decomposition gases and leachate is minimized. These processes, which include composting, generally yield both recyclable materials and biogas, in other words, methane.

   The main type of cold treatment is mechanical-biological treatment (MBT). It separates the organic fraction and recyclable materials, thus allowing a further reduction in the use of landfills and incinerators, all with much lower pollutant emissions than these plants. In fact, it treats undifferentiated waste downstream of separate collections, increasing the recovery of materials. In Germany, for example, TMB plants have been widespread for about ten years.

   TMB can also be used to produce RDF (refuse-derived fuel): this is the main application officially made of it in Italy, especially in the South. In this case, only wet waste and non-combustible materials (glass and metals) would be removed, while paper and plastic would be packed in 'eco-bales' to be incinerated: in this way, cold treatment can be intertwined with thermal treatment.

2. **hot treatment**, i.e. incineration as such or downstream separation and production of RDF and landfilling;

Among the hot (or thermal) waste treatment processes, three basic processes can be distinguished:

- Combustion (incineration)
- Pyrolysis
- Gasification

All these technologies produce residues, sometimes special ones, which require disposal, usually in landfills. Both in Italy and in Europe, by far the most common thermal treatment plants for municipal waste are incinerators or waste-to-energy plants as they recover energy and heat.

In any case, the inevitable residues of these processes will inevitably end up in landfills as the last resort for disposal.

3. direct landfilling (widely used today, but certainly to be avoided).

In Italy, 'integrated waste management' is mentioned for the first time in Legislative Decree No 152 of 3 April 2006 ('Environmental Regulations'), indicating a system designed to manage the entire waste process (including production, collection, transport, treatment, final destination) with the aim of recovering energy and raw materials, and thus minimizing the fraction destined for landfill, and whose activities, including the construction and management of plants, are entrusted to a single entity.

Specifically:

- Priority Criteria (Art. 179)

    - Development of clean technologies
    - Designing and marketing products that contribute little or nothing to waste generation and pollution
    - Technological improvements to eliminate hazardous substances in waste
    - Active role of public authorities in the recycling of waste and its use as an energy source

- Prevention of waste production (Art. 180)

    - Correct assessment of the environmental impact of each product during its entire life cycle
    - Tender specifications that consider the ability to prevent production
    - Promoting agreements and experimental programmes to prevent and reduce the quantity and hazardousness of waste
    - Implement DL 18 February 2005 no. 59 and the specific Directive 96/61/EC for integrated pollution reduction and prevention

- Waste recovery (Art. 181)

    - reuse, re-use and recycling
    - Production of secondary raw material by processing the waste itself
    - Promoting the market for re-used products through economic measures and tender specifications
    - Use of waste to produce energy (cold biological oxidation, gasification, incineration)

Therefore, if the first level of attention is directed towards the need to prevent the formation of waste and to reduce its hazardousness, the next step concerns the need to reuse products (e.g. bottles, with a returnable vacuum) and, if reuse is not possible, recycle materials (e.g. paper recycling). Finally, only with regard to the material that could not be reused and then recycled (e.g. paper napkins) and the under-sieve (i.e. the indistinguishable and therefore non-recyclable small-piece fraction of waste, which accounts for about 15% of the total), the two solutions of energy recovery through cold or hot systems, such as bio-oxidation (aerobic or anaerobic), gasification, pyrolysis and incineration or landfilling, arise.

So even in an ideal situation of complete recycling and recovery, there will be a percentage of residual waste to be landfilled or oxidized for disposal and energy recovery. From an ideal point of view, the use of incineration and undifferentiated landfill should be limited to a minimum. The lack of effective integrated reduction, recycling and reuse policies make landfilling still the first solution applied in Italy and other European countries.

As far as recovery is concerned, there are projects and associations that deal with the exchange of used goods and products.

Also relevant is the share of exports that commits a poor country to take on the sources of pollution that producers do not want to have close to home (NIMBY effect).

As of 2018, Italy was the eleventh largest exporter of plastic waste to Third World countries, often derogating from EU Regulation No 1013 of 14 June 2013, which stipulates that treatment and public health protection rules similar to those in Europe must be applied in destination centres. China has banned waste imports, shifting the routes of licit (and illicit) trafficking from Asia to Africa.

In particular, the rule does not regulate the sinking of barges in international waters, which are considered a 'no man's land'.

Waste combustion is not in itself opposed to or an alternative to the practice of separate collection for recycling but should only be a possible final link in the disposal chain. Moreover, it is obvious that if an incinerator is sized to burn a certain amount of waste, it will necessarily have to be fed with that amount, effectively requiring the further input of waste mass in the event of an inadequate quantity.

For technical-economic reasons, the trend today is to build ever larger incinerators, with the consequence of fueling 'waste tourism' (i.e. the transport of waste from other provinces if not other countries). In Italy, this phenomenon has been accentuated by strong state incentives that have favored incineration to the detriment of other, more environmentally friendly disposal methods.

In Italy about 3.5 million tons/year were incinerated in 2004 out of a total of about 32 million tons of total MSW produced, i.e. about 12%; this practice is increasing, especially in the North, and in Lombardy for example it reaches 34%. What stands out is the great recourse to landfill disposal, which is decreasing (from 2001 to 2004, in the North -21%, in the South -4% and in the Centre -3%) but which currently accounts for about 56.9% of the total urban waste produced (45% in the North, 69.5% in the Centre, 73.2% in the South; it is estimated that 76% of the national total is waste from undifferentiated collection and 24% is residues from the various treatment processes: biostabilisation, RDF, incineration, residues from sorting of R.D.), with environmental consequences that are worsening especially in the South, where the few final treatment plants are now saturated and differentiated waste collection is struggling to take off: incinerators should therefore, according to some, be increased (especially in the South). However, if one considers that in the most virtuous municipalities separate waste collection already exceeds 80%, one deduces that even in the North it is still much less developed than it could be and that in some areas of the North incineration plants would even be oversized. Therefore, the fear of some is that it will not be possible to fully develop separate collection and recycling to allow incinerators to operate at a loss, or else waste will have to be imported from other regions.

An important consideration is in fact that the investments required to build waste-to-energy plants are very high (the cost of a plant capable of treating 400,000 tonnes/year of waste can be estimated at about 400 million euros, i.e. about €1,000 per tonne of treatable capacity), and their amortization requires, also taking into account the significant energy recovery, about 20 years; therefore, building a plant means having the 'obligation' (sanctioned by actual contracts) to incinerate a certain minimum quantity of waste for quite a long time.

