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Regenerative Agriculture. An innovative approach towards mitigation of climate change through multi-tier learning

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DEGLI STUDI
FIRENZE
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DIPARTIMENTO DI SCIENZE
E TECNOLOGIE AGRARIE,
ALIMENTARI, AMBIENTALI E FORESTALI

National Report

Italy

Regenerative agriculture. An innovative approach towards mitigation of climate change through multi-tier learning

REGINA

REGINA

Contents of National Report, Result 1.

Chapter 1. Overview of RA uptake and prospects in the country (IT)

1.1 Introduction, including some basic statistics about agriculture and farm, produce in the country, e.g. share of employment, the share of GNP, % of land farmed, types of products, and % in the overall agricultural production

As reported in the report of the 7th National Agricultural Census (ISTAT, 2022), "as of October 2020, 1133023 farms were active in Italy, about 30.1% less than those registered in 2010 (1620884). 93.5% of farms are managed as individual or family-owned businesses. Over 664000 farms (approximately 58.6% of the total) exclusively cultivate their land, while 41.4% of farms cultivate only leased land or combinations of owned and leased land. On average, the utilized agricultural area (UAA) and total agricultural area (TAA) of Italian farms are approximately 11.1 and 14.5 hectares, respectively. The individual or family-owned farms have an average UAA of about 8.6 hectares, much lower than that of general partnership companies (41.6 hectares) and capital companies (41.5 hectares). In general, most of the farms have a UAA comprised between 1 and 10 ha (57%), followed by farms with a UAA of less than 1 ha (21.3%) and comprised between 10 and 100 ha (20.2%), while the farms with a UAA higher than 100 ha represent the 1.6% of the total. More than half of the UAA is cultivated with arable crops (57.4%), followed by permanent meadows and pastures (25.0%), woody crops (17.4%), and family vegetable gardens (0.1%). In more detail, arable crops are grown on over half of the Italian farms (more than 700000), for an area of over 7 million hectares and an average size of 10 hectares by farm. Among the arable crops, the most widespread are cereals for grain production (44% of the arable crop area). In particular, durum wheat is grown in over 135000 farms for an area of over 1 million hectares. Agricultural woody crops are cultivated by around 800000 farms for a total surface area of 2.1 million hectares and an average size of 2.7 hectares by farm. Most woody crops are concentrated in South Italy, especially in Puglia, Sicily, and Calabria which together hold 46% of the farm and 47% of the area cultivated with woody crops. Among the woody crops, the olive tree is the most widespread with more than 994000 ha over about 619000 farms (22.6% of farms cultivating woody crops), then the vine is cultivated by about 255 thousand companies for an area equal to over 635 thousand hectares. Fruit trees, which include fresh fruit, nuts, or berries, are grown in 154000 farms, for an area of over 392000 hectares. Permanent meadows and pastures are present in around 285000 farms and occupy an area of 3.1 million hectares. In 2020, there are about 214000 farms with livestock in Italy (18.9% of active farms). The overall extensions in terms of UAA and TAA of livestock farms are respectively 5 million and 6.5 million hectares, or 40.4% and 51.9% of the respective national totals. Compared to the total number of farms, farms with livestock have a greater impact in the North-West (36.2%), while the smaller incidence characterizes the South (10.6%). On a regional scale, Sardinia excels with around 24000 farms (10% of the total), followed by Lombardy and Veneto, with around 20000 farms, and Piedmont with 18000 farms. There were 203 million animals raised, of which 8.7 million pigs, 7 million sheep, and 5.7 million cattle. The largest contribution of farmed

animals goes to the North-East, where half of all registered animals are found. Traditionally, farms are characterized by the strong prevalence of farms with family labor (about 1114000 farms). The most common type of non-family labor is the seasonal one (about 128000 farms), followed by permanent staff (about 347000 farms) and other kinds of contract (over 87000 farms). In 2020, women are around 30% of the total number of employed persons and 31.5% of farm heads are women. Only 13% of farmers are under 44 years old, while over 57.5% are over 60. In 2020 almost 2.8 million people work in the agricultural sector. In 2021, the agricultural sector recorded a GDP of 38.8 billion euros, corresponding to 2.2% of the entire Italian national GDP.

ISTAT, 2022. Report sul 7°Censimento generale dell'agricoltura: primi risultati. https://www.istat.it/it/files//2022/06/REPORT-CENSIAGRI_2021-def.pdf

1.2 Overview of regenerative agriculture and other alternative farming methods uptake (e.g. organic, conservation, etc from published sources and the internet. Make a brief presentation of the history of alternative farming methods in the country, including Regenerative Agriculture and related farming methods, legislation, and regulations (if they exist)

Regenerative Agriculture and related farming methods are not regulated in Italy. The only alternative agriculture methods regulated by the Italian state are organic farming and, partly, conservation agriculture.

1.2.1 Organic farming system

As reported in Organic Europe (Organic Europe, 2022), organic farming begins to take hold during the 1970s. In the mid-80s the national commission for organic farming was born. In 1986 the first Italian organic farming regulations were published. in 1988 AIAB (Italian Association for Biologic Agriculture) is founded. In 1990 the first international congress of organic agriculture in the Mediterranean countries takes place in Vignola. In 2000 the ministry of Agriculture, food and forestry policies established the SINAB, the national information system for organic agriculture. This platform offers information and services to organic stakeholders for the development and promotion of the sector. In 2008, the 16th organic world congress of the international federation of organic farming movements (IFOAM) takes place in Modena.

Today, in Italy, the consumption of organic food products accounts for over 3.3 billion euros corresponding to 4% of Italian food spending and representing 10% of the total value of the organic market at the European level (Willer et al., 2021). In 2020, Italy accounted for over 1990000 hectares of cultivated land in the organic farming certification system and organic farming accounts for 15.8% of the national UAA (ISTAT, 2022). There are over 80000 registered operators, representing 6.2% of total Italian farms. Of the operators, almost 59000 are exclusive producers (farmers), about 9500 exclusive food processors, and the remaining are producers/processors (CREA,

2021). the average UAA of organic farms is about 28.3 hectares, so higher than the national UAA of 11.0 hectares. According to bioreport2020 (BIOREPORT, 2020), the main crops comprise permanent grassland (over 550000 ha), followed by the extent of plants harvested green (over 395000 ha), cereals (about 330000 ha), olive groves (about 243000 ha) and vineyards (about 109000 ha). Organic arable and vegetable crops are mainly represented in decreasing order by sunflower (26%), tomatoes (21%), soy (15%), legumes (13%), rice (12%), alfalfa (8%), durum wheat (6%), and barley (3%).

Organic farming is an agricultural method aimed at producing food with natural substances and processes. This means that it tends to have a limited environmental impact, as it encourages: using energy and natural resources responsibly; conserving biodiversity; conserving regional ecological balances; improving soil fertility; maintain water quality. Furthermore, organic farming rules promote animal welfare and require farmers to meet the specific behavioral needs of animals.

According to AIAB recommendations, the main actions on which cultivation under OA is based are:

• Improve and increase organic fertility – through the use of composted organic fertilizers, the practice of green manure, the burial of crop residues is the inclusion in large rotations of legume crops, to increase the quantity and quality of the organic substance of the soil. To support yields and improve the quality of production, it is possible to resort to the list of fertilizers allowed by the regulation;

• Rotation or rotation of crops – is the key to the success of herbaceous and horticultural crops. An Italian Ministry Decree indicates that: between a crop and its return on the same land, there is the cultivation of at least two cycles of different crops, of which at least one is composed of legumes or green manure. This should be considered the minimum certifiable limit, it would be appropriate to diversify as many as possible the type of crops, also to encourage the company's biodiversity. The rotation is then the main control element of weeds supplemented by mechanical actions and containment and prevention against pathologies and pests;

• The varietal choice – to date, research has produced and tested very few specific varieties for the organic; it is, therefore, useful to base oneself on the technical know-how and experience of organic producers in your area, to orient oneself to varieties that have demonstrated adaptability to the territory, ability to compete with weeds and resistance to major adversities. This attention is very valid for new plants of fruit trees and tree crops in general;

• Creation of hedges and trees – useful not only to improve the landscape but to increase biodiversity, therefore protecting crops, giving hospitality to natural predators of pests, and also acting as a physical barrier to possible external pollutants;

• The consociation – not turning over the ground over 25/30 cm and ensuring the breaking of the deeper layers with disjointed tools, always trying to protect the soil, favoring stability with suitable hydraulic arrangements and applying, where possible and especially in the arboretum's vegetable cover;

For animal breeding, according to AIAB the general principles should ensure maximum well-being, provide that animals are allowed to express their natural behavior, limit any form of intensive breeding and provide that animals can enjoy the minimum spaces defined in the regulation, have freedom of movement inside of the stable and free access to the outside. In addition, a balanced diet and veterinary care are based on homeopathy and phytotherapy.

EU legislation on organic farming and other regulations apply in Italy, but there are also additional provisions. The competent authority is the ministry of agriculture, food, and forestry. The European Union regulations on organic farming are designed to provide a clear structure for the production of organic products across the EU. The intention is to satisfy consumer demand for reliable organic products while creating a fair market for producers, distributors, and retailers. The EU maintains the following strict control and enforcement system to ensure that the rules and regulations on organic products are properly complied with. Each EU member designates the "control bodies or authorities" responsible for inspecting operators in the organic food chain. Producers, distributors, and retailers of organic products must register with their local regulatory body before they can market their products as organic. After inspection and control, they will receive a certificate confirming that their products comply with organic farming standards. All operators are audited at least once a year to ensure they continue to follow the rules. Imported organic foods are also subject to control procedures to ensure that they have also been produced and transported following organic production principles.

Since 1 January 2022, Regulation (EU) 2018/848 of the European Parliament and of the Council of 30 May 2018 is the applicable legislative act, also known as the basic act, laying down the rules on organic production and labeling of organic products

1.2.2 Conservation agriculture

As reported by Caretta et al. (2021), conservation agriculture (CA) was promoted in the European Union's Common Agricultural Policy (CAP, Rural Development 2014–2020) as a means of addressing the primary environmental problems, such as carbon dioxide (CO2) emission from agricultural lands, decreasing biodiversity, and limited water availability (Armengot et al., 2015; Bouma and McBratney, 2013).

