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# Chapter 4

## Implementation of circular economy in rural area of Italy and *Piedmont region*, realisations and perspectives

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### 4.1 Circular economy in Italy

#### 4.1.1 Structure of the territory and rural area presentation

Italy is a parliamentary republic with a total area of 301,337 km$^2$ and a population of 60.7 million inhabitants divided into 20 regions. It is a peninsula surrounded by the Mediterranean Sea which has a great influence on its mild climate. The territory is mainly hilly (41.6%), mountainous (35.2%) and flat (23.2%).

The majority of the cities (67.9%) are located in areas with low urbanization, which represents 72.5% of the total area, with a population of 24.3%. Only 3.3% of cities are located in highly urbanized areas (representing 4.8% of the total surface area) but they are inhabited by 33.3% of the population, causing territorial imbalances in terms of population concentration.

According to the Rural Development Programme 2014-2020, in 2012 the Italian rural area is 262,465 square kilometres which represent 87.1% of the total surface area. In this area live 37.6 million people (63.3% of the total population), with a density of 143.2 hab/km$^2$. The agricultural area represents 42.7% of the total area with about 12.9 million hectares of Utilised Agricultural Area (UAA) of which 31% is irrigable and 21% is irrigated. Forests and other wooded land represent 36.2% of the total area with about 10.9 million hectares.

#### 4.1.2 Companies connected with or working in rural area

In Italy the agricultural sector is a complex and variegated reality in which different companies coexist: within the sector, large agricultural companies operate with a complex and organizational structure and a strongly integrated

approach with the agricultural processing industry and large distribution; at the same time, there are small traditional realities whose production is mainly aimed at self-consumption or small market.

Istat 2017 data show that there are 413,000 agricultural enterprises in Italy (27.3% of the total) and they occupy more than 65% of the utilised agricultural area (UAA). In terms of Utilised Agricultural Area (UAA), Italy recorded one of the highest values among the EU Member States: 12.9 millions of hectares, accounting for 43% of the whole territory.

In general, there are just over 1.5 million economic units operating mainly or as a secondary activity in the agricultural sector. This value is the second highest within the EU-27, after the one recorded in Romania, even if in the past 20 years roughly one out of three farms ceased its activity. Conversely, the average size of agricultural holdings increased in the past years, reaching 7.9 ha per farm: however, this remains among the smallest value recorded within the EU-27.

As regards/Regarding agriculture, the Italian agricultural labour force is one of the biggest within the EU-27 and represents 14 % of the total economically active population

**Overall, the Italian rural sector employs 24.7 millions of people, the 61.9% of the total population and thus, the primary sector contributes about 2% of the gross value added.**

The animal livestock has remained rather constant over the past 20 years: **about 220,000 livestock farms and a total of 10 millions livestock units (LSU) make Italy one of the EU Member States with the largest animal livestock**.

The Italian livestock population is extraordinarily rich in native breeds whose origin can be attributed to the great diversity of the different regions. The huge variety of the Italian climate and the numerous populations that have inhabited Italy over the last millennia have contributed to this unique genetic variety. However, since the 1950s, Italy has gradually reduced certain native and local breeds. In recent years, thanks to the growing awareness of breeders, the preservation of local breeds at risk of extinction has become a pillar of the agricultural development policies. Today, Italy has several livestock breeds: 66 sheep, 52 goat, 39 cattle, 27 horse, 8 donkey and 6 pig breeds. The Italian

livestock population is composed of: 186,129,009 poultry, 8,729,314 sheep and goats, 8,624,449 pigs, 6,148,675 cattle and buffalo.

According to the ISTAT (Italian National Institute of Statistics), in 2017, there were 1,516,315 economic units with activities related to the agricultural sector. The majority is represented by 700,000 units (46.9%), which are placed in the south Italy regions (Puglia, Sicilia, Calabria e Campania). In particular, the agricultural economic units use 12.8 millions of UAA, with an average of 8.4 ha of UAA per unit and an average standard production of 38,700 euro. However, **the economic size of the farms varies largely depending on the region, in particular, the northern regions (Lombardia, Emilia-Romagna and Veneto) record the highest values**.

The agricultural economic units are divided into:

- 27.3% agricultural enterprises
- 5.7% agricultural enterprises managed by enterprises operating in other productive sectors or by public and non-profit institutions
- 36.3% agricultural enterprises whose tenant is a non-active economic unit, which can operate occasionally for the market
- 30.7% enterprises managed directly by individuals (families).