The case of the incinerator recently built by Amsa in Milan, Silla 2, is emblematic in this respect: initially it was authorised to burn 900 t/day of waste, then it was increased to 1250 and finally to 1450 t/day. If one looks at waste management in Milan, one realizes that separate waste collection reaches about 30 per cent (a figure that has remained essentially unchanged for years), and much of the remainder is incinerated by Silla 2. Consider that the average recycling rate in the province of Milan is, excluding the provincial capital, 51.26%, which is constantly improving, and in particular 59.24% for municipalities with less than 5,000 inhabitants and 55% for those with between 5 and 30,000 inhabitants, and that in Milan organic waste collection has never gone beyond experimentation in small areas of the city, despite the more than proven door-to-door waste collection system and the considerable awareness of the population, which would certainly allow much more to be done.

It is interesting to compare the waste disposal costs of a city like Milan that makes extensive use of incineration with those of cities that focus on differentiated waste collection: in Milan in 2005,

€135.42/inhabitant was spent against a provincial average of €110.16 and against the €83.67 of Aicurzio, the most virtuous town in Lombardy in 2005 with 70.52% differentiated waste collection.

Improving waste management at local level, and thus stimulating the circular economy, is also possible through innovative *governance* tools, such as **PAYT** ('Pay-as-you-throw') and **KAYT** ('Know-as-you-throw'*).*

PAYT, a punctual pricing model used for municipal solid waste disposal*, requires* users to pay according to the amount of waste they have produced and provides incentives to collect recyclable waste and reduce mixed waste. Prevention of waste production, waste reuse and better separation at source thus become more cost-effective and increase citizens' responsibility. The tariff in question is made up of a fixed fee, covering operating and waste management costs, and a variable fee, related to the amount of waste produced; the user pays mainly in proportion to the waste he produces and is therefore rewarded for not producing any waste at all. The implementation of the *pay-as-you-throw* system requires the measurement of the quantity of waste produced, an identification tool of the user generating the waste and the definition of the charging cost, based on the quantity of waste collected and the services provided.

The *know-as-you-throw* (KAYT) system*,* which can be considered as a supplement to PAYT or, more simply, as an alternative to punctual pricing, was developed within the framework of the Horizon 2020 Waste4think Project, with the objective of reducing municipal waste by providing citizens with knowledge and persuasion tools. The behaviour of citizens who sort their waste can in fact be improved simply by informing them better and more continuously, by means of technological tools, meetings with service employees and economic and social incentives.

Ultimately, it escapes the notice of many that the health emergency due to the coronavirus exerts unprecedented pressure on many economic activities, including those essential to our well-being, such as proper waste management.

On 14 April 2020, the European Commission issued a document containing guidelines necessary for Member States to deal safely with the waste crisis during the pandemic emergency. The central theme is the optimal management of municipal waste from healthcare facilities and its hazardousness, without neglecting the protection of the health and safety of operators. In this regard, Member States and waste managers throughout the EU have made considerable efforts to ensure continuity of service, the interruption of which would lead to an overload of the collection and treatment infrastructure and additional health risks.

It is recognised that specific infection prevention and control measures are needed for persons in custodial isolation with suspected or confirmed coronavirus infection. In particular:

- an individual waste bag must be placed in the patient's room;
- the paper handkerchiefs and face masks used by the patient must be immediately disposed of in the waste bag placed in the patient's room;
- gloves and respiratory masks used by healthcare workers and cleaners must be disposed of, immediately after use on leaving the room, in a second waste bag placed next to the door of the patient's room;
- waste bags must be closed before being removed from the patient room and replaced frequently; they must never be emptied into another bag. Closed waste bags from patients can be disposed of directly into unsorted waste;

- After handling the waste bags, strict hand hygiene must be observed, using soap and water or alcohol-based hand disinfectants.

Waste from healthcare services, laboratories and related activities associated with coronavirus patients should be handled and treated in accordance with Directive 2008/98/EC on hazardous waste and the national provisions applicable to this category of infectious waste. Finally, Member States must ensure proper planning of treatment and storage capacities for medical waste, and in the event of interruptions of disposal and incineration services, it is essential that such waste is stored temporarily in a secure manner, using sealed and disinfected containers placed in secure areas, with access restricted to authorised personnel only.

Adequate precautions should also be taken in terms of health and safety measures in the workplace, such as, for example, adapting the organisation of personnel to avoid contagion between work teams, respecting social distancing, providing workers with personal protective equipment (PPE) and appropriate disinfectants.

Composting at Community Scale

Composting is a *sustainable waste management practice* that converts any volume of accumulated organic waste into a usable product.

Compost, also known as *composted soil* or *compost*, 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. Within the so-called organic cycle, composting, or biostabilization, is an aerobic, human-controlled biological process that leads to the production of a mixture of humified substances (the compost) from biodegradable plant residues, both green and woody, or even animal residues through the action of bacteria and fungi. Once produced, it 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.

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:
- balanced nutrients composed of a mixture of carbonaceous matter (brown-hard-dry) and nitrogenous matter (green-soft-wet)
- moisture from 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 are:
- 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. In this way it is possible to reduce the amount of rubbish by 30-40%; moreover, many Italian municipalities provide a reduction in waste tax for those who demonstrate that they practice composting.
- 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);

- coffee grounds, tea filters, egg shells, dried fruit shells;
- biodegradable bedding of herbivorous animals;
- paper, avoiding printed paper (even though newspapers today no longer contain toxic substances) and, above all, glossy paper;
- pieces of cardboard (they also serve as shelter for earthworms);
- pieces of 100% natural fabrics (wool, cotton), etc.

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 practise 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. There are industrially produced compost bins, but it is also possible to construct them at home from recycled materials. 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. In practice, to compost with the pit, you need at least two: 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.

The decomposition process is favored by oxygenation, so periodic turning of the material maintains a sufficient level of porosity. 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. Turning, 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. Kitchen waste can be collected in biodegradable bags made of maize (Mater-Bi). The material obtained in three to four months of composting (more time in winter, less in summer) can be used as fertilizer for the garden or vegetable garden; commercially available compost is produced by industrial composting, with mechanical turning, but the processes and results are equivalent. The spread of home composting makes it possible to significantly reduce the weight and volume of municipal solid waste that must be transported and disposed of. In many Italian municipalities, composting is therefore incentivized through a discount on the municipal solid waste disposal tax granted to citizens who practice it; some municipalities also provide the composter or reimburse its purchase. If compost bins are used in which the waste is not in contact with the soil (e.g. in terraces), it must be ensured that the compost is not too dry (otherwise the composting process will not be activated), nor too wet (it may give off unpleasant odors due to anaerobic decomposition reactions).