Soil conservation is one of the main priorities of the 2014–2020 Rural Development Plant in Italy where 15 out of 21 RDP programs granted support to farmers to adopt soil-friendly practices such as no-tillage, cover crops, and mulching under the scheme of Measure 10, allocating 280 million euros for a target area of about 200,000 hectares of UAA (Marandola et al. 2019).

There are no official data on the number of farms practicing conservation agriculture in Italy. According to Aigacos (Associazione Italiana per la gestione agronomica e conservativa del suolo - Italian association for the agronomic and conservation management of the soil) estimates, based on projections of the sixteen Italian Regions that have adopted RDP measures in favor of the CA and on direct surveys carried out by the various Regions, in Italy we have gone from 80 thousand hectares in 2008/09 to around 800 thousand in 2018.

As reported by Marandola et al. (2019), CA aims at sustainable agricultural production and soil management in both environmental and socio-economic terms. Quite apart from the difficulties related to investments in purchasing equipment for CA, from an economic perspective, the issues considered in the literature are those related to the impact on costs and revenues related to the adoption of CA. Cost reduction is largely due to oil and energy saving, but also to labor savings and machinery depreciation, and some other authors report CA benefits on investment efficiency and productivity. Labor requirements are generally reduced by about 50%, which allows farmers to save on time, fuel, and machinery costs. Fuel savings in the order of around 65% are in general reported. On the other hand, the effects of CA adoption on yields seem to be limited. The yield levels of CA systems seem to be comparable with those under conventional intensive tillage systems, which means that CA should not lead to yield penalties. Several studies indicate that conservation agriculture has positive effects on soil quality and protection, water regulation, energy use, and production costs, but productivity increases are minimal or even negative and often dependent on herbicide use.

This approach consists of practices aimed at achieving sustainable and profitable agriculture through the application of three fundamental principles: (1) minimizing mechanical soil disturbance (reduced tillage or no-till), (2) maintaining permanent soil cover by using crop residues and cover crops, and (3) adopting crop rotations (Caretta et al., 2021).

• Minimal mixing of the soil (using no-till sowing or reduced tillage) to preserve its structure, organic matter content, and living beings. In this way, the mixing of the surface layer of soil takes place naturally by the fauna present in the soil (earthworms and other organisms) and by the roots of the plants.
• Permanent cover of the soil with organic material (crop residues, cover crops) in order to protect it from the sun, rain, and wind and to provide food for the living beings that inhabit the soil (microorganisms, earthworms, insects, etc.) and contribute to maintaining its fertility. The biomass covering the ground reduces the mineralization of the organic matter, which is maintained and gradually increased. Furthermore, the development of weeds is prevented, while the infiltration of water into the soil is facilitated by reducing evaporation.
• Crop rotations, which reduce weed and disease pressure on crops. The alternation of crops with different root systems favors the exploration of the soil at different depths and better extraction of nutrients useful for the crops.

Armengot, L., Berner, A., Blanco-Moreno, J.M., Mäder, P., Sans, F.X., 2015. Long-term feasibility of reduced tillage in organic farming. Agron. Sustain. Dev. 35, 339–346.

Bouma, J., McBratney, A., 2013. Framing soils as an actor when dealing with wicked environmental problems. Geoderma 200–201, 130–13

Carretta, L., Tarolli, P., Cardinali, A., Nasta, P., Romano, N., Masin, R. Evaluation of runoff and soil erosion under conventional tillage and no-till management: a case study in northeast Italy Catena, 197 (2021), Article 104972, 10.1016/j.catena.2020.104972

CREA (2021), Annuario dell'agricoltura italiana 2019, Vol. LXXIII, Roma.

Marandola, D., Belliggiano, A., Romagnoli, L. et al. The spread of no-till in conservation agriculture systems in Italy: indications for rural development policy-making. Agric Econ 7, 7 (2019)

Organic Europe, 2022. https://www.organic-europe.net/country-info/country-info-italy/country-report.html Last time accessed 20/11/2022.

Willer H., Trávníček J., Meier C., Schlatter B. (a cura di) (2021). The World of Organic Agriculture, Statistics and Emerging Trends 2021, Research Institute of Organic Agriculture FiBL, Frick, IFOAM – Organics International, Bonn.

1.3 Interviews with stakeholders: public authorities, farmers' associations, agronomists' associations etc, LEADER network, Chamber of Agriculture etc. Short presentation of the views of the stakeholders; and of any other information they would provide, which is of interest for the REGINA library.

The Alberese Demo-Farm

Interview with Dr. Alessio Mariotti, technician officer of the Tuscany region.

Alberese Demo-farm, located in the heart of Maremma south of Grosseto, covers more than 4200 hectares, of pine forest and woodland, arable land, natural pastures, and olive groves. The Alberese Farm is owned by the region and its objectives are agricultural management activities but also dealing with experimentation and testing of agricultural innovation. In addition, they have livestock farming for the local cattle "Maremmana" typical of the area between lower Tuscany and upper Lazio near the coastal strip. They have never heard about regenerative agricultural practices but their demo farm is in contact with a lot of farmers that apply organic and conservation agricultural practices, but none of them know what is the RA. In their opinion, RA practices should be interesting for the farmers that are open the innovations, but there are cultural obstacles and technical knowledge gaps that can represent a big problem for RA development. According to their thought, farmers will obtain some benefits only if well-restored by the national and international institutions that will cover the increasing costs for RA adoption. Regarding the society and environment, they think that RA practices could increase the awareness of biodiversity in their surrounding landscapes while reducing greenhouse gas emissions. From their point of view, agriculture is not only the cultivation of crops but also a profound link with the territory, hence they will be very happy with any techniques that improve the quality of their environment while ensuring them an adequate wage. However, as previously mentioned, they think that financial support is pivotal because none of the farmers will consider the changing the way of cultivating their land if they will have lost money. Their farm is is used for improving the knowledge of the farmers, therefore its role is basically the supporting of the innovation adoption from the farmers by means of training, information days, demonstration days, seminar, the writing of practical protocol for the application of RA practices. If they will not afford the training for farmers, maybe agricultural associations, as well as other organizations, will provide them. However, they are not so sure about the prospects of spreading RA because on the one hand there is interest in the application of new practices, on the other hand, the business-as-usual model is a real problem for the farmers. They think that the possibility of RA adoption should be well evaluated by the European institutions, which should be in contact

with local farms and organizations as their point of view is necessary for the adoption of RA practices.

Bristol Soc. Agr. Cons.

Interview with Dr. Tommaso Concari, quality management manager and agronomic technician of Bristol Soc. Agr. Cons.

The Bristol Soc. Agr. Cons. born in 1999 to commercialize melons and watermelons with the best agronomical techniques respecting both product quality and the environment. They have already heard about Regenerative Agriculture (RA), but without a clear idea; actually, they know some farmers that apply both organic and conservation agriculture, but no one that applies RA practices. Furthermore, in their opinion there is little knowledge about the topic, therefore training courses and financial support are necessary for farmers because currently there is no clear framework on how It will be regulated in the EU. The obstacles they have identified are the lack of adequate legislative, regulatory, bureaucratic, and financial support; hence, RA practices could be risky as they can represent an additional burden of bureaucratic activity for the producers. According to their thought, on the one hand, RA could reduce farmer's workload, on the other hand, it could reduce farm productivity, determining a need for economic support for purchasing the tools and compensating for the unproductive land; regarding society and the environment, it could achieve a healthier society that poses attention to the environment and ecology for combating climate change. The way they see it, funding and the duration of the funding will be the pivotal aspects for any likelihood of farmers taking up RA: specifically, a long-term perspective should be considered, for example making the products obtained from RA practices recognizable in the market, enhancing their value. They are willing to support RA through disclosing activity only if a well-regulated practice will be achieved. They think that strong financial support will be required and they can also cooperate with experts for providing training to farmers on RA; otherwise, some of the training facilities should provide RA training courses to the farmers. Overall, they think that only strong regulation can give any prospect of spreading RA among the farmers in this country. The practices should be addressed from the European institution to the local level, going through states and regions.

Cesa Demo-Farm

Interview with Dr. Luigi Fabbrini, expert programming, and planning officer of the Tuscany Region

The Cesa Demo-Farm is owned by the region and has been engaged in the testing and transfer of innovation together with the applied research in the field of agriculture and forestry for more than 20 years; therefore, it is an experimental farm where the following take place: trials for supporting the choices in terms of Common Agricultural Policy (PAC) and respond to the needs for innovation from the rural world. They don't know any farmers that apply different-from-conventional

practices. In their opinion, RA practices should be feasible and they are very interested. The lack of technical skills on this topic has been identified as one of the main obstacles to taking up RA; however, the possibility of knowledge transfer will be assessed for different farms and landscapes. According to their thought, better prices for agricultural products are required as well as lowers costs in the medium term for the adoption of RA practice. Regarding the environment, they think that RA practices could increase biodiversity through the increase of the use efficiency of the agrochemical input while reducing pollutants. From their point of view, some of the RA practices have been already used; this kind of approach is simply keeping them together and giving them practical function. To sum up, it is an approach in which known techniques are used in an integrated and coordinated way. Furthermore, the availability of funding is a good incentive for the farmers, meanwhile creating rural districts to encourage the dissemination of RA practices among the farmers; they think that only creating a local identity will encourage the marketing of productions. Their farm is supporting the wider uptake of RA by farmers, even if they don't currently have a policy; being a regional company for demonstration and technology transfer in agriculture, they could adopt demonstration models together with scientific institutions to illustrate the pro and cons of these techniques to the farmers. We could organize days with demonstration visits and public meetings. Their thought is that financial support is useful but not essential. From the future perspective, they can see a lot of farmers that have already adopted organic farm principles, and they think that the same should be done for RA practices. Regarding the RA policy, some incentives for this type of agriculture are required, from their point of view, encouraging the formation of aggregation centers of the farmers at the district level, while supporting technology transfer.