The 97.4% have cultivations and the 16% have livestocks. They hold 65% of the total UAA, with an average dimension of 20 ha, 2 employees (although the 61% are without employees), and create 75.8% of standard production.

| TYPOLOGIES | ENTERPRISE | EMPLOYEES |
|---|---|---|
| not permanent crops | 130,599 | 244,460 |
| permanent crops | 151,551 | 279,610 |
| plant reproduction | 4,634 | 18,333 |
| livestocks | 49,008 | 97,625 |
| mix: crop + livestock | 51,343 | 94,544 |
| Support activities to agriculture | 11,755 | 41,251 |
| forestry | 5,685 | 13,445 |

| | | |
|---|---|---|
| fishery | 4,798 | 20,140 |
| aquaculture | 3,963 | 6,362 |
| TOTAL | 413,336 | 815,770 |

Fig. 1 Data refer to 2017. *Retrieved from https://www.istat.it/it/archivio/236288*

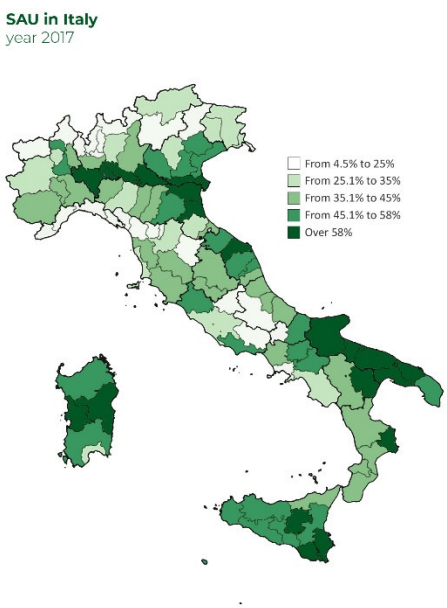


Fig.1 SAU over total surface. *Retrieved from Istat (2017)*

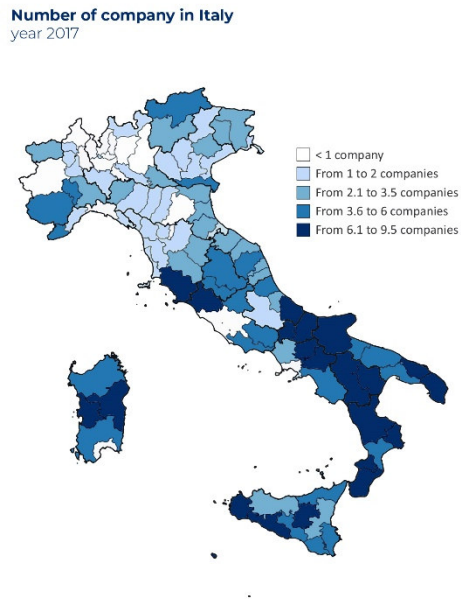


Fig. 2 Number of company in Italy. *Retrieved from Istat (2017)*

Rural economy is also related to the growth of agri-food quality production. The Italian agri-food industry is mostly made up of small, often family-owned companies, which have faced price competition on foreign markets and have therefore focused on improving the quality of their products and maintaining close links with the Italian territory and its cultural heritage. The PDO, PGI and Stg products represent the excellence of the Italian agri-food sector and a factor of strong competitiveness for the agricultural production realities. The value of this sector is underlined by the supremacy of the country in terms of number of PDO, PGI and TSG awards (299 PDO-IGP certified specialities recognised at EU level and 415 DOC-DOCG certified wines) conferred by the

European Union. In 2018, the number of awards reached 299, four more than the previous year.

According to Coldiretti (2019), the Italian agri-food chain is worth 538 billion euros, representing 25% of the country's GDP and employing 3.8 million people. Italian food and wine are largely consumed abroad and food exports are growing by 4% per year.
According to ISTAT (2017), **the food and beverage sector involved over 50,000 Italian enterprises** divided into:

- food industries: 52,153
- meat processing, meat conservation and meat-based products: 3,238
- fish processing and conservation: 420
- fruit and vegetable processing and conservation: 1,796
- vegetal and animal oil and fat production: 3,248
- dairy: 3,496
- grains and starch processing: 1,161
- production of bakery products and flour: 33,743
- other food products: 4,548
- production of animal feed: 503
- drinks: 3,445
    - distillation 540
    - wine 2,032
    - cider and fruit wine 3
    - non-distilled fermented drinks 57
    - beer 582
    - malt 3
    - non-alcoholic drinks and water 228

Overall, the Italian agri-food sector is relevant both at the European and world level, thanks to its wide range of quality products and excellent safety standards. However, the sector has some critical points: first of all, the fragmentation of the system is a sign of insufficient innovation dynamics among SMEs. This implies a very slow growth in export values, compared to the European competitors - such as France and Germany. Another important problem to be tackled is the phenomenon of counterfeiting, as a result of which there is a disquieting rise in the phenomenon of fake goods, which brings with its numerous threats for the companies' revenues as well as making consumers lose their confidence in authentic products. The

phenomenon of the so-called "Italian sounding", compared to what Coldiretti declared in May 2019, involves about 52 million euros of estimated economic losses.