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. The economic interest for community composting can be increased in countries with orographic characteristics, such as, in Italy, the presence of many small municipalities far from composting plants. In home and community composting, at least two or three times a year, the material must be turned over to reactivate the composting process. It is essential to maintain the right degree of moisture in the material, otherwise the process will be slowed down if it is too dry or too wet; moreover, in the latter case, unwanted putrefaction will occur (anaerobic process). To dry a compost heap that is too wet, the material is turned over, to moisten it, water is poured in (with a garden hose or watering can). 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 utilized, 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:

- a first phase, known as the active phase, 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.
- a second phase, known as the ripening phase, 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.

The use of compost as a fertilizer is the basis of some of the agronomic techniques defined as 'sustainable', such as permaculture, natural farming, organic farming, and biodynamic farming. Soil treatment with compost is however widespread across all cultivation techniques as the addition of organic matter improves the soil characteristics of the soil (as a soil conditioner, in fact). On an industrial basis, composting is used to transform organic waste, such as the so-called wet fraction of municipal solid waste, into compost.

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. Floriculture, both amateur and professional, also makes convenient use of this compost. The marketing of composted soil improver is regulated by Legislative Decree no. 75 of 29 April 2010: 'reorganization and revision of regulations on fertilizers'. Compost is also commonly used for covering waste dumps and for agricultural reclamation.

Anaerobic digestion also makes it possible to obtain biogas that can be used as fuel.

Reuse of hydroponic waste solution: SOILLESS AND HYDROPONIC CROPS

Trivially, even a common potted plant that we keep on our balcony at home is an above-ground crop. It must therefore be made clear that the term hydroponics is used to refer to crops without substrate or on liquid medium: 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 this second 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 solution of nutrient

solution.) 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.

The technique is otherwise known as hydroponics. Hydroponic cultivation allows for controlled production from both a quality and hygienic point of view throughout the year. This technique is becoming increasingly popular in plant cultivation. 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. This particular production technique, allows for significant benefits, from a quality and hygienic-sanitary point of view, throughout the process. In the 4.0 agriculture scenario, hydroponic cultivation constitutes a highly innovative system intended to make agricultural cultivation possible even in extreme habitats such as a desert, a spaceship or a habitat such as the Moon or Mars. By the way, with traditional cultivation today, we can barely feed the world's population. At present, each of us has on average about 2,000 square meters of agricultural land at our disposal (in the 1970s it was more than double that). Let alone in 2050, when the population will reach 9.7 billion. Not to mention that the availability of agricultural land is gradually decreasing as it is converted into building land.

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 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.

Tillage and the addition of soil conditioners can improve the softness of the soil by encouraging the deepening of roots. The use of supports, stakes and wires improves plant anchorage. The addition of fertilizers (manures, soil conditioners, correctives) and irrigation are operations that, properly integrated in a technique that exploits their synergies, improve the trophic conditions of the soil. However, these interventions can be partly thwarted by the complexity of the soil system, which always manifests an active or passive homeostatic reaction to anthropic intervention: temporary or definitive losses of water and mineral elements (insolubilisation, leaching, adsorption, biological absorption, evaporation, etc.), caused by atmospheric (evaporation), mechanical (permeability, porosity) and physico-chemical (ion exchange, redox potential, pH, matrix and osmotic tension, etc.) factors. Taken together, these factors are difficult to control for the purposes of optimizing the technique. The difficulty of optimization is aggravated by the fact that fertilization and irrigation are discontinuous interventions that do not fit in with the dynamics of the plants' needs in the different phenological phases. Conventional cultivation techniques have a considerable impact on the telluric ecosystem, transforming it into an agroecosystem. The natural soil can be traced back to a climax stage in which biodiversity is able to maintain an internal balance and ensure the natural depletion of the flow of matter and energy.

The agroecosystem can be traced back to an evolving ecosystem in which agronomic interventions generate a surplus of resources in terms of energy and matter. The purpose of this

surplus is to completely direct the flow of energy and matter into agricultural production, yet it creates temporary conditions favorable to the entry of organisms that can take advantage of it. The reduced homeostatic reaction capacity of the agroecosystem means that the organisms that settle in are those with the highest biological power (high reproductive potential, resistance to adverse conditions, etc.). In this settlement, organisms antagonistic to the agrarian species tend to prevail, as the evolutionary dynamics of an ecosystem spontaneously lead to an increase in biodiversity. Some non-conventional farming techniques (integrated production, organic farming, sod seeding, etc.) exploit the ecological function of the soil, but conventional farming must dispense with this function because it only manifests itself as antagonistic.

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 basic requirement is a sufficient degree of porosity to allow the nutrient solution to circulate and accommodate the root capillaries. The volume available to each plant loses importance as the concentration of the nutrient solution creates the optimal conditions for root uptake in a small space. In other words, 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.

Compared to conventional techniques, hydroponics shows significant advantages in this respect as contact with soil pathogens (nematodes, agents of basal rot and trichomycosis) is eliminated at the source. These adverse factors force conventional agriculture to resort to crop rotation in the open field and geo-infestation in protected crops. In any case, plants raised in hydroponics generally show better vegetative growth and offer higher yields not only because of the control of the nutritional status but also because of the better health status. Of course, these considerations go beyond the adversities that affect the aerial root system.

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: this is the parameter by which the concentration of the nutrient solution is controlled. 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.

Soilless cultivation has clear advantages in environmental situations where the substrate is not in a condition to grow the crop optimally, such as rock or excessively sandy soils. Another advantage of this type of cultivation is the 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 fertilisers 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 Agro-Food Sector

Data compiled by the Waste Watcher International observatory at national and international level paint a picture with much still to be done to combat food waste while promoting a healthy and sustainable diet.

The circular economy and sustainable development (also) go (also) from here: that is, from awareness of what we can do as individuals and as a community starting with our food, by significantly reducing the anthropic pressure on the environment and adopting a more balanced lifestyle, without any disruption.

For example, every year in Italy 135 ml t of special waste and 35 ml t of municipal waste are produced: on average, each citizen produces 1.5 kg of waste per day and about 30% is food waste (wet). Although Italy excels in material recovery and composting rates from separate waste collection with percentages close to 70%, it goes without saying that these percentages of food waste must be drastically lowered.

EATING FOOD FULFILLS A PRIMARY NEED, eating sufficiently and healthily is - or should be - a fundamental right for everyone on earth. However, global data present us with a totally unbalanced world with great disparities in terms of food access and distribution and negative impacts not only on health and the economy but also on the environment and climate.