Italian Farmers Confederation (Cia)

Interview with the agronomist Lapo Baldini, director of the executive committee of CIA Toscana Centro

The "Italian Farmers Confederation (Cia)" is one of the largest trade organizations in Europe working for the improvement and enhancement of the primary sector and the protection of the conditions of its workers, counting on about 900,000 members in Italy. The Cia focuses on sustainable agriculture with attention to quality, safety, food education, environmental protection and enhancement, forestry, organic farming, and alternative energies; its areas also include publishing and agricultural legislative information. They have never heard about Regenerative Agriculture (RA), and they don't know any farmers that apply the AR, but they know some farmers that apply the principle of conservation agriculture. In their association, there are no farmers that apply RA, but probably throughout the country, there are some of them that apply previous principles. However, the feasibility of RA should be taken into account by the consequences of RA adoption. In their opinion, the main obstacles are represented by international trade as a lower yield may be a consequence of this kind of agriculture, therefore determining an increase in the production costs per unit of product. The customer would not accept paying more for the products, being

a problem for the same farmers, which could determine progressively an abandonment of the field. They don't think there are huge benefits for the farmers as is not a cropping system that can be applied to all agro-environments. In particular, no-tillage management is not feasible throughout the clay-silty hillside of our territory. Additionally, a detectable increase in the prices caused by the lower productivity of the agricultural area could affect society, determining lower national production and causing an increase in the dependence on external products. Accordingly, farmers could progressively abandon the management of the land because of the lower income. In hilly areas, no-tillage could reduce water infiltration and as a consequence increase the runoff. It could increase hydraulic risk in the valley bottom as well as reduce the groundwater recharge in the hillside area. They supposed that farmers could start to apply for RA only if they will be financially supported in the long-term period, otherwise, no one will adopt it. Their confederation is a farmer organization, hence if they will not see any benefits for the farmers, they will not support it. Till now no policy about the RA as well as RA methods is available. They could be willing to give rise to courses at the request of the farmers, only if there were a comprehensive, long-term structured design from a policy perspective. The strong financial support from the government is seen as an essential point from the confederation for the farmers to take up RA. However, they think that nowadays RA is not a priority. For the future adoption of RA, the policy should be accounted at the national level under a European context. However, since choices have both economic and territorial impact, the management should be done at the local base in a well-structured framework

The Consorzio di Bonifica Medio Valdarno

Interview with Dr. Daniele Vergari, office manager of Consorzio di Bonifica Medio Valdarno

The "Consorzio di Bonifica Medio Valdarno" is a mandatory consortium among property owners to safeguard their property from hydraulic and hydrogeological hazards The Consortium maintains and manages waterways and designs works and new works; it is therefore a technical-operational entity structured to design and execute works internally and through external contracts. The ordinary activities of the Consortium are financed by the land reclamation fee and public funding for new works. Despite they have already heard about Regenerative Agriculture (RA), none of the members of their consortium practice the RA. In their opinion, RA practices seem interesting it would not be applied without adequate legislative, regulatory, bureaucratic, and financial support. Accordingly, training courses are required as there is no certainty about the right framing in the regional administrative procedures. They see the risk of RA transformation as an additional burden of bureaucratic activity on producers. Farmers could enhance their skills and knowledge about new practices, while society should have a better awareness about the common staff. Regarding the environment, they think that RA practices could increase awareness of the management of the ecological and environmental dynamics while contrasting climate change. In general, they think that the likelihood

of farmers taking up RA practices depends on funding sources and bureaucratic efforts; if properly supported farmers have every interest in participating in this kind of activity. However, in their opinion only creating opportunity and bringing real benefits (bureaucracy alleviation, simplified forms of control, economic sustainability) would allow the farmers to adopt the RA practices. On the consortium's behalf, they are interested in developing the diffusion of this kind of agriculture through training courses for farmers or coordinating the farm activity at the basin and landscape level. Financial support from the government is seen as a good point for the farmers to take up RA. However, they think those good perspectives are available for the spreading of RA among the farmers in Italy. Their thought is that RA adoption should be afforded at the state level to harmonize the legislation among the regions, together with European Union

Giovan Battista Landeschi Association

The Giovan Battista Landeschi Association was born in 2005 to contribute to the design and reconstruction of the identity in the agricultural sector as well as of the rurality as a whole. The association is a kind of “laboratory” where cultural and historical heritage is necessary for the development of agricultural and agro-industrial activities. They have limited knowledge about Regenerative Agriculture (RA); despite they know some farmers that apply both organic and conservation agriculture (CA), they don’t know any farmers that apply RA, even if RA and CA have common practices. In their opinion, first of all, the RA definition must be accepted by the Italian agricultural societies, then training activities should be necessary; otherwise, a wrong classification for the public administrative procedures could mean an un-useful bureaucratic burden for the farmers. The obstacles they have identified are RA acceptance and classification. According to their thought, a strong economic restoration for introducing RA practices is required, such as a discount for the sale of no-tillage instruments, a restoration for the initial lower yield, and a money supply for the increase of the unproductive area. Regarding society and the environment, they think that nowadays it is difficult to state a potential reduction of pesticide use because it should be assessed; on the other hand, RA practices could enhance the attention to the ecological and environmental dynamics to obtain a healthy environment through the reduction of greenhouse gas emissions. From their point of view, strong financial support will simplify the application of RA practices, but also the duration of the financial support will affect RA acceptance; another condition they consider necessary is a common policy for reducing the agricultural bureaucracy linked to the RA practices. However, they are willing to support RA training courses and seminars only if a well-regulated definition will be achieved by the agricultural scientific societies. Financial support from the government will be required according to their point of view. They are not training centers but they can help to develop this kind of the project; the duty would go to the regional training centers if they’ll not provide training. Overall, they think that only strong regulation can give any prospect of spreading RA among the farmers in this country. The practices should be addressed from the European institution to the local level, going

through state and region; moreover, in standardization, states and regions should rely on the Italian academies of agricultural science, since they are trying to standardize principles of agriculture.

1.4 Conclusions regarding the RA uptake and prospects

Nowadays, RA could represent a good opportunity for farmers. As RA is mainly based on Conservative Agriculture (CA) principles, can contribute to higher farmers' income. It must be noted that farmers can rapidly convert to RA farming as it is profitable to do so.

However, AR is not a well-known form of agriculture in Italy. Few farmers and stakeholders have heard of it and generally not in depth. The lack of training courses and available knowledge on this topic has been identified as one of the main obstacles to taking up RA. Further, RA and related farming methods are not regulated in Italy. The only alternative agriculture methods regulated by the Italian state are organic farming and, partly, conservation agriculture. A common policy for reducing the agricultural bureaucracy linked to RA practices is needed. Furthermore, long-term support is required as the supposed environmental and economic benefits should be obtained on a long-term basis. However, it is not only a matter of production but also a matter of marketing or selling the RA products. Hence, the joint marketing practice that has been implemented by farmer groups in organic agriculture can be one of the ways to ensure the viable marketing of RA products. Moreover, creating rural districts to encourage the dissemination of RA practices among the farmers and creating a local identity around these districts will encourage the marketing of productions.

Chapter 2. The farmers' online survey

2.1 Introduction, including the number of respondents, and any problems that came to your attention. Timing and duration of the survey.

The aim online survey is to identify acceptance and land managers' behavior towards Regenerative Agriculture. The sample size of the survey is 141 respondents. The main problem was finding a connection with the farmers. Connections were sought throughout the territory with farmers' associations and consortia at the provincial level, but there was little feedback (both positive and negative). Another problem was the reduced propensity of many farmers, also given the high average age of this category of workers, towards the use of information systems. The questionnaires are forwarded to consortia and farmers' associations distributed throughout the country. The questionnaires were proposed to farmers during meetings in which the concept of regenerative agriculture and the aims of the Regina project were briefly illustrated. The questionnaires were completed not in digital format, but in hard copy and delivered by hand to the partner UNIFI.

2.2 Report of results. Report per question please, include absolute values and percentages, and use graphs according to your judgment (pies and histograms are automatically produced by google docs).

2.2.1 Gender

The final number of compiled questionnaires is 141. The majority of respondents (77.3%) in the sample are male (109), while the remaining 22.7% of the respondents are female (32). All in all, for a sector in which the male presence has always been dominant, the number of female farmers is substantial and is a positive result of the policies and economic supports that have been adopted over the past twenty years by the Italian Regional administrations to encourage the entry of women into agricultural activity. Figure 1 shows the share of respondents by gender.

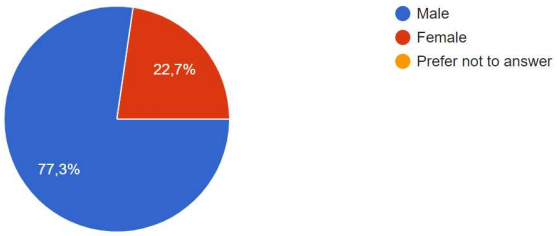

Figure 1. Share of respondents by gender (N=141)

2.2.2 Please fill in your age

The majority of respondents in the sample are between 36 and 45 years old (n=45; 31.9%), followed by respondents older than 55 years old (n=32; 22.7%), respondents aged between 25-35, and respondents between 46-55 (for both n=28; 19.9%), and finally respondents younger than 25 years old. Contrary to what we would have expected, the survey sees a fairly young sample of farmers, compared to the average composition of Italian farmers. This is probably because few older farmers participated

in the survey as there is less interest in their age group in changes in farming techniques which are often viewed with suspicion. Figure 2 shows the share of respondents by age.

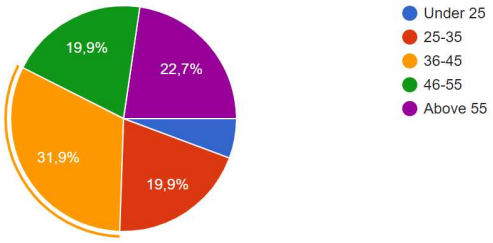

Figure 2. Share of respondents by age (N=141)

2.2.3 Please add the location of the farm (type in the postal code)

The majority of respondents in the sample come from Tuscany (34 individuals, 24.1%), followed by Campania (n=26; 18.4%), Apulia (n=22; 15.6%), and Emilia Romagna (n=12; 8.5%). As regards the remaining Regions, the number of acquired questionnaires is less than 10 per Region. Figure 3 shows the distribution map of respondents.