### 4.1.3 Circular economy indicators: realisation and perspectives

The Eurostat indicators on Circular Economy provides an overview of the role of Italy in the European circular economy. The indicators have been analysed in the 'Report on circular economy in Italy 2020' issued by the Circular Economy Network. The different indexes (based on the Eurostat indicators) of the five largest European economies (Germany, France, Spain, Italy, Poland) are compared to establish trends and ranking. Summing up the scores of each sector, the "overall circularity index" is obtained, which in 2020 confirms, as in 2019, the first position of Italy. In particular, Italy ranks first in terms of circularity of production, while third in terms of consumption, showing some deficiency, especially in the repair and distribution sectors. Regarding waste management, the recycling rate is very high compared to the EU-27 average, Italy showing lower performance in the market of secondary raw materials. The overall assessment of the performances connected to investments and employment put Italy on the second place among the EU biggest economies, highlighting as weak points the number of patents and the low eco-innovation input index.

**Production and consumption**

National circularity performances in the production sector are confirmed to be the best of the other four main European economies. In particular, Italy is among the economies with the highest economic value generated per unit of material consumption. At equal purchasing power, for every kg of resource consumed, 3.5 € of GDP is generated, against a European average of 2.24 € of GDP. The total waste generation is 22.5%, one of the highest in Europe compared to a European average of 12.9%. Overall, the indicators of circularity in production place Italy in an excellent position compared to the rest of Europe. The critical factor is the slightest improvement in these indicators from 2016 to date, therefore, in the future, this competitive advantage within the circular economy could be lacking.

| **Production and consumption** | **EU-27** | **Italy** |
|---|---|---|
| Self-sufficiency of raw materials for production in the EU | N/A | N/A |
| Green public procurement | N/A | N/A |
| Waste generation | | |
| *generation of municipal waste per capita in 2018 (kg per capita)* | 492 | 499 |
| *generation of waste excluding major mineral wastes per GDP unit (kilograms per thousand euro)* | 67 | 64 |
| *generation of waste excluding major mineral wastes per domestic material consumption (%)* | 12.9 | 22.5 |
| Food waste *(million tonne)* | 70 | N/A |

**Waste management**

The per capita production of urban waste in Italy in 2018 was 499 kg of waste /inhabitant, which is essentially unchanged compared to 2016, but slightly higher than the average European production of 492 kg/inh. It is interesting to consider the data in relation to GDP: despite an unchanged waste production, the GDP grew by 4.6% in the period 2013-2018. In Italy, the recycling of urban waste is growing. In 2018, it was 50%, in line with the European average. The recycling rate of all waste is 68%, slightly higher than the European average (67.5%). In individual waste streams, Italy also shows excellent results in recycling, generally in line (plastic packaging, e-waste) or higher (wooden packaging, biowaste, construction and demolition waste) than the European average.

| **Waste management** | **EU-27** | **Italy** |
|---|---|---|
| Recycling rates | | |
| *recycling rate of municipal waste (%)* | 47.4 | 49.8 |

| | | |
|---|---|---|
| *recycling rate of all waste excluding major mineral waste (%)* | 56 | 68 |
| Recycling/recovery for specific waste streams | | |
| *Recycling rate of overall packaging waste by type of packaging (%)* | 67.5 | 66.9 |
| *Recycling rate of plastic packaging (%)* | 41.2 | 42.4 |
| *Recycling rate of wooden packaging (%)* | 41.2 | 60 |
| *Recycling rate of e-waste (%)* | 38.8 | 32.1 |
| *Recycling rate of biowaste (%)* | 84 | 105 |
| *Recovery rate of construction and demolition waste* | 87 | 98 |

**Secondary raw materials**

In the secondary materials market, Italy is on the second place following France.

The main parameter used to assess the sector is the rate of circular use of material, which for Italy is 17.7%. Although the Netherlands (29.9%), France (18.6%), and Belgium (17.8%) show higher values, the Italian performance is still among the highest in Europe.