The road to a more equitable and sustainable world passes through how and what we consume, it concerns the use of limited natural resources (soil, water, energy) and the entire agri-food system that puts food on our plates, in our stomachs or in the dustbin. Moreover, inequalities in terms of food quality, access to and surplus of food have increased because of the pandemic: the challenge is therefore even more urgent and complex. But it is also an investment in the future: by eating better, we are better off, as many studies show on the positive effects of balanced diets.

While it is true that today more than 800 million human beings live in food emergencies, almost twice as many (1.6 billion) soffre suffering from diseases related to overeating.

The excess of calories ingested, the so-called metabolic food waste, in addition to having consequences on health (and on the economy for the related care costs) also determines an impact on the environment expressed in carbon, water and soil. Some estimates for Italy report that the metabolic food waste referred to the overweight and obese population is equal to over 2 billion kilos of food for an amount of CO2 emissions equal to 11.8% of those emitted by Italian agricultural production. Moreover, and this aspect is better known, the climate-altering gases emitted by agro-food production that is lost and wasted along the fireways, 33% of the total, with 3.3 billion tonnes of C02 are in third place behind China and the United States in the unenviable class of global polluters. But it is food waste at household level that is the most significant in proportion and in absolute terms, especially in the most developed countries: more than 50% of the total ends up in the rubbish bin in our homes.

In short, **if food were not wasted in the fields, in our homes and in our stomachs today, we could feed more than twice as many of the earth's current inhabitants** and drastically reduce pollution. Instead, precisely because of these imbalances, we currently use 1.7 times the natural resources available on earth, which means that every year, we consume and exploit more than the earth can

offer, taking these resources away from future generations. **Going on like this, we will need three (3) Earths in 2050**.

Instead, we will always have just one, and moreover, one that is increasingly hotter and more inhospitable to humans and their food production. Plants, animals and humans will move further north and higher with ever increasing economic, environmental and social costs.

Will the world only be able to sustain itself with technological innovation as some believe?

Not unless there is also a reversal of our eating behaviour, our diet, and our lifestyle. At least starting with those who can afford it today, those who have access to food, with the goal of preventing access from becoming excess and ensuring a fair distribution given the growth of the food poor. Reducing the global food gap is possible, and right now it is a top priority, achievable with some efforts and commitments that each of us can make by exercising our awareness. In two ways, concretely.

First, it is necessary to reduce food waste in our homes to zero by managing food more carefully: from planning purchases to storing food in the refrigerator, from understanding food expiry dates to the recovery kitchen. Nothing that is still good to eat should remain in the rubbish bin, except packaging materials that have been well differentified so that they can be recycled as a second raw material.

Secondly, we must adopt balanced and healthy diets according to our personal calorie requirements, without excesses and favouring local and traditional diets, of which we have an extraordinary and balanced but little practised example at home: the **Mediterranean Diet.** Our stomach should not be the bin where junk food ends up.

It is through a holistic approach towards sustainability, equity, and health of food production that we will be able to reduce (and eventually eliminate) food from waste in a sustainable manner with a broader goal of contributing to a healthier, ecological, economically viable, social, ethical and resilient sustainable food system.

Food waste

Waste occurs along the entire supply chain, from collection, storage, transport, processing, distribution, finally to the consumption of food by individuals. But it is at consumer level that the greatest waste occurs. We are responsible for 70% of all food waste.

To tackle this problem, the European Commission in its Farm to Fork Strategy has committed to halving per capita food waste by 2030, in line with the UN Sustainable Development Goal. The transition to a fair, healthy and environmentally friendly food system necessarily requires a reduction in food waste. Among the main causes is the misuse (producer side) and misinterpretation (consumer side) of food durability labels, phenomena that alone account for 10% of food waste in Europe.

Yet the terms 'Best before' and 'Best before' have very different meanings, and to clarify the differences, the Commission has committed to review the EU rules for these terms by the end of

2022. Any changes adopted will have to meet consumers' information needs and ensure food safety.

Not only that, the Commission in 2019 launched a new common methodology for measuring food waste in all Member States. Food waste levels have been underestimated for too long due to a lack of data and a shared monitoring framework. This step will harmonize the way EU countries quantify waste at each stage of the file so that they have adequate data to assess the extent of the problem.

What is certain is that the Commission will have to play an important role in coordinating all the actions implemented at the various levels, confirming the fact that combating waste requires the commitment of everyone. It is precisely through the synergy between institutions, the private sector, the third sector and civil society, that the best results can be achieved.

And to mark the day against food waste on 5 February, SlowFood with Zero Waste Europe published a guide to reducing waste at the local level.

In the document Guidance for municipalities to reduce food waste within local food systems (at www.slowfood.it), the key position of municipalities is highlighted, citing virtuous examples of cities (Milan, Paris and Porto) that have triggered new models of collaboration between profit, non-profit, public and private to prevent food waste.

The Waste Framework Directive also requires Member States to prepare food waste prevention programmes, encourage food donation and other redistribution for human consumption to meet Sustainable Development Goal 12.3, to reduce food waste at retail and consumer levels by 50 per cent by 2030.

In the logic of **FARM TO FORK,** food districts and organized short supply chains are grafted on, for which the production context is still characterized by excessive fragmentation; despite the high vocation to produce quality products, in the absence of strong cooperation in the supply chain and due to a poor connection with organised distribution systems, low remuneration of production factors is determined. The geographical connotation of the territory penalizes local businesses in their approach to outlet markets, leading to low levels of competitiveness, both due to the incidence of transport costs and logistics (preservation and perishability of fresh and very fresh products). Reducing the number of intermediaries in marketing and enhancing the value of production, also through the identification of effective distribution outlets, may be fundamental to promote the sale of products locally through direct relations between producers and consumers.

The development of the short supply chain, in a broader perspective, generates a system oriented towards a different dialectic in the relationship between producers and consumers and determines the creation of an organisational model that shortens the physical, social, cultural and economic distances between the worlds of production and consumption. Local food, in fact, can be considered as the reason for the interactions between the actors and symbols involved in the phases of the entire supply chain, from production to distribution to consumption, which must be considered as interconnected and simultaneous processes, the ultimate result of which is the creation of a network. For this result to be possible, it must take place in an environment that allows the sharing of meanings, values and objectives among all the stakeholders belonging to the network. It is seen as the catalyst for a more sustainable food system, the driver of new business models and the source of a modern structure of links and connections between small farms, the environment, traditions, and the land.