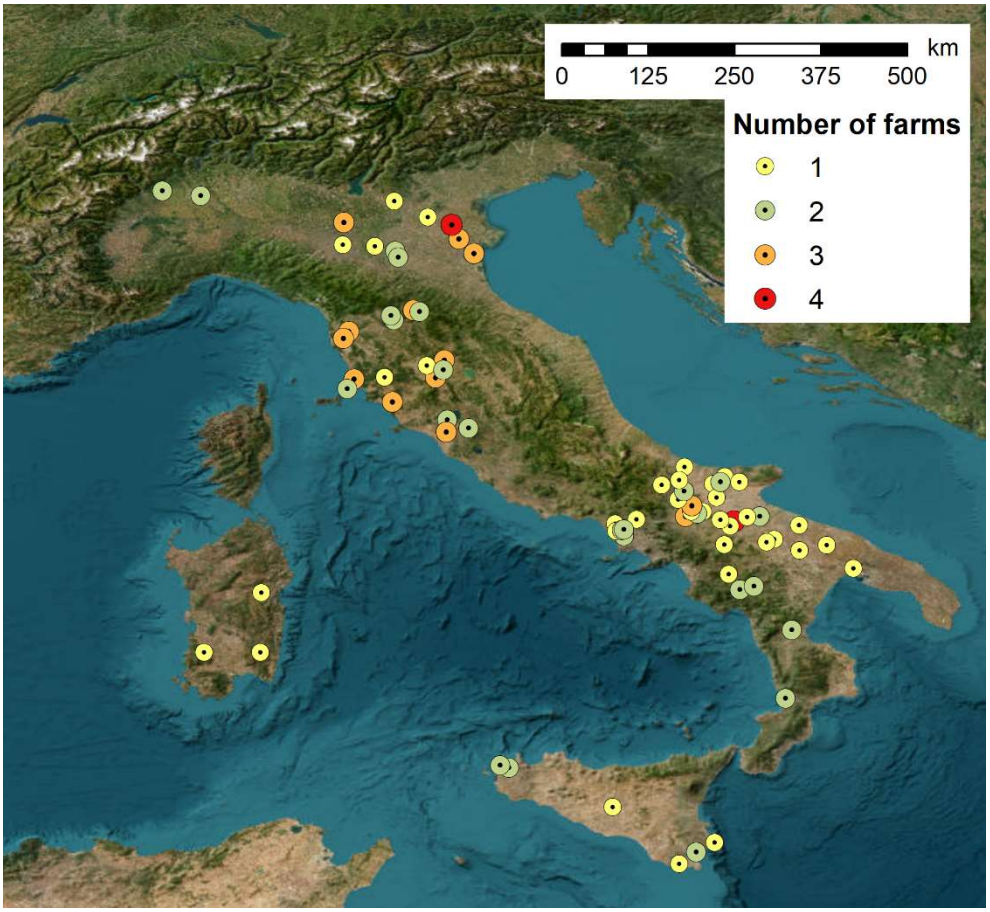

Figure 3. Distribution map of the respondent.

2.2.4 Please indicate the size of the farm (in hectares)

Most of the farms have an extension comprised between 50 and 100 ha (n=65; 45.1%), followed by farms with an extension comprised between 11 and 50 ha (n=38; 27%) and farms with an extension comprised between 100 and 1000 ha (n=30; 21.3%). Further, 8 (5.7%) of the respondents hold a farm with a surface of less than 11 ha, while none of the respondents hold a farm with a surface larger than 1000 ha. Figure 4 shows the share of respondents by farm surface.

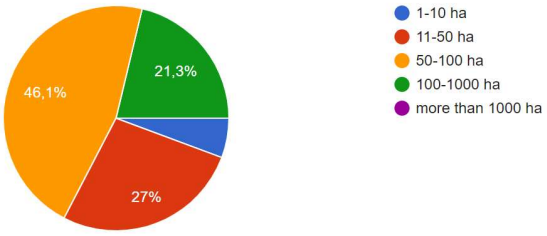

Figure 4. Share of respondents by farm surface (N=141)

2.2.5 Please indicate the number of people working on the farm (permanent staff)

The analysis of the answers to question "2" highlighted some anomalies. Indeed, 7 and 3 farms indicated that they have 10-30 and 30-50 permanent employees, respectively. The data was verified by contacting the farms and it turned out that in all the cases the questions had been misread and the number of seasonal employees had been added to the number of permanent employees. After verifying the data, it turns out that 115 farms (81.6%) have less than 5 permanent staff, while 26 farms (18.4%) have between 5 and 10 permanent staff. Figure 5 shows the share of respondents as a function number of people working on the farm as initially indicated by the farms.

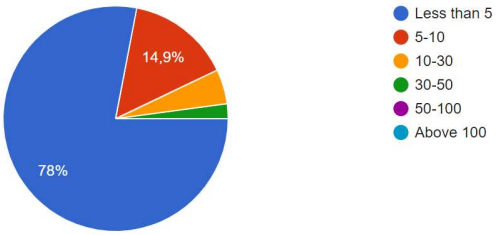

Figure 5. Share of respondents as function number of people working in the farm as initially indicated by the farms (incorrect data is present)

2.2.6 Please indicate the main products of the farm (considering the last 5 years)

almost all respondents in the sample (n=135; 95%) cultivate "arable crops". Both those growing "fruit production" and those growing "vegetables" account for 47.5% of the sample (n=67). Finally, 21 farms (14.9%) cultivate vineyards. Only some farms in the sample (n=20; 14.2%) carry out mixed farming, equally divided into farms having dairy livestock (n=10; 7.1%) and dry stock (n=10; 7.1%). Figure 6 shows the share of respondents by the main production of the farm (considering the last 5 years).

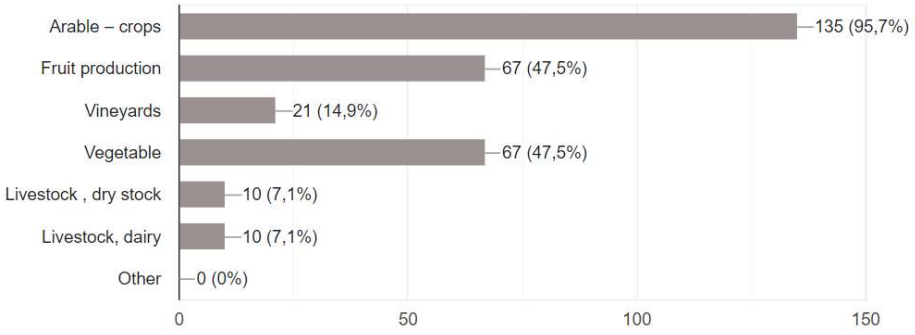

Figure 6 shows the share of respondents by the main production of the farm (considering the last 5 years).

2.2.7 I would consider myself a farmer, who mainly follows…

Mainly, the sample is composed of farms adopting conventional farming practices and methods (n=83; 58.9%), while 52 farms (36.9%) cultivate their field adopting alternative farming practices (such as organic, regenerative, conservative, etc.) (Figure 7). Finally, 6 farms (4.3%) cultivate part of their field by adopting conventional farming practices and part with alternative farming practices.

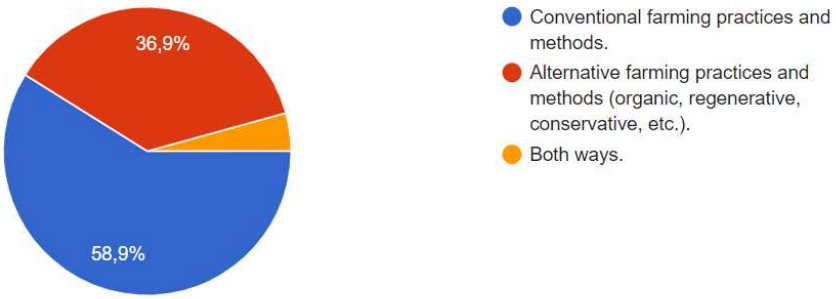

Figure 7. Share of respondents cultivating with adopting conventional farming practices or with alternative farming practices (N=141)

2.2.8 How well do you know the following terms and practices? Are you familiar with the definitions and the meaning? Please mark your understanding on a 1-4 scale, where 1 means "never heard of it" and 4 means "I know a great deal".

In general, farms declare that they are familiar with the concepts of climate change, its causes, and its effects. Mainly, the sample is made up of individuals who claim to have "moderate knowledge" (n=80; 56.7%) and to "know a little bit" (n=52; 36.9%) on "Climate change – what it is, causes and effects", while just 2 farms "never heard of it". Almost 90.1% of respondents declare to have "moderate knowledge" (n=73; 51.8%) and to "know a little bit" (n=54; 38.3%) on the "Impact of climate change on food production". Further, almost 82.2% of respondents declare to have "moderate knowledge" (n=59; 41.8%) and to "know a little bit" (n=57; 40.4%) on "Agriculture is accelerating climate". Similarly, almost 82.2% of respondents declare to have "moderate knowledge" (n=61; 43.2%) and to "know a little bit" (n=69; 48.9%) on "Mitigation of climate change".

As far as alternative cultivation techniques are concerned, the answers are heterogeneous and show how organic cultivation techniques are among the best known. While 24 and 19 farms claim to "Know a little bit" and to "Know a great deal" about organic farming, respectively, the majority of them (n=98; 69.5%%) indicate to have "moderate knowledge" of organic farming.

The answers are given to questions "Conservation agriculture" and "Sustainable farm management" follow a similar pattern. 77 (54.6%) of respondents declare to have "moderate knowledge" and 45 to "know a little bit" (31.9%) on "Conservation agriculture", while 81 (57.4%) of respondents declare to have "moderate knowledge" and 44 to "know a little bit" (31.2%) on "Sustainable farm management".

As regards the question on "regenerative agriculture", the majority of respondents "never heard of it" (n=75; 53.2%), while 47 and 19 farms claim to "Know a little bit" (33.3%) and to "Know a great deal" (13.4%), respectively.

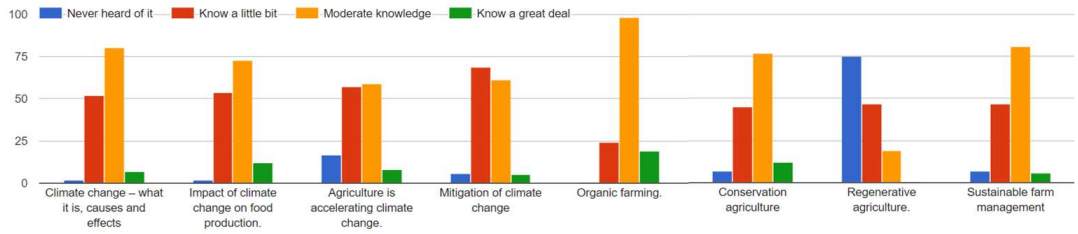

Figure 8. number of respondents on level of knowledge of each of the reported concepts and agricultural practices (N=141)

2.2.9 *How would you rate the general uptake of alternative farming practices, and especially conservation agriculture and regenerative agriculture? (On a 1-10 scale, where 1 means "not at all spread", and 10 means "very well spread").*

The majority of respondents in the sample (n=102; 72.3%) rate the uptake of alternative farming practices in their farm from spread to well spread, in decreasing order 6 (n=43; 30.5%), 7 (n=22; 15.6%), 8 (n=20; 14.2%), 9(n=17; 12.1%). The answer to the question "how do you rate the adoption of alternative agricultural practices in your country" divides the respondents into two groups. The largest group (48.2%)

rates the diffusion of alternative practices 6 (n=40; 28.4%) and 5 (n=28; 19.9%), while 26 respondents (18.4%) rate 9 rate the adoption of alternative practices.