Considering the trade of recyclable raw materials between the EU Member States and the rest of the world, in Italy, the import/export balance shows that import of recycled material is more than double that of export. This data not only suggests an unfulfilled potential for re-introducing these materials into internal production processes, but also a total handling of over 99 million tons of goods. Therefore, it is clear that the Italian production system is capable of enhancing the value of recycled material and that there is a demand for it. However, Italy is not able to fully satisfy this demand by increasing the value of waste in the national area.

| **Secondary raw materials** | **EU-27** | **Italy** |
|---|---|---|

| | | |
|---|---|---|
| Contribution of recycled materials to raw materials demand | | |
| *End-of-life recycling input rates (%)* | N/A | N/A |
| *Circular material use rate (%)* | 11.2 | 17.7 |
| Trade of recyclable raw materials between the EU Member States and with the rest of the world | | |
| *Imports from non-EU countries (tonne)* | 8,877,945 | 744,116 |
| *exports to non-EU countries (tonne)* | 25,467,976 | 2,004,497 |
| *intra EU trade (tonne)* | 47,905,897 | 6,249,544 |

**Competitiveness and innovation**

In the assessment of investment and employment performance, Italy shows as a weakness the low number of patents filed: Eurostat indicates that only 18 patents have been filed, which is significantly lower than in other major European economies.

Another weakness is the low level of public funding and private investment in the circular economy sector, as well as the number of workers employed in eco-innovative research and development.

On the other hand, the level of the eco-innovation output index (the results obtained from investments) is satisfactory, placing Italy above the European average. Moreover, the value added at factor costs shows positive results: in Italy is 18,632 M€, 1.07% of GDP, slightly higher compared to 2016 and in line with the European figures.

As regards employment in some sectors of the circular economy (repair, reuse and recycle) Italy shows an employment rate of 2.06% compared to the total employment, which is significantly upper than the European average.

| **Competitiveness and innovation** | **EU-27** | **Italy** |
|---|---|---|
| Private investments, jobs and gross value added to CE sectors | | |
| *Gross investment in tangible goods (% of GDP)* | 0.12 | 0.09 |

| | | |
|---|---|---|
| *Person employed (% of total employment)* | 1.72 | 2.06 |
| *Value added at factor costs (% of GDP)* | 0.96 | 1.07 |
| Numbers of patents related to recycling and secondary raw materials as a proxy for innovation | 337.74 | 18.91 |

## 4.2 Piedmont Region and circular economy

### 4.2.1 Presentation of Piedmont Region

Piedmont Region is located in the north-west of Italy and represents a part of the Italian border with France. It has the Alps as a reference landmark which has established the economic and cultural development of the territory, surrounding the area as a strategic point of growth for Italy, being influenced by its neighbouring countries, such as France and Switzerland.

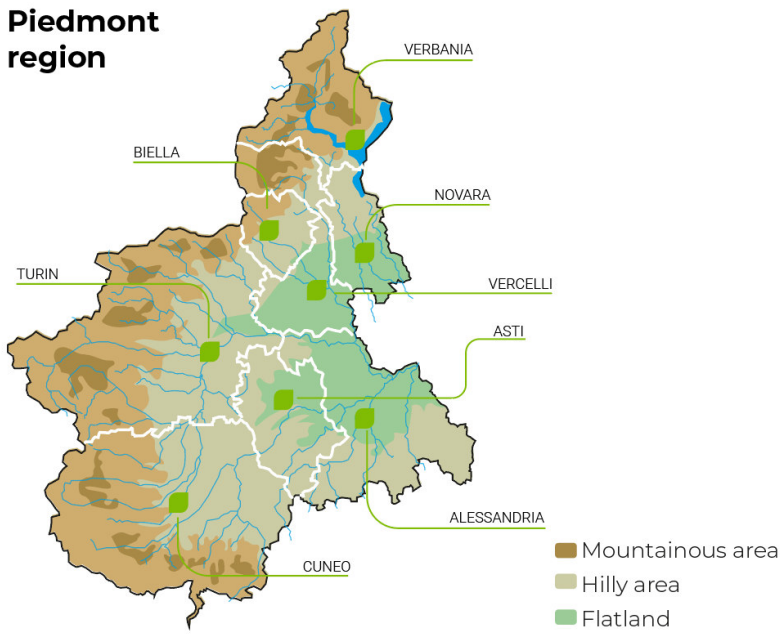


Fig. 2. Geomorphology of the Piedmont region.

Following the main city of Turin, where most of the infrastructures and services are located, other 7 cities well distributed on the entire territory are important, such as: Biella, Cuneo, Vercelli, Novara, Verbania, Alessandria

and Asti. According to the data reported on the site of the Piedmont Region, on the basis of ISTAT surveys, the total area is 25,403 square meters and is mainly mountainous (43.3%); only 30.3% is hilly and 26.4% is flat.