The need to sustain the economy and the territory, to reduce greenhouse gas emissions, to abandon the use of pesticides and chemical fertilisers, and to connect many people linked by the

same traditions, implies the need to build a reality based on the local, with the consequent reformulation of the food system itself. The demand for locally produced food that is sold and consumed is, in fact, continually expanding and consequently the need to 'problematise' the issues that can be linked to the types of products belonging to the 'local food' category is emerging.

The Short Food Supply Chain

The short supply chain is considered a relevant vector of innovation, in particular with regard to sustainable production. The environmental costs of the short supply chain, then, in terms of carbon dioxide emissions, air and noise pollution, packaging production and disposal, and risk of accidents, are lower than those associated with global agri-food chains.

The current distribution chain penalises producers and consumers as it absorbs more than 85% of the final sales value of products. Short supply chain experiences are an interesting approach to the problems of the distribution chain, but an innovative process needs to be defined to organise and structure the relationships between the parties involved, producers on the one hand and consumers on the other. The aim is to define and test these innovations, preparing and disseminating a new organised short supply chain model.

The objective is to design and implement the organised short supply chain model that will consist of a network of producers and consumers organised in GDAs, which will interface with the Food Districts and local food policy actions. The organisational prototype, linked to a web platform, will allow the booking, sale and delivery of the product through an innovative "tailor-made" ECommerce system, i.e., customizable according to different local needs

This innovation responds to the current needs of the main players in the agri-food system: the producer and the consumer. In recent years, in fact, there have been even profound changes in food consumption trends and consumer expectations, with an increasing focus on the origin and quality of agricultural products and a growing interest in establishing a direct relationship with the producer (so-called marketing or experiential purchasing). This system makes it possible to revitalise local farms that are less structured and unable to compete in the new scenarios designed by the globalisation of markets.

As can easily be guessed, the short supply chain initiatives that have been activated in the world, mainly in countries with developed economies, are innumerable. Based on the heterogeneous forms that direct selling has taken on at a global level, with different operational characteristics in relation to the different objectives that are set - not all of them ideologically oriented - which are also the result of the territorial context and the historical period of reference, an attempt is made here to provide a brief review of the most widespread experiences, without claiming to be exhaustive.

The promoters of these initiatives were from the outset both producers and consumers, culturally and ideologically oriented towards the creation of direct links between the world of production and the world of consumption. At a later stage, in varying forms in different contexts, other actors - public administrations, associations and social movements, organisations, research bodies - showed a strong interest in these alternative systems, seen not only as a commercial alternative, but also as an important tool to support local rural development processes. However,

the most widespread experiences remain those activated by producers or consumers, with similar dynamics in all the contexts where they have developed.

In all cases, re-localisation implies a process of organisational innovation, the salient features of which are new production, distribution and consumption practices and new ways of relating between the actors involved. Short supply chain experiences therefore take on different configurations in relation to the promoters, the management and organisational methods, and the ideals underlying their implementation.

Short supply chain experiences first emerged in those countries where the problems linked to the industrialisation of agricultural processes, the consequent abandonment of the countryside and the increasing difficulties farmers faced in accessing conventional sales channels that, in any case, did not provide sufficient income for the survival of farms. This situation has not improved substantially over the years, leading to an increase in such initiatives promoted by producers and consumers.

The direct sale of foodstuffs is a practice that, despite the modernisation process of the agri-food system (but perhaps precisely because of its incomplete nature in Italy), has never disappeared and is still present throughout the country. In recent years, a strong impulse to the return to this form of trade through farm shops, at first in individual form and later in collective form, came from the so-called 'orientation law' (Legislative Decree 228/2001), which gave strength to this practice and introduced the possibility for agricultural entrepreneurs to market, in addition to their own production, also products purchased from third parties, as an exception to the ordinary discipline of trade.

Moreover, while initially the best known and most widespread experiences were related to wine, olive and livestock production (meat, but especially cheese) and typical products, the situation that has developed in recent years appears to be much more diversified and cannot be attributed solely to these activities, evidently referring to a much broader and more dynamic casuistry, which also includes small fruit and vegetable producers, cereal producers and processors, livestock farmers with a slaughterhouse and sales outlet, small fruit, vegetable and meat processors, not to mention the many marginal experiences, in many cases very small or located in disadvantaged areas.

In Europe, particular interest is being aroused by the many collective forms of direct sales which, over the years, have taken on different configurations, from more spontaneous, informal, and sometimes episodic experiences of collaboration between producers, to more structured modes of management.

Numerous experiences have been rapidly spreading producers' markets and collective outlets, as far as initiatives promoted by that part of the world of production that fails in exploiting its own production in conventional commercial channels are concerned; purchasing groups set up by citizens moved by ideological motivations or simply for economic convenience and family supply management, as far as experiences activated by the world of consumption are concerned. In recent years, however, such initiatives have also been promoted by trade organisations (OOPP), agricultural organisations, producer associations, as well as attracting strong interest from local authorities and other organisations. On a national level, producer markets have seen exponential growth over the last two years, following a similar path to that described above.

The reference context has, in fact, undergone substantial changes, which on the one hand have led to the emergence of new experiences, and on the other have in various ways influenced initiatives that had already been active for some time.

Case Study: the Mercato in Italy

In Italy, the experiences of producers' markets that have been implemented so far can be traced back to the regulatory framework envisaged by Art. **1 (reform of Art. 2135 of the Civil Code that redesigned the figure of the agricultural entrepreneur) and Art**. **4 of Legislative Decree 228/2001.** In this framework, the producers' markets are configured as a collective management of the individual moment of direct sales, in itself not subject to the provisions of Legislative Decree 114/1998 on the Reform of the discipline of the trade sector. At the regional level, numerous bills or laws have already been approved on this issue: in addition to Tuscany, which has promoted the project 'Filiera Corta - Regional Network for the valorisation of Tuscan agricultural products' (D.G.R.T. n. 335 of 14/05/2007)31 , other regions and provinces have also issued laws for the support and promotion of various direct sales initiatives, such as farm and collective outlets, events in the piazza, supply chain agreements (Calabria Region, Piedmont Region, Veneto Region, Lazio Region), but mainly for producers' markets (Province of Bologna, Sicily Region, Lombardy Region, Lazio Region).

In other cases, the realities present throughout the country have ancient origins even though they have changed morphology over time, remaining in many cases daily markets but losing the direct presence of producers; in others, the characteristic of real farmers' markets has been maintained, as is the case in Bolzano, where three weekly markets are held in addition to the traditional district markets, where farmers sell their produce directly.