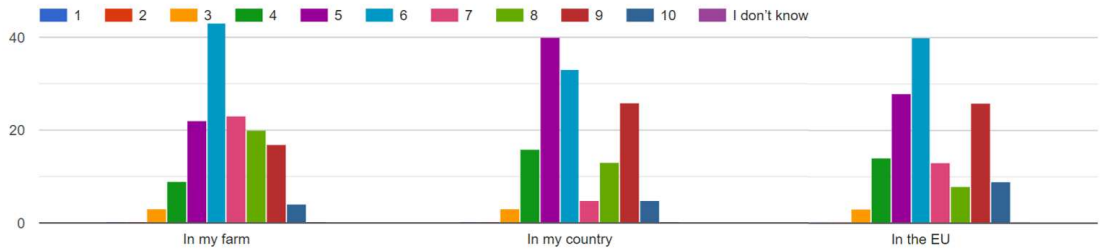

Figure 9. Answers of respondents on the perception they have about the diffusion of alternative agricultural practices on their farms, in Italy and the EU (N=141)

2.2.10 Please mark, if you know the following techniques and if you have already implemented them on your farm.

The majority of respondents in the sample (n=87; 61.7%) indicate that they are familiar with the technique of "Reducing or eliminating mechanical interventions in the soil (tillage)", while just 25 indicate that they are not familiar with this technique (17.7%). Further, 18 respondents indicate that they have already implemented the technique (12.8%) and 11 (7.8%) say that they will implement it in the future.

The majority of respondents in the sample (n=107; 75.9%) indicate a positive attitude toward the technique of "Keeping the upper part of the soil overgrown with vegetation (eg. cover crops)". 55 (39%) indicate that they are familiar with the technique, 39 (27.7%) indicate that they already have implemented the technique on their farm and 13 (9.2%) plan to implement the technology in the future.

Despite a large share of the respondent (n=62; 44%) indicating that they are not confident with the technique of "Increasing plant biodiversity", a large number of respondents (n=79; 56%) has a positive attitude toward it. 24.8% (n=35) indicate that they are familiar with the technique, 24 (17%) indicate that they already have implemented the technique on their farm and 20 (14.2%) plan to do it.

The majority of respondents (n=136; 96.5%) indicate confidence with "Increasing organic matter in the soil". 51.1% of respondents (n=72) indicate familiarity with the technique and 39 (27.7%) that they already have implemented the technique, while 25 (17.7%) plan to improve the soil organic matter in the next future.

Most of the respondent farmers do not adopt the mixed-farming system. 44.7% of respondents indicate that they are not familiar with including livestock in farmland to fertilize the soil. On the contrary, 17% of respondents (n=24) indicate they are familiar with the technique, 28 (19.9%) that they already have implemented the technique, and 28 (18.4%) plan to do it in the future.

The majority of the respondents (n=63; 44.7%) indicate that they are not familiar with "implementing habitat conservation techniques "e.g Preserving hedgerows, leaving field margins to grow." It must be considered that, while in the past green structures

were very widespread in the Italian countryside, following agricultural mechanization, they were almost completely removed as they were considered unproductive surfaces and an obstacle to the free movement of agricultural machinery. Further, it must be considered that the Italian landscape is not a single patch of cultivated land. According to the national census carried out in 2020, in Italy the average surface area of farms is 14.5 ha, of which only 11.1 ha are cultivated while the remaining 23.4% consists of green areas (consisting of woods, scrub, uncultivated areas, riparian buffer strips).

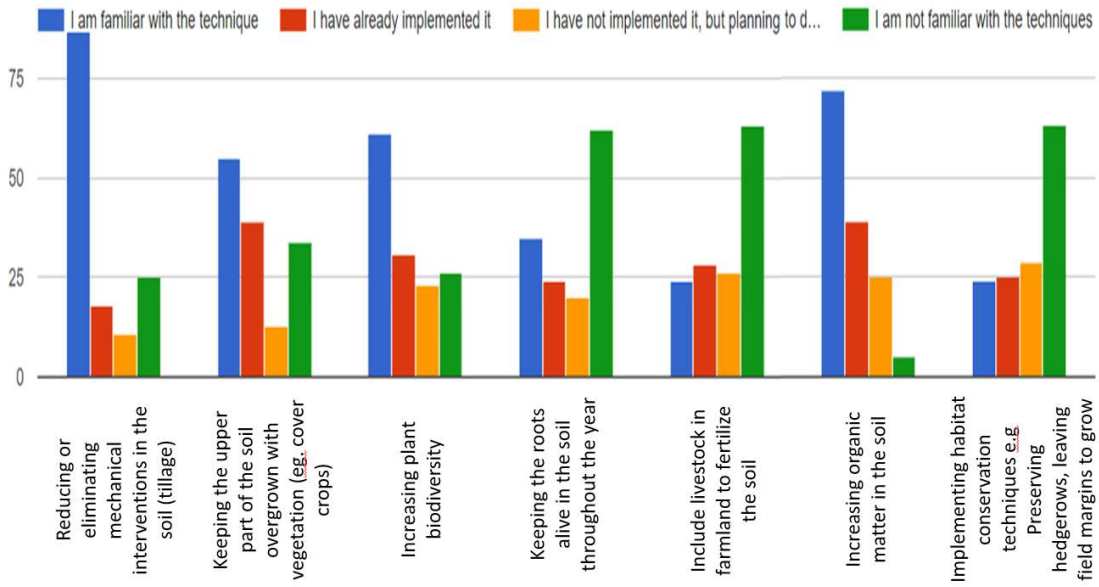

Figure 10. Answers of respondents on the familiarity with alternative techniques and mixed-farming systems (N=141)

2.2.11 Are you aware of the following benefits of regenerative agriculture?

The results highlighted a lack of knowledge among farmers on regenerative agriculture and the benefits that could be achieved with it. Most farmers know that through regenerative agriculture they can obtain an “Enriched soil” (n=86; 61%) with “Less farm mechanization” (n=88; 62.4%) and thus achieving a “Reduction of labor for farming” (n=92; 65.2%).

On the contrary, many other benefits achievable through RA are mostly unknown. The 60.3% (n=56) of the respondent unknown that there is a “Need for substantially less water”. Most of the respondents ignore they can achieve “Higher crop quality” (n=43; 69.5%), “Greater crop stability” (n=39; 72.3%), and “Higher CO2 retention in the soil” (n=46; 67.4%). Also, most of the respondents unknown the possibility to obtain “Less problems with plant diseases” (n=28; 80.1%), and that RA is “More beneficial for insects (pollinators)” (n=42; 70.2%). Also, the “The varied appearance of the cultural landscape” obtainable by performing RA is almost ignored (n=69; 51.1%). Finally, 62.4% (n=53) of the respondent are not confident with the possibility to obtain an “Increased farm revenue” by applying RA.

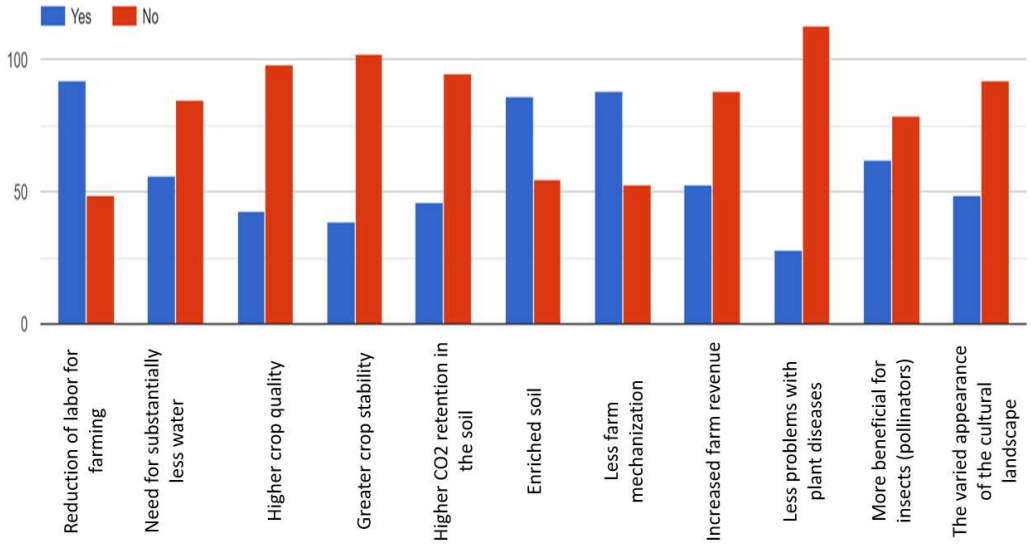

Figure 11. awareness of the benefits of regenerative agriculture (N=141)

2.2.12 What do you consider the main obstacles to taking up regenerative agriculture?

Almost all of the respondents in the sample think that the lack of know-how is an important obstacle to the adoption of regenerative agriculture (n=137; 97.2%), while a low percentage think that it is not an obstacle (n=4; 2.8%). According to the majority of the respondents (n=135; 95.7%), another important aspect that impedes the diffusion of regenerative agriculture is the financial support from the state, instead, a strict minority did not agree with that (n=6; 4.3%). Although most of the respondents (n=133; 94.3%) are suspicious about the results of regenerative agriculture, a slight percentage (n=8; 5.7%) is no doubt about its results. Furthermore, most of the farmers (n=122; 86.5%) think that the acceptance of regenerative agriculture is hindered by the changes in the way they currently do farming, while the remaining (n=19; 13.5%) is not worried about it. 90.8% (n=90.8) of the farmers express concerns about the financial uncertainty regarding the short-term future, which was not considered by the remaining part of them (n=13; 9.2%). Additionally, a similar percentage of them (n=129; 91.5%) care about the expensive investments they should afford to apply regenerative agriculture, while 8.5% of them (n=12) don't agree with that. Another pivotal aspect that the majority of them (n=124; 87.9%) highlighted is the difficulties in the organization of achieving the year-round coverage of the soils, which was not considered by the others (n=17; 12.1%).