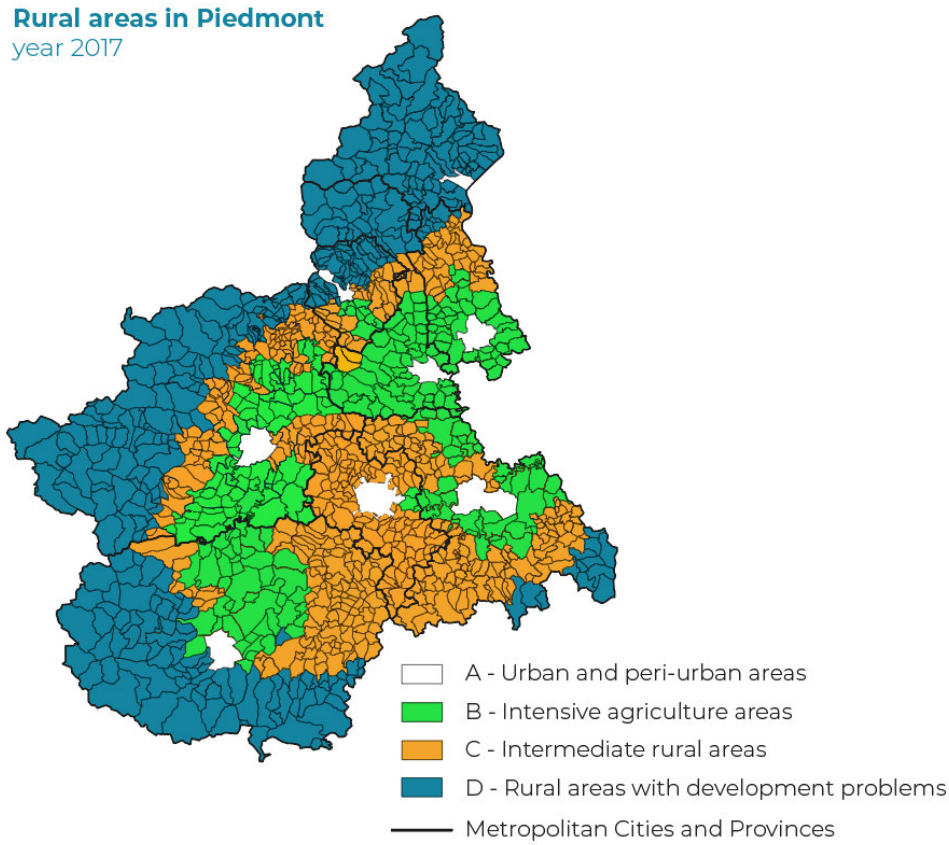


Fig. 3 Identification of rural areas. *Retrieved from: Rural Development Programme (RDP) for the Piedmont Region, 2014-2020.*

Fig. 4 Ostana and Monviso. Province of Cuneo. *Retrieved from: https://www.comune.ostana.cn.it/vivere-ostana/gallery/ostana-e-il-monviso*
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The same Istat surveys report that the population, in 2018, recorded 4,356,406 inhabitants and was distributed according to the development of economic activities and the location of urban centres. In particular, Turin, the main city and administrative centre, is the densest urban centre, while the Alps are sparsely populated. Specifically, there is a clear imbalance in population distribution with 58.3% located in the plains, mainly in the major urban centres, 30.3% in hilly areas and 11.1% in mountainous areas.
The map in Fig.2 shows that the Piedmont's territory is very variegated. This variety of environments and territorial contexts determines an equally wide range of specialisations and possible local developments. Considering the extent of the mountain territory, it is easy to deduce that the area of cultivable land is limited, and, consequently, the agricultural sector - if compared to the secondary sector, thanks to which the Region is among the leaders in Italy. Referring to the data of the Rural Development Programme 2014-2020, the rural area of Piedmont is about 18,595 km$^2$, equal to 73.2% of the total area of

the Region. It corresponds to the area outside the urban centres and coincides with the low population density area and most of the UAA. The rural area hosts about 2.2 million inhabitants, equal to 48.4% of the total population, and has a population density of 116.2 inhabitants/ km$^2$.

**Primary sector and food industry**

The agricultural sector occupies about 40% of the territory and its contribution to the Gross Added Value is 1.4% of the total. According to the Annual Report of IRES 2018, the agricultural sector has undergone a negative evolution. The anomalous meteorological trend of 2017, was reflected on the agricultural production determining a negative trend also on the number of farms and the UAA: in 2010, there were 67,148 farms and they occupied 1,010,773 ha of UAA, while in 2018, it decreased to 46,524 farms out of 890,258.29 UAA.