A particularly interesting experience in this respect is the *Porta Palazzo market in Turin.*

Other experiences, born recently on the wave of the growing interest shown in markets by institutions, are the 75 'Identity Markets', supported by ANCI - Res Tipica, which offer quality products and cultural services linked to the art and wine and food traditions of the territory, representing important vehicles for attracting tourists and enhancing the territory.

Approximately 33% of these markets are held monthly, 28% weekly; seven out of ten markets are held at weekends and act as a powerful vehicle for attracting tourists and enhancing the territory, considering that the regions where they are most present are Emilia Romagna, Tuscany, Piedmont, and Sicily.

Then there are the markets promoted by Coldiretti in many Italian regions also through the Campagna Amica Foundation project, which provides a series of initiatives to support direct sales. These markets, called 'Campagna Amica Markets', are attended by associated farmers who sell their produce directly in compliance with a regulation/discipline that provides, among other things, for the control of maximum prices charged, as established by a framework agreement with the main Italian consumer associations. In these markets, producers undertake to guarantee, in a

transparent manner, a saving of at least 30% with respect to product prices, which can be compared through the 'SMS Consumers' service.

Finally, a new project with a view to short supply chains has been promoted by the Slow Food Foundation. These are the 'Earth Markets', which involve small agricultural producers and have been activated for the first time in Lebanon. Each market is managed by a committee whose members are all members of the Alliance, i.e. the network of actors that will promote the market (public bodies, producer associations and Slow Food). So far, the project has seen the creation of five '*Earth Markets*' in Italy, including the Valdarno Market in Montevarchi and the San Miniato Market in Tuscany, which have joined the memorandum of understanding.

Alternative food networks

In recent years, the academic world has witnessed a flourishing of studies on Alternative Food Networks (AFNs) and Short Food Supply Chains (SFSCs) that are developing in countries with developed economies and how they attempt to reconfigure, in space and time, the relationships between producers and consumers (Marsden et al., 2000; Renting et al., 2003; Sage, 2003).

This interest has emerged because of the exponential growth these experiences have experienced over the last twenty to thirty years. Many of these studies suggest that these new food networks, beyond the diversity of definitions - "new" / "alternative" / "short" / "sustainable" (Murdoch et al., 2000; Renting et al., 2003) - are a response to the dominant agri-food system that distances and separates food production from its consumption (Venn et al., 2006).

On the one hand, post-World War II agriculture had increasingly become a specialised activity, undertaken by fewer and fewer people and remote from most citizens and even many rural dwellers (Holloway and Kneafsey, 2004); on the other hand, due to the industrialisation of food production practices and the just-in-time efficiency of the large-scale distribution network, still few consumers fully appreciate the process behind the farm-to-table concept as well as the opportunity to meet the people and places behind the production of the food they eat (Venn et al, 2006).

The innovative aspect of short supply chains lies precisely in their ability to 're-socialise' and 're-spatialise' food, through 'proximity' and more 'authentic' relationships that are created between producers, consumers and food (Marsden et al. 2000; renting et al. 2003). Such initiatives are thus configured as organisational forms of 'relocalisation' of food production and consumption, in contrast to the tendency towards standardisation and delocalisation that characterises the dominant agrifood system (Arce and Mardsen, 1993; Watts and Goodman, 1997; Whatmore and Thorne, 1997; Murdoch et al., 2000; Hendrickson and Hefferman, 2002; Watts et al, 2005; Roep and Wiskerke, 2006; Hinrichs, 2000 and 2003; Winter, 2003; Goodman, 2003).

The importance of initiatives to relocate food circuits lies in their intrinsic innovative potential. Short supply chains, in the various forms in which they are declined, are united by the willingness of the actors involved to build alternatives to conventional production-consumption circuits, aggregating and involving different subjects around values, principles, meanings, objectives - such as environmental, cultural, and ethical ones - and since rules other than purely economic values and objectives. (Lee, 1996; Thorne, 1996; Whatmore and Thorne, 1997; Sotte, 1997; Marsden et al., 2000; Hinrichs, 2000; Holloway and Kneafsey, 2000; La Trobe, 2001; Goodman and

DuPuis, 2002; Sage, 2003a,b; Renting et al., 2003; Ilbery and Maye, 2005; Kirwan, 2004 and 2006; Fonte and Grando, 2006; Brunori, 2003; Brunori, 2007; Roep and Wiskerke, 2006).

A common characteristic of such circuits is the willingness/ability to assign a meaning to food that goes far beyond that of a simple consumer good. In particular, food is assigned a strong 'relational value' (Goodman and DuPuis, 2002), linked, for example, to belonging, solidarity and conviviality, and all the processes that revolve around it are perceived not only for their functional aspect, but also for aspects relating to the sphere of social and political relations (Giddens, 1991; Cova, 1996 and 1997; Tovey, 1997; Holloway and Kneafsey, 2000; Lockie and Kitto, 2000; Allen and Kovach, 2000; Hinrichs, 2000 and 2003; Lockie, 2002; Guthman, 2002; Goodman and DuPuis, 2002; Renting et al., 2003; Winter, 2003; Goodman, 2003; Hassanein, 2003; Brunori, 2006; Brunori, 2007; Hendrickson and Heffernan, 2002; Feenstra, 2002), and environmental and health concerns (Thorne, 1996; Whatmore and Thorne, 1997).

Not being able, in fact, to compete on the same grounds as conventional supply chains - technological innovation, production volumes, production costs - short supply chains have shifted the focus of attention to the territory (Ploeg and Long, 1994; Ploeg and Dijk, 1995; Ray, 1999; Bryden, 1998; Iacoponi et al., 1995), as a key turning point in the "transition towards quality" (Murdoch et al., 2000; Marsden et al, 2000; Goodman, 2003) of the economic processes of production and consumption and in the affirmation of a "new paradigm of rural development", based on the principles of sustainability and multifunctionality, aimed at enhancing endogenous resources (Ploeg et al., 2000; Marsden et al., 1999; Marsden et al, 2000; Murdoch et al., 2000; Renting, 2003; Renting and van der Ploeg, 2003)46 as a "space of resistance" to the logic of globalisation in the food system (Holloway and Kneafsey, 2004; Hassanein, 2003; Murdoch and Miele, 2002; Kloppenburg et al, 2000) or as its alternative (Nestle, 2002; Norberg-Hodge et al., 2002).