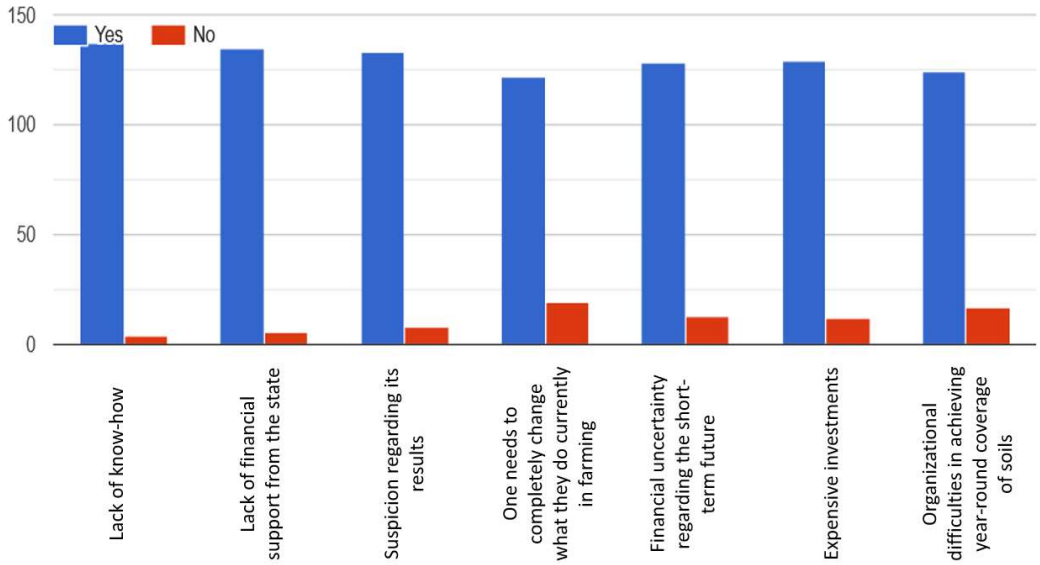

Figure 12. Answers of respondents on the perception of the obstacles to taking up regenerative agriculture (N=141)

2.2.13 Would you like to take up regenerative agriculture farming practices?

At the moment, only 29.8% of the respondent (n=42) indicate that they are already performing some of the RA practices, probably those already performing conservative agriculture, while 47.5% (n=67) indicate that they could take up RA in the future and the 22.7% (n=32) do not consider the possibility to convert their farm to RA practices.

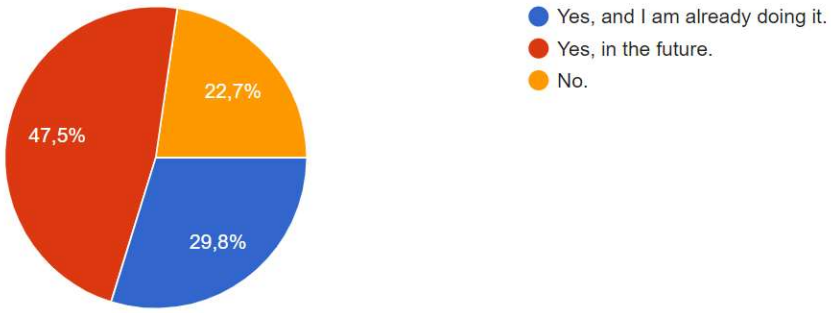

Figure 13. Percentage of respondents intending to adopt agricultural practices of regenerative agriculture (N=141)

2.2.14 If you have answered "No", what is the reason behind it?

There were more answers to this question (n=49) than expected (n=32), given that it was also filled in by some farmers who answered "Yes" to the previous question. However, we decided not to exclude the extra responses, as these responses also contribute to assessing farmers' perceived difficulties in undertaking RA. So for this question, the sample consists of 49 answers (N=49). The majority of respondents in the sample indicate "Economic barriers (I could not make enough money out of it)" as the main reason creating mistrust to undertake RA. Secondarily, "Knowledge gaps (I would not know how to start regenerative agriculture practices)" (n=5; 12.2%) and "Lack of interest (I simply do not have the time or interest)" (n=2; 4.1%) were reported as obstacles in undertaking RA.

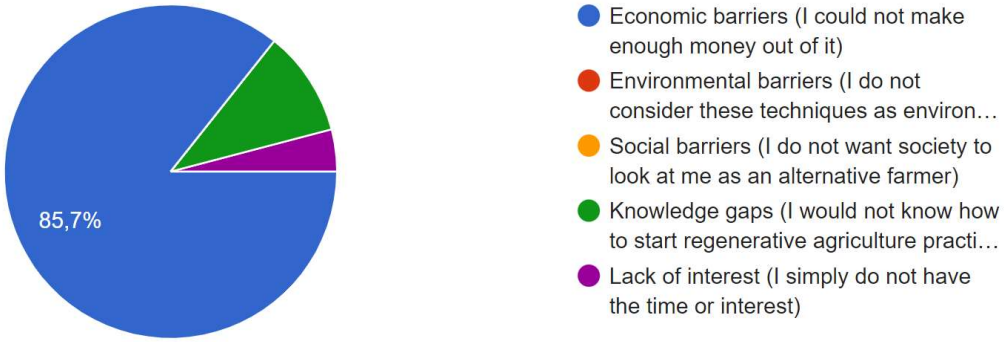

Figure 14. reasons why farmers are not confident in undertaking RA (N=49)

2.2.15 Would you like to receive further information and training on the following topics?

According to the majority of the respondents (n=74; 52.8%), information about the adoption of regenerative agriculture in terms of economic and environmental benefits but also their obstacles and difficulties would be well accepted. Furthermore, a lower percentage of the farmers (n=61; 43.5%) want to receive training about previous topics. The remaining farmers (n=5; 3.7%) are not interested in receiving both information as well as training.

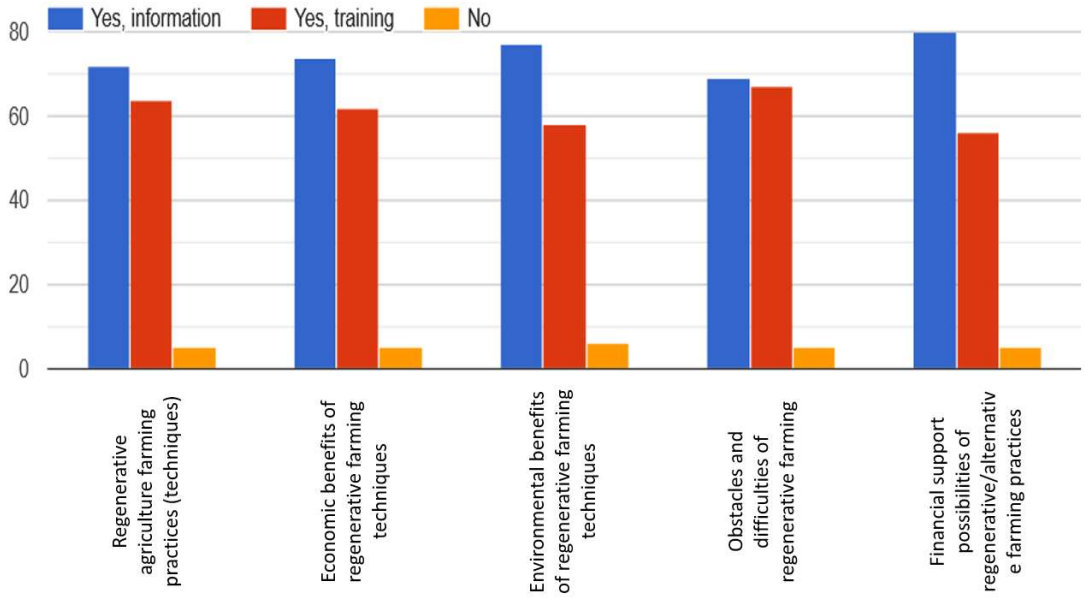

Figure 15. Answers on the availability of respondents to receive further information and training on regenerative agriculture and related aspects (N=141)

2.2.16 *Which of the following factors could enhance the uptake of regenerative agriculture practices on your farm? Please rate each of the following factors on a 1-4 scale, where 1 means "wouldn't enhance RA at all" and 4 means "would enhance RA a lot"*

In general, the 4 questions were answered by farmers in a very uniform way. The majority of respondents indicate that all the proposed factors "would enhance RA a lot" (averaged for the 4 questions; n=110; 78%) and *"would enhance RA"* (averaged for the 4 questions; n=28; 19.9%).

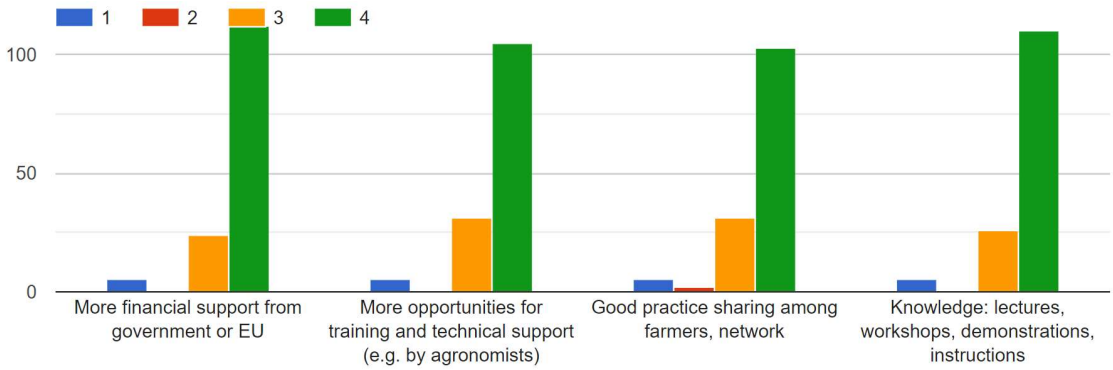

Figure 16. The share of respondents based on what factors could improve the adoption of regenerative agriculture practices on their farm (N=141)

2.3 Conclusions. What we learn from the survey regarding the current situation and prospects of RA uptake among farmers in the country.