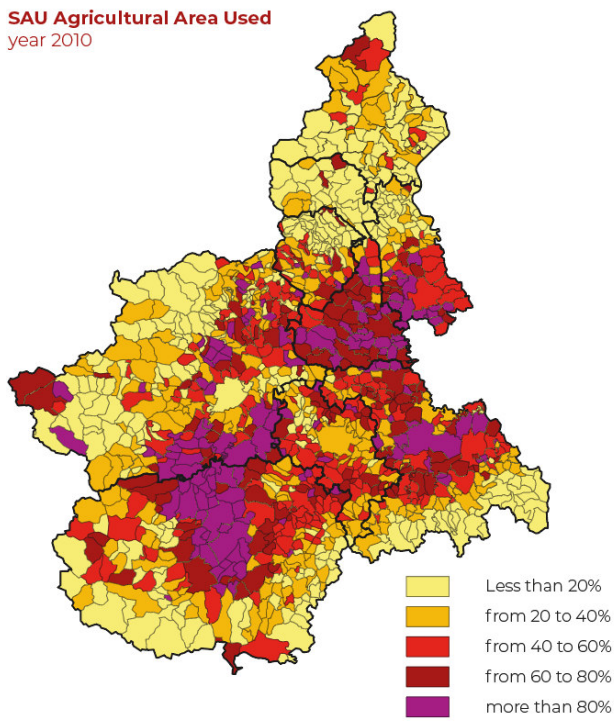


Fig. 5 SAU in Piedmont Region (2010). *Retrieved from Arpa Piemonte: https://www.arpa.piemonte.it/reporting/indicatori-on_line/uso-delle-risorse/agricoltura-zootecnia/agricoltura_superficie-agricola-utilizzata-sau*

Nowadays, the UAA occupies about 39.8% of the total regional area. Forests and woodland account for 38.3%.
The table in Fig.6 shows how the division of the UAA is not homogeneous among the provinces: the province of Cuneo is at the top, with over 270,000 ha of UAA.

| division for province | UAA in 2018 (ha) |
|---|---|
| AL | 148,578.25 |
| AT | 62,355.63 |
| BI | 21,529.53 |
| CN | 271,307.47 |
| NO | 59,006.20 |
| TO | 209,274.88 |
| VB | 16,266.59 |
| VC | 101,939.73 |
| **Piedmont** | **890,258.29** |

Fig. 6 Division of the UAA for province. *Retrieved from http://www.arpa.piemonte.it/reporting/indicatori-on_line/uso-delle-risorse/agricoltura-zootecnia/agricoltura_superficie-agricola-utilizzata-sau*

As far as agricultural production is concerned, the Piedmont's territory is distinguished by a diversified production, linked to the geomorphological characteristics of the territory. In general, most of the agricultural land is used to grow fodder and cereals (see Fig. 7-8): mainly maize and rice. Rice is the characteristic crop of the Po Valley area - thanks to the presence of the Po and its tributaries, and involves the provinces of Vercelli and Novara.
Another important part of the agricultural area is dedicated to fruit crops (see Fig. 9), in particular vineyards: in this case, the territory of the province of Cuneo is distinguished by the production of fruit and vegetables, including apples, pears, kiwis, cherries and peppers, and wine production. The cultivation of grapes has allowed the development of the production of very fine and internationally known wines with DOCG denomination - such as Barbera and Moscato d'Asti.

| Typologies of cultivation | UAA in 2018 (ha) |
|---|---|
| Cereals | 352,045.96 |
| Vegetables | 9,765.06 |
| Dried legumes/beans | 8,574.05 |
| Industrial crops | 23,236.32 |
| Forage | 378,049.34 |
| Wine yards | 43,096.58 |
| Fruits | 46,936.21 |

Fig. 7. *Retrieved from http://www.arpa.piemonte.it/reporting/indicatori-on_line/uso-delle-risorse/agricoltura-zootecnia/agricoltura_superficie-agricola-utilizzata-sau*

**Areas and harvested production of the main cereal and industrial crops in Piedmont in 2017**

| Cultivation | Area (ha) | %change on previous year | Harvest production (000 q) | %change on previous year |
|---|---|---|---|---|
| Corn | 143,366 | -3.7 | 13,502 | -6.3 |
| Common wheat | 82,156 | -4.3 | 3,956 | -24.1 |
| Barley | 18,462 | +7.9 | 908 | -9.9 |
| Rice | 115,000 | -1.1 | n.a. | n.a. |
| Soyben | 20,824 | -7.9 | 540 | -23.1 |

Fig. 8 *Retrieved from http://www.piemonterurale.it/images/documenti/PiemonteRurale2018.pdf*