At first, such initiatives arose from spontaneous movements and were mainly promoted by producers and consumers, culturally and ideologically oriented towards the creation of an alternative economic space, which would leverage the direct links between the world of production and the world of consumption. These originated as new forms of consumption characterized by a strong political orientation, even though they were not initially part of an organised social movement and supported mainly by the upper middle classes (DuPuis, 2000; Goodman, 2003).

The innovative potential of short supply chains lies in the ability of producers and consumers to succeed in creating a link, unifying business, and consumer interests, especially at local level (Hinrichs, 2003; Goodman and DuPuis, 2002): in this way, consumer choices take shape and integrate with those of producers, thus influencing the dominant food system (Kirwan, 2004; Lockie and Kitto, 2000; Tovey, 1997).

Relocalisation, therefore, takes the form of a process of transferring power into the hands of small farmers instead of a few multinational corporations. In this sense, from the point of view of small farmers and rural communities, the short supply chain can be understood as a strategy to reposition themselves with respect to the globalisation processes of the food system (Gilg and Battershill, 1998; Goodman 2003). In fact, producers express the need to find solutions to the difficult situation in which many companies find themselves: the process of concentration of production on an industrial scale and in the hands of the distribution system, as well as the globalisation of trade have marginalised many production systems, making small-scale activities unsustainable (Brunori et al, 2008c). Price squeeze ("price squeeze" Ploeg, 2000), low bargaining power along the food chain, difficulties in accessing conventional trade channels due to the lack of

regularity in production: in short supply chains producers identify a means of diversification to get out of this situation.

From the consumers' point of view, it appears to be a response to the growing needs emerging in terms of quality, safety, authenticity, but later, more political demands are added to these - linked to the unfair distribution of value along the food chain and to the negative environmental impact of the current food system (Tovey, 1997; Lockie, 2002; Goodman and DuPuis, 2002; Lockie and Kitto, 2000; Hassanein, 2003; O'Hara and Stagl, 2002; Fonte and Grando, 2006) - configuring these experiences as a social movement expressing increasingly developed forms of "food citizenship" (Hassanein, 2003; Wilkins, 2005) and incubators of broader forms of "citizenship" based on the values of the "alternative economy" (solidarity, sobriety, equity, sustainability, etc.) (Saroldi, 2003; Saroldi, 2005; Bonaiuti, 2004; Magnaghi, 2004; Perna, 1998; Pallante, 2005).

The desire to take an active political role in the food system on the part of consumers in short supply chains is associated with the need for participatory spaces where different visions, values and interests can be confronted in order to organise a food governance system (Welsh and MacRae, 1998; O'Hara and Stagl, 2002; Lang, 1999; Hassanein, 2003; Whatmore et al., 2003; Sonnino and Marsden, 2006).

The motivations that prompted producers and consumers to activate direct procurement channels have been changing over time: due to the food scandals of the last decade (BSE, dioxin-tainted chickens, etc.); for organisational reasons in the context of simple family procurement management; due to the desire to buy exotic or high-quality products at a discount; due to the need to buy products at a lower price. Currently, although there continues to be a certain sensitivity towards the quality of food products, the growing economic crisis and the reduction of the family budget constitute a further reason for establishing direct supply relationships, which allow the price of products to be reduced.

Finally, in some contexts and for some experiences, the entry into play of other actors - local authorities, traders, entrepreneurs - in the field of short supply chains has led to a destabilisation of the pre-existing balances, changing the reference values, objectives and strategies originally underlying these initiatives. These initiatives can, in fact, take on meanings quite different from those described above, representing an important tool to support local rural development processes within territorial marketing strategies (especially in the case of producers' markets) and in a broader vision, in the creation of sustainable local economies (in the case of movements promoted mostly by consumers, the final users of all the goods and services produced) (Brunori et al, 2007; Brunori et al, 2008; Rossi et al, 2008; Brunori et al, 2007a; Brunori et al, 2007b; Brunori et al, 2007c).

Relocation

From a public policy perspective, relocation has been considered for different reasons. Marescotti (2001) suggests the strong link between local food and rural development and sees in the promotion of typical and local products a key to territorial marketing strategies: in this regard, the impressive growth of the Slow Food movement (Petrini, 2001; Miele and Murdoch, 2002)

demonstrates the importance of local culture felt as a source of specificity and excellence. At the same time, other authors emphasise that such promotion can be placed at the basis of the strategy to improve the competitiveness of the food sector in Mediterranean countries on international markets: Fonte (2006), analysing Slow Food presidia, speaks of the transformation from a system based on 'local production for local consumers' to a system of 'local production for distant consumers'.

Focusing, however, on the local level, relocation implies a process of organisational innovation, the salient feature of which is the identification of a different conception of resources - and their communication - on which to leverage competitiveness (Dixon, 1999; Brunori, 1996; Brunori, 2007).

Collective experiences of direct selling take on different configurations in relation to the subjects that promote them, the methods of management and organisation, and the ideals underlying their implementation. In this thesis, two forms of short supply chains are analysed that can be traced back to experiences with a strong value base and can be traced back to 'food democracy' activities since they are based on food governance systems, i.e. participatory and democratic systems of interaction on food production and consumption issues (Whatmore et al., 2003; Hassanein, 2003; Sonnino and Marsden, 2006): farmers' markets and GAS. The latter are similar to the "Community Supported Agriculture" of Anglo-Saxon countries and to the "box schemes" widespread in all countries with developed economies.

Both experiences can be traced back to an alternative food chain, based on an organic, holistic, and ecologically sustainable production method (Kloppenburg et al., 2000).

Farmers' markets and GAS are configured as experiences that are deeply embedded in the local context, radically innovative (Brunori et al, 2007, Brunori et al, 2008), in which proximity, trust and reciprocity are values at the basis of their growth (Hollowayand and Kneafsey, 2000; Hinrichs, 2000) and their path towards consolidation (Brunori et al, 2007, Brunori et al, 2008). They provoke, from the inside, profound changes in the system of knowledge, techniques, and artefacts, as well as organisational models, and rules, routines, individual behaviour and systems of relationships (Brunori et al, 2007, Brunori et al, 2008).

Looking at these initiatives precisely because of their strong innovative implications, we are going to investigate their alternative nature through, the conditions underlying their growth and development (the learning and negotiation processes), the critical aspects that characterise them internally (communication and organisational skills, inclusion/exclusion dynamics) and those that influence them from outside (external rules, forms of support) (Brunori et al, 2007, Brunori et al, 2008).