The main aim of this survey was to investigate the acceptance and the farmers' behavior towards regenerative agriculture principles and adoption. The majority of respondents in the sample are male (n=109; 77.3%) and most of the respondents are farmers between 36 and 45 years old (n=45; 31.9%) with farms having an extension comprised between 50 and 100 ha (n=65; 45.1%). Mainly, the sample is composed of farms adopting conventional farming practices (n=83; 58.9%) and prevalently cultivating "arable crops" (n=135; 95%) along with "fruit production" and "vegetables" (n=67; 47.5%). In general, farms declare that they are familiar with the concepts of climate change, its causes, and its effects. As far as alternative cultivation techniques are concerned, the answers are heterogeneous and show how organic cultivation techniques are among the best known. The majority of respondents in the sample have a positive attitude toward "Reducing or eliminating mechanical interventions in the soil (tillage)", "Keeping the upper part of the soil overgrown with vegetation (eg. cover crops)", "Increasing plant biodiversity", and "Increasing organic matter in the soil". On the opposite, the respondents seem suspicious concerning "including livestock in farmland to fertilize the soil", and implementing habitat conservation techniques "e.g Preserving hedgerows, leaving field margins to grow". The results highlighted a lack of knowledge among farmers on regenerative agriculture and the benefits that could be achieved with it. Most farmers just know that RA could "Enriched soil" (n=86; 61%) with "Less farm mechanization" (n=88; 62.4%) and thus achieving a "Reduction of labor for farming" (n=92; 65.2%). The majority of respondents in the sample indicate "Economic barriers (I could not make enough money out of it)" as the main reason creating mistrust to undertake RA. So, to convert their farms to RA cultivation techniques, farmers require the certainty that the activity will be supported for a long time by public authorities with enough public funding.

Chapter 3. The case studies

3.1 Introduction to the case studies, how they were selected and contacted, number of case studies, geographical spread, type of farms included

The case study approach was used (Creswell, Maietta, 2002; Laws et al., 2003; Yin, 2002), an approach widely used for studies of Agricultural Economics and Rural Sociology (Ventura, Milone, 2004; van der Ploeg, 2008; Giare, Caggiano, Vignali, 2009). This methodology represents a very useful tool, especially in the analysis of ongoing processes or practical applications, and being a description of reality, it allows one to reflect and identify one's conclusions on the case. The methodological choice, therefore, adapts to the aims of the project and in this work, the case study is used precisely to grasp relevant perspectives for agricultural managerial practice concerning specific production contexts (Larsson, 1993, Leonard-Barton, 1990). The lack of statistical robustness is compensated by the detail of the collected information which can provide a thorough understanding of the decision-making processes and the factors that contribute to the success or failure of the different agricultural management strategies, e.g., organic, conventional, conservative, or regenerative agricultural management (Lampkin, Padel, 1994). This allows you to replicate/adapt the results to other production contexts. The questionnaire includes questions on respondents' farm characteristics (total size, cultivated and uncultivated area, permanent and seasonal staff employed, type of farm, main crops and presence of livestock, etc.) and agricultural technology features of the respondents' farms, existing agricultural techniques and environmental constraints, as well as the vision and potential response of land managers about the adoption and introduction of regenerative agriculture techniques. The questionnaire was translated into Italian language.

The selection of the case studies was preceded by an initial exploratory survey carried out on farms collaborating with UNIFI (10 farms) and with farms that are members of AIPAS (25 farms) and AIGACOS (10 farms), located throughout the country, located throughout the country. In this first phase, the managers of these companies were directly interviewed and, through a questionnaire concerning the general organization of the activity, the data was collected and processed which made it possible to trace the salient characteristics of the companies and their respective compliance (or less) of these production units to the needs of the project. Based on the processing of the answers obtained, 6 case studies located in Tuscany (3) and Apulia (3) were selected and the managers of these were administered, through direct interviews, a questionnaire, the first for the collection of information of an agronomic nature, the second for those of a socio-economic-organizational nature relating to regenerative agriculture. The results of the questionnaire are presented below.

Figure 17: Case Studies in Italy

Creswell J.W., Maietta R.C. (2002), Qualitative research, In: Miller D.C., Salkind N.J. (eds.), Handbook of research design and social measurement, 6th Ed., Sage Publications, Trousands Oaks.
Giarè F., Caggiano M., Vignali F. (2009), Vite contadine – storie dal mondo agricolo e rurale, Inea, Roma.
Lampkin N., Padel S. (1994), The economics of organic farming. An international perspective, Cab International, Wallingford.
Yin K.R. (2002), Case Study Research, Design and Methods, 3rd eds. Newbury Park, Sage Publications, Trousands Oaks.
van der Ploeg J.D. (2008), The new peasantries: struggles for autonomy and sustainability in an era of Empire and Globalization, London, Sterling, Earthscan.
Ventura F., Milone P. (2004), Novelty as Redefinition of Farm Boundaries, In: Wiskerke, J.S.C., & Ploeg, J.D. van der (eds.), Seeds of Transition. Essays on novelty production, niches and regimes in agriculture (European Perspectives on Rural Development). Assen, The Netherlands: Van Gorcum, 54-92.
Laws S. et al. (2003), Research for development, a practical guide, Sage Publications, Trousands Oaks.

3.2 Brief presentation of each case study, accompanied by selected photos

3.2.1 Baccoleno Farm

The Baccoleno Farm is located in Asciano, a small village in the province of Siena (Tuscany region, Italy). The farm has a surface area of 300 ha with 270 ha as a sowing area. The farm staff is composed of 2 people as permanent staff, 1 person as a temporary worker, and another person as temporary staff for the farmhouse. They are cultivating the following crops: durum wheat (*Triticum durum* L.), barley (*Hordeum vulgare* L.), oat (*Avena sativa* L.), field bean (*Vicia faba* subsp. Minor), Italian sainfoin (*Hedysarum coronarium* L.), Egyptian clover (*Trifolium alexandrinum* L.), trifolium squarrosum (*Trifolium squarrosum* L.), Crimson clover (*Trifolium incarnatum* L.). The farm adopts the principle of conservation farming throughout the farm surface, so also applies some of the practices of regenerative agriculture (RA), i.e. no-tillage management, keeping the residues on the soil, precision agriculture to reduce the agrochemical input, crop rotation, and cover crop sowing. In 2017, he started to apply conservative agriculture (CA) practices and he still applies those practices nowadays. He started to apply the CA practices on a part of the farm; after he detected that no yield differences were obtained with respect to conventional agriculture, all the farm surface was converted to the previous practices. He also detected lower costs as compared to conventional agriculture. He did not receive any training about conservative practices he was self-taught, obtaining information from agricultural websites and other farmers; no training was provided from the regional as well as from agricultural technicians. However, he received financial support to start soil conservative practices from the Tuscany region through Rural Development Program (PSR). As I previously mentioned, he detected lower production costs resulting from lower fuel consumption as compared to conventional agriculture, lower wear and tear on agricultural machines, less labor use and more free time for the farmer, soil protection against erosion, and improved soil organic matter. On the other hand, he claimed about the lack of training on the previous practices as well as about the skepticism from other farmers; he overcame previous through the advice of other farmers and advice on agricultural websites. To sum up, the farmer is very happy to apply soil conservative practices, but he wants to introduce some changes in conservative practices methods because of soil compaction as the soil of his farm is very heavy and tenacious.

Fig. 1 Sod seeding of winter wheat by means of tractor and sod seeding machine

Fig.2 winter wheat in no-tillage system

Fig.3 winter wheat in no-tillage system. The vertical cuts left by the seeder in the moist clayey soil are visible

Fig.4 Durum wheat intercropped in autumn in a red clover field.

Fig.5 Digital devices for precision fertilization and sowing.

3.2.2 Bevere's Farm

The Roberto Bevere's Farm is located in Lesina, a small village in the province of Foggia (Apulia region, Italy). The farm has a surface area of 36 ha with 5 people as permanent staff. They are cultivating the following crops: durum wheat (*Triticum durum* L.), common wheat (*Triticum durum* L.), barley (*Hordeum vulgare* L.), and field bean (*Vicia faba* subsp. Minor). Nowadays they don't apply no-tillage management as they have had some problems with the contractor that was carrying out fieldwork. However, they apply a two-year crop rotation, alternating legumes, and cereals. In the past, they carried out no-tillage management in the overall field. The no-tillage practice has been used from 2014 to 2019. They started to apply no-tillage because they are curious about the innovations. He did not receive training on soil conservative practices, but they have studied in some books. The farmer did not receive any financial support to start soil conservative practices. After the application of the soil conservative practices, he experienced a lower workload and lower costs, especially in terms of fuel, but also an improvement in terms of fertility. On the other hand, he obtained a lower grain yield with respect to previous years, but the lower yield was balanced by the lower costs for cultivation. Altogether, the farmer was very happy to apply soil conservative practices and in the future, he wants to re-apply with no-tillage management because of the high costs of conventional agricultural operations.

Fig.1 Winter wheat seedling after the end of the sunflower cycle with no-tillage

Fig.2 winter wheat in a no-tillage system

Fig.3 Direct sowing of winter barley in the winter wheat straw of the previous cycle

Fig.4 Sunflower seedling, sowed after the harvest of winter barley

Fig.5 Development of sunflower between barley straw

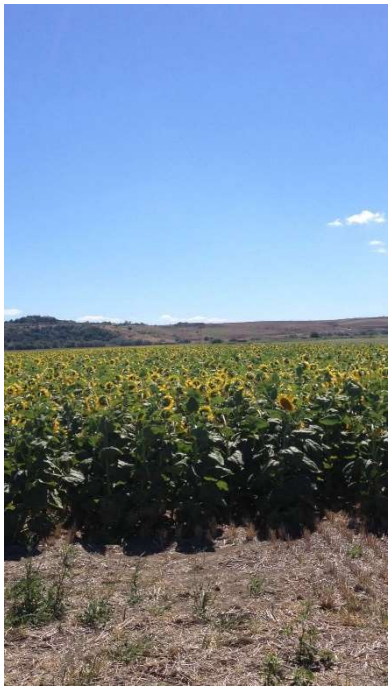

Fig.6 Flowering of sunflower with no-tillage management

Fig.7 Sunflower plants with no-tillage management

3.2.3 Giuntoli's Farm

The Sante Giuntoli's Farm is located in Troia, a small village in the province of Foggia (Apulia region, Italy). The farm has a surface area of 100 ha with 3 people as permanent staff. They are cultivating the following crops: durum wheat (*Triticum durum* L.), field bean (*Vicia faba* subsp. Minor), sunflower (Heliantus annuus L.), and chickpea (*Cicer aretinum* L.). They have also a small livestock breeding with 20 calves. They apply some of the practices of regenerative agriculture (RA) that are common to soil conservative practices. In particular, they apply a two-year crop rotation, alternating legumes and cereals. They also execute no-tillage soil management and use legumes as cover crops. They apply the abovementioned practices on the overall farm. Specifically, they started to apply previous practices in 2008, and they are still applying them in the present. The farmer is an agronomist. In 1977, a Professor held a lesson about the benefits of sod seeding, therefore he was very passionate about it. Therefore. he started to apply it very roughly with old machines, but with the new machine for sod seeding ha has entirely converted his farm. He received training from some agricultural associations, but also from the company that sold him the sod seeding machine. However, he received financial support from some regional funds (330 €/ha). After the application of the soil conservative practices, he experienced an increase in gross production, soil organic matter, and soil fertility, but also a reduction of workload. On the other hand, he has had a problem with Lolium and he solved it with the use of a decision-supporting system (DSS). Altogether, the farmer is very happy to apply soil conservative practices.