**Areas and harvested production of the main fruit and vegetable crops in Piedmont in 2017**

| Cultivation | Area (ha) | %change on previous year | Harvest production (,000 q) | %change on previous year |
|---|---|---|---|---|
| Apples | 5,019 | +11.0 | 1,565 | +9.8 |
| Pear | 1,122 | +0.1 | 354 | +7.3 |
| Nectarines | 4,429 | +4.6 | 1,212 | -9.6 |
| Kiwis | 4,597 | +1.2 | 1,010 | +0.7 |
| Apricots | 733 | -10.0 | 100 | -13.0 |
| Plums | 1,365 | +15.3 | 312 | +14.7 |
| Hazelnuts | 17,665 | +1.1 | 316 | +0.0 |
| Potatoes | 1,632 | -0.1 | 459 | -4.5 |
| Processed tomatoes | 1,175 | -2.2 | 632 | -1.0 |

Fig. 9. *Retrieved from http://www.piemonterurale.it/images/documenti/PiemonteRurale2018.pdf*

**The statistics of viticulture in Piedmont**

| | 2014 | 2015 | 2016 | 2017 | change% on 2014 | change% on 2016 |
|---|---|---|---|---|---|---|
| area under vines (ha) | 43,949 | 42,761 | 42,195 | 42,284 | -3.8 | +0.2 |
| grape production (thousands of quintals) | 3,416 | 3,522 | 3,662 | 3,008 | -11.9 | -17.9 |
| wine production (thousands of hectolitres) | 2,402 | 2,467 | 2,549 | 2,043 | -14.9 | -19.8 |
| production of DOC/DOCG wine (% of total) | 2,107 (87.7) | 2,104 (85.2) | 2,112 (82.6) | 1,828 (89.5) | -13.2 | -13.4 |
| red wine production | 1,417 | 1,395 | 1,401 | 1,105 | -22.0 | -21.1 |
| white wine production | 985 | 1,072 | 1,148 | 938 | -4.7 | -18.2 |

*Fig. 10. Retrieved from http://www.piemonterurale.it/images/documenti/PiemonteRurale2018.pdf*

All crops have recently suffered from a decrease in production due to the climatic effects of 2017, to which reference was made earlier. In particular, many fruit and vegetable farms have had to face increased costs to resort to extraordinary irrigation or drastic reductions in production. In the wine sector, on the other hand, low water availability caused a drop in harvested quantities to the point where production fell by one fifth compared to the previous year (see Fig.10).

The wine industry, and more generally the beverage industry, is also at the forefront of exports in the agri-food sector. Piedmont has an agri-food system structurally oriented towards a production organization that imports raw materials and exports processed products. Fortunately, the percentage of foreign imports has been reduced in some cases, such as for hazelnuts, thanks to the increase in local production, which is then destined for processing within the large Ferrero chocolate company.

The main element of the success of Piedmont's, and consequently also Italian agri-food production is represented by certified quality products, both those linked to the territory of origin (DOP and IGP) and those obtained with sustainable processes, through an organic process. Today Piedmont can boast with 23 names in the food sector and 59 in the wine sector.

**Administrative institution**

Piedmont Region is divided into 8 main provinces which take the name from the main cities (or head of province): metropolitan city of Turin, Biella, Cuneo, Vercelli, Novara, Verbano-Cusio-Ossola, Alessandria and Asti. Turin is the administrative centre of the region.

The capital of the region is Turin, the largest city in Piedmont with almost 1 million inhabitants: it is considered to be one of the most important industrial epicentres of Italy. Although it is close to the borders, it is very well connected to the rest of Italy and Europe with 5 trains stations and one airport. Novara is the 2nd biggest city in Piedmont where over 8,000 companies are located. Alessandria follows up in population numbers, which is in a privileged position at the centre of the industrial triangle Turin-Milan-Genoa. The 4th urban centre is Asti, with a medieval urban configuration is

considered to be the epicentre for the wine industry in the region. The next city is Cuneo which has long partisan tradition and concentrates a significant number of agrifood companies. On the 6th position regarding population is Biella, located at the foot of the Alps. This city has been the centre of the textile craft district for years. Last but not least is Verbania with a population of 30,000 habs, being located by the Lake Maggiore.

Piedmont Region has a certain autonomy in respect to the national government and national law. It is divided into 11 directorates: direction of the council, financial resources, health and welfare, education and job, environment and energy, agriculture and food, public works and transports, competitiveness, culture tourism and commerce, European funds and policy, transparency and anticorruption. The province and the cities also have a certain autonomy to manage the local territory.