Adjustments in the identification of a common trajectory are, in fact, necessary to overcome inconsistencies (especially in relation to principles and objectives) (Feagan and Henderson, 2008; Smithers et al., 2008) that still hinder the full development of these short supply chain experiences, limiting their space of action within niches. From the analysis it emerges that, through endogenous and mediated learning processes on the level of production and organisational routines (based on processes of comparison and integration between different rules and their codification), within the 'spaces of protection' created by the regime itself, producer markets and GAS are indeed creating an alternative system, but it is still in the process of 'stabilisation'.

These experiences, at the moment, appear to be well consolidated in the territory, given, on the one hand, the growing propensity of consumers to seek out and establish a direct relationship with agricultural producers, contributing to the creation of a local economic space as an alternative to

the dominant globalised one; on the other hand, the growth of organisational and relational capacities on the part of producers has favoured the affirmation of these innovative experiences, both as a sales-supply channel but also, at a cultural level, as a different way of approaching the production-consumption process.

At the same time, it is possible to state that, as niches, they have not yet reached the stage of consolidation: they do not yet appear capable of modifying the dominant socio-technological system, even though, at the local level, they are beginning to exert important pressures on different levels of society - the economy, ecology, culture, the sphere of social relations and institutional practices. This innovative power is increased exponentially by the interactions between individual niches belonging to different systems: if the challenge of producer markets and GAS is to address a transition from intensive, specialised, productivity- and export-oriented agriculture controlled by a few multinationals, to a more sustainable agricultural system based on a better use of available natural resources and social resources, the integration between these and other niches has the potential to induce a wider transition, involving several regimes at the same time. The path that these niches are taking on the road to their own consolidation and subsequent (desirable) transition, must consider, first and foremost, factors that will enhance their sustainability over time, rather than elements that promise immediate success, but may be a source of potential failure.

The multifunctionality of agriculture

The change in the relative importance of agriculture in the international economy also entails the transformation of the sector's internal production characteristics, which is evolving towards a 'modern' type of agriculture, characterized no longer only by the production of tangible goods, but also intangible ones, i.e. services, such as those related to the landscape, tourism or the rural territory, giving rise to multifunctional agriculture. Research centres, universities, farms, companies belonging to supply chain segments other than production and producer associations can respond in a broad and organic manner to market needs:

- cultivation and sale of organic products where the obvious strength lies in the concept of auxiliary energy
- offering fresh and genuine products free of chemicals, reducing environmental impact through short supply chains
- production diversification
- recovery of traditional plant varieties and craftsmanship
- tending the rural landscape and maintaining the vitality of rural communities

The multifunctionality of agriculture is thus part of a process of transformation of companies and the primary sector, which has seen the changing objectives of companies. In this sense, the concept of food safety, understood for developed countries in terms of food quality, has become increasingly widespread. One of the most important aspects of the short supply chain is the creation of a different production and distribution system of local food: on the one hand, a new process of revaluation of the local product is being initiated by untying it from the game of large-scale production and, on the other hand, new entrepreneurial ideas are being stimulated in a

sector with interesting development prospects in the long term. This impulse is generating the birth of several innovative start-ups in the agri-food sector, which are dedicated to the advancement and support of the short supply chain.

Specifically, it addresses the need expressed by the focus area

- Stimulating innovation, cooperation, and development of the knowledge base in rural areas
- Strengthen the links between agriculture, food production and forestry on the one hand and research and innovation on the other. Promoting the economic development of rural areas, reducing the risks attributable to the market power of wholesale retailers, and creating new job opportunities for people in the agricultural sector and thus contributing to the focus area.
- Improving the economic performance of all farms and encouraging the restructuring and modernisation of farms, to increase market share and market orientation as well as the diversification of activities, foster integration between producers and increase the level of concentration of supply and encourage the creation of supply chains and the direct linking of farms with processing and markets.

A very important aspect refers to the phenomenon that farms, which adhere to the short supply chain model, tend to implement more sustainable production methods, with positive effects on biodiversity, landscape, and natural resources.

- Preserve, restore, and enhance biodiversity.

The protection of biodiversity is confirmed by the analyses of several authors on the types of farms that approach the short supply chain most frequently. In France, for example, it has been verified that many agricultural entrepreneurs, practising direct sales, are in marginalised areas where the conservation potential of natural resources is very high. This indicates that the development of the short chain in marginalised areas may prove to be a favourable opportunity to ensure their conservation against the risk of abandonment. A study conducted by the FAO estimated that 75% of the diversity of national cultures has been lost since 1900, not only due to climate change, but also because of today's organised distribution systems that favour intensive production techniques, large quantities and standardization of supply. In this way, there is the risk not only of impoverishing the food diet, but also of losing an important heritage of biodiversity, and with it the cultural and environmental identity of a given region. According to a survey by Coldiretti, in Italy about one hundred plant varieties defined as minor and products obtained from thirty different breeds of animals bred on a small scale, can only find an outlet thanks to the emergence of alternative food chains.

The reorganization of the production process is favored by the adoption of the short channel, as producers have the opportunity to regain control of the decision-making power over their activities, avoiding the so-called 'squeeze on agriculture'. This situation arises when the first link in the short chain is squeezed, on the one hand, by the input costs of multinational input suppliers and, on the other, by the low prices of the wholesale market to which it sells its products. Reorganisation of production can also result from the propensity to adopt farming techniques with a lower environmental impact, such as organic farming.

Conclusions

The choices and strategies mentioned seem to be made to better guarantee the quality and food safety requirements increasingly demanded by consumers. "In this context, the proliferation of different forms of short supply chains represents a great opportunity to reduce the negative externalities of agriculture on the environment - soil impoverishment, water pollution, animal welfare problems, the disappearance of natural habitats and special landscape features - associated with the intensive methods of conventional agriculture, and to respond actively to the resource-efficient and climate-resilient economy.

The *short chain* represents a more environmentally friendly alternative system to the traditional one: the highest environmental costs of the food chain - in terms of carbon dioxide emissions, air pollution, accident risk, noise pollution - are associated with large-scale production and distribution over areas far away from the production site. Finally, an assessment of the environmental costs is not complete without considering the final stage of the supply chain itself, i.e. waste management. The reduction of intermediaries translates, for example, into the elimination of much of the waste and residue associated with the use of packaging required by conventional distribution. Waste from the conventional food sector, created in industrial preparation and processing processes and caused by the waste of irresponsible consumers, is very high: it is estimated that total food losses, from field to consumption, reach 30-40% of production. The impact of this waste is predominantly environmental: in addition to the economic and ecological costs in terms of water, pesticides and fertilizers for production and oil for transport, the decomposition of waste contributes to the production of methane, and thus to increased levels of air pollution.

Resources & Linkography

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