Fig. 1 Sod seeding of winter wheat

Fig. 2 Sod seeding of winter wheat by means of tractor and sod seeding machine

Fig. 3 Particular of sod sowing machine

3.2.4 Grappi's Farm

The Luchino Grappi's Farm is located in Pienza, a small village in the province of Siena (Tuscan region, Italy). The farm has a surface area of 165 ha with 3 people as permanent staff. They are cultivating the following crops: durum wheat (*Triticum durum* L.), olive (*Olea europaea* L.), field bean (*Vicia faba* subsp. Minor), chickpea (*Cicer aretinum* L.), and different types of clovers. The farmer applies organic cultivation techniques over the entire cropped surface. They apply some of the practices of regenerative agriculture (RA), i.e. the application of crop rotation as well as the use of cover crops. Regarding soil tillage, they usually perform conventional plowing, but also they substitute it with disk harrowing. In addition, it is an organic farm, hence it cannot cultivate the same crop for two following years, and legumes are commonly used as cover crops; the previous practices are applied to the overall field, and although they have never heard about regenerative agriculture they apply them. No training was received for applying them. After the application of crop rotation as well as the use of cover crops, they experienced an increase in grain yield, better soil fertility, and a lower weed problem.

Fig.1 tractor with soft tooth harrow for weed removal in winter wheat

Fig.2 residues in field after winter wheat harvesting.

Fig.3 Red clover spring intercropped over winter wheat

Fig.4 Old winter wheat varieties (long straw varieties)

3.2.4 Lanini's Farm

The Giuseppe Lanini's Farm is located in Mucigliano, a small municipality of Asciano in the province of Siena (Tuscany region, Italy). The farm has a surface area of 200 ha with 1 person as permanent staff and 2 people as temporary staff. In addition, the farmer works as a contractor and can cultivate 600 ha. They are cultivating the following crops: durum wheat (*Triticum durum* L.), barley (*Hordeum vulgare* L.), and different kind of clovers, mainly squarrosum and alexandrinum. Besides, the farm also includes livestock with almost 700 sheep. They apply soil conservation practices overall on the farm surface. Specifically, they carry out no-tillage management of the soil. They usually execute a four-year rotation, settling clover as the first-year crop followed by three-year cereals. In addition, they manage legumes with cover crop purposes. Anyway, a part of the sewage produced by sheep is used as fertilizer, while the other is sold. The previous practices have been used from 2014 to the present (2022). They started to apply no-tillage because they had a very high cost for cultivation and low revenues from the sale of agricultural products. He received training on the practice of soil conservation from the company that sold him the sod seeding machine. However, he did not receive any financial support to start soil conservation practices. After the application of the soil conservation practices, he experienced a similar grain yield compared to the previous years, but with a lower workload and lower costs, in terms of fuel. Additionally, better soil quality was obtained in terms of fertility as assessed by the amount of organic matter and the number of earthworms in the first soil layers. Because of the lower workload, he was able to cultivate more land as compared to the previous years. On the other hand, he pointed out the diffusion of weeds, especially Lolium, overall the field; he solved the problem using Lolium as hay and applying the pre-emergence herbicide. Altogether, the farmer is very happy to apply soil conservation practices and he doesn't want to change anything.

Fig 1. Sowing machine for sod seeding

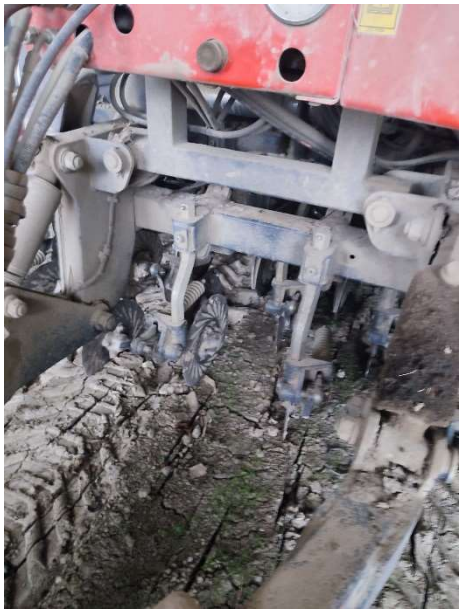

Fig 2. Particular of the sowing machine

Fig 3. Seedling of winter wheat sowed in the winter wheat straw of the previous cycle

Fig 4. Winter wheat field, sowed by means of sod seeding

3.2.4 Zannella's Farm

The Franco Zannella's Farm is located in Candela, a small village in the province of Foggia (Apulia region, Italy). The farm has a surface area of 104 ha with 2 people as permanent staff. They are cultivating the following crops: durum wheat (*Triticum durum* L.), field bean (*Vicia faba* subsp. Minor), chickpea (*Cicer arietinum* L.), white clover (*Trifolium repens* L.), sunflower (*Helianthus annuus* L.). They apply soil conservation practices overall on the farm surface. Specifically, they have a sod seeding machine, therefore no-tillage management of the soil is carried out. Furthermore, they use some legumes for cover crop purposes, and they usually execute two-year rotations, alternating cereals, and legumes. The previous practices have been used from 2008 to the present (2022). They started to apply no-tillage because the soils of the farm became very poor with a low level of fertility as a consequence of deep soil works. The owner of the farm used to work as a tractor conductor for the plowing operations. He did not receive any training about the practice of soil conservation, but he learned the RA farming practices from agricultural websites and newspapers. Additionally, he did not receive any financial support to start soil conservation practices. After the application of the RA practices, he experienced even higher grain yield compared to the previous years, better soil quality in terms of fertility as assessed by the number of earthworms in the first soil layers, a lower workload compared to the previous year, and a higher income; on the other hand, he pointed out the diffusion of weeds, especially Lolium, overall the field. For this reason, he decided to cultivate spring crops, such as sunflowers, but he highlighted the difficulty of growing sunflowers under no-tillage management. However, the farmer is very pleased to apply soil conservation practices as well as he wants to continue to apply them also because of the increasing costs of fuel.

Fig.1 Soil after 15 years of sod seeding

Fig 2. The land before the sod sowing of winter wheat (October 2022)

3.3 Conclusions from case studies. Discuss what motivated the case study farmers, how they did or did not overcome the difficulties they faced, and what lessons we learn that can be useful to other farmers.

Most farmers started to apply conservative agriculture and in particular no-tillage because they are curious about the innovations and in the hope of being able to save on production costs. Many of the farmers we interviewed chose more sustainable agricultural systems even before the possibility of obtaining financial support through public funding. As previously mentioned, with conservative agriculture most farmers detected lower production costs resulting from lower fuel consumption as compared to conventional agriculture, lower wear and tear on agricultural machines, less labor use and more free time for the farmer, soil protection against erosion, and improved soil organic matter in the top surface layer. On the other hand, most of the farmers recorded a lower yield per hectare compared to the conventional system. However, they also report that the lower yield has been largely offset by significantly lower cultivation costs. In addition, some farmers have raised the issue of weed management and are concerned about new regulations on herbicide reduction which could undermine the effectiveness of conservation agriculture. In general, they claimed the lack of training on conservative agriculture practices as well as the skepticism from other farmers. Farmers overcame the lack of training by consulting with other farmers who had already started experimenting with conservation agriculture and by consulting specialized websites. In general, so far, those farmers who have started to carry out conservation agriculture are happy with their choice.

Chapter 4 Overall conclusions

Nowadays, RA could represent a good opportunity for farmers. As RA is mainly based on Conservative Agriculture (CA) principles, can contribute to higher farmers' income. It must be noted that farmers can rapidly convert to RA farming as it is profitable to do so. However, AR is not a well-known form of agriculture in Italy. Few farmers and stakeholders have heard of it and generally not in depth.

In general, most farmers are familiar with alternative cultivation techniques such as organic cultivation and conservation agriculture. Our survey indicates that farmers have a positive attitude toward "Reducing or eliminating mechanical interventions in the soil (tillage)", "Keeping the upper part of the soil overgrown with vegetation (eg. cover crops)", "Increasing plant biodiversity", and "Increasing organic matter in the soil" which are the main principles of Conservation agriculture as well as of RA. However, they seem suspicious with respect to "including livestock in farmland to fertilize the soil" and implementing habitat conservation techniques "e.g Preserving hedgerows, leaving field margins to grow". Most farmers just know that RA could "Enriched soil" with "Less farm mechanisation" and thus achieve a "Reduction of labor for farming". The lack of training courses and available knowledge on this topic has been identified as one of the main obstacles to taking up RA. Further, RA and related farming methods are not regulated in Italy. The only alternative agriculture methods regulated by the Italian state are organic farming and, partly, conservation agriculture. A common policy for reducing the agricultural bureaucracy linked to RA practices is needed. The survey also indicates "Economic barriers (I could not make enough money out of it)" as the main reason creating mistrust to undertake RA. So, to convert their farms to RA cultivation techniques, farmers require the certainty that the activity will be supported for a long time by public authorities with enough public funding. Furthermore, long-term support is required as the supposed environmental and economic benefits should be obtained on a long-term basis. However, it is not only a matter of production but also a matter of marketing or selling the RA products. Hence, the joint marketing practice that has been implemented by farmer groups in organic agriculture can be one of the ways to ensure the viable marketing of RA products. Moreover, creating rural districts to encourage the dissemination of RA practices among the farmers and creating a local identity around these districts will encourage the marketing of productions.