The Piedmont plan for rural development 2014-2020 has a financial allocation of 1,093,054.267 Euro: 43.1% from the European agricultural fund for rural development (EAFRD); 39.82% from the national funds and 17.06% from the regional funds. In Italy, the Country Budget for 2014-2020 was of €75,130,734.582: 44.6% dedicated to ERDR (European regional development fund) and 27.8% to EAFRD, 23.2% to ESF (European social fund), 3% to YEI (Youth Employment Initiative), 1.3% to EMFF (European maritime and fisheries fund).
Thanks to the ERDR 2007-2013 programme, 12 innovation poles/hubs were activated in 2009, which became 7 in 2015 with the ERDR programme 2014-2020. They are in line with the RIS3 (Regional Innovation Smart Specialization Strategy):

- agrifood
- green chemistry
- textile
- life science and health
- energy and clean technologies
- Smart Products and Manufacturing
- Information and Communications Technology

Actually, RIS3 identified seven priority productive sectors which Piedmont region is particularly specialized in, considering the enterprises concerned, the technological know-how and the presence of high-level research centres,

resulting in a strong concentration of innovation activities: Aerospace, Automotive, Green Chemistry/Clean Tech, Mechatronics, Textile, Agrifood and Life Sciences.

1,194 regional units have joined the innovation poles (June 2017): 858 SMEs, 133 large enterprises, 60 research organism and 43 other typologies of actors. In particular the agrifood innovation hub is located in Cuneo province and has four main thematic areas: track to market, food-core (product, process, packaging innovation), food-sustainability (by-products and environmental impact), farm of the future. In 2018, it has 120 members, mainly about the food production (34%) and consulting and R&D (25%) while the agricultural enterprises where only the 1%.

**Contribution to the country economy- details**

Overall, from an economic point of view, the Piedmont's scenario confirms a slow and steady decline that has persisted for several years now: the recovery is slower than the Italian average and the drive for innovation seems to be slightly lower than the Italian north-west.
Despite this, both the surveys conducted by the IRES (Istituto di Ricerche Economiche e Sociali per il Piemonte) and ARPA (Agenzia Regionale per la Protezione Ambientale) place Piedmont in a medium-high position in the Italian regional socio-economic landscape.

In general, in year 2015, Piedmont produced the 8% of the national GDP with about 126,335.4 millions euro. In this region, there were located the 7.3% of business and the 8.1% of employees. Comparing with the Italian data, the Piedmont contributes with 11.1% of the millions euro of export and with 11.9% of the R&D sector.

Piedmont: year 2015

| | Piedmont | % in Italy |
|---|---|---|
| Population | 4,424,467 | +2.0 |
| GDP (in million euros) | 126,335.4 | +24.8 |
| Nr. of businesses | 442,862 | -0.4 |
| Employees ( in thousand euros) | 1,821 | +0.6 |
| Export (in million euros) | 45,776.9 | +53.6 |
| R&D (in thousand euros) | 2,487,578 | +46.0 |

Fig. 11 *Retrieved from http://www.politichepiemonte.it/images/pdf/archivio/59_PolitichePiemonte_rivista.pdf*

Considering more recent data, in 2018, the Piedmont's economy has recorded a moderate recovery, producing in the region about 135 billion euros, which corresponds to 7.7% of the country's economy. The rate reaches +0.6 compared to 2017.

Regarding the agrifood sector, an estimate of the turnover in the Piedmont Region was of 13 billion euros, whereas in Italy of 133 billion euros. The data about the export in Piedmont are about 4,7 billion euros, compared to Italy with about 27 billion. It means that in the agrifood sector, the Piedmont contributes with about 10% to the national turnover.

Agrifood in Piedmont

| Regions | Turnover (estimate - billion euros) | incid. % regional turnover | Export (billion euros) | incid. % regional export |
|---|---|---|---|---|
| 1. Lombardia | 32,6 | 25,2 | 4,8 | 19,5 |
| 2. Emilia Romagna | 27,8 | 21,3 | 4,1 | 16,0 |
| 3. Veneto | 14,0 | 10,7 | 3,4 | 13,9 |
| **4. Piemonte** | **13,0** | **9,1** | **4,7** | **16,1** |
| **Total Italy** | **133,0** | **100,0** | **27,0** | **100,0** |

Fig. 12 *Retrieved from https://www.poloagrifood.it/site/homepage*

### 4.2.2 Economic activities and population structure

#### 4.2.2.1. Specific activities of Piedmont region

Over the last few years, Piedmont's production structure has changed significantly from an economic system characterised by a multitude of SMEs into one that focuses on emerging medium-sized enterprises and pushes SMEs towards greater attention to quality.

The drive towards growth comes from three dominant features that characterise the Piedmont's economy: high technology, high tendency to export and supplying chains of excellence.

Surveys on the economic sector confirm that the Piedmont region is one of the main national realities for the production of added value. In detail, there is a greater weight in the service sector, which contributes with about 70% of the Region's total wealth, followed by the manufacturing industry, which

contributes with about 24% and then by the construction sector (4%) and the agricultural sector (about 2%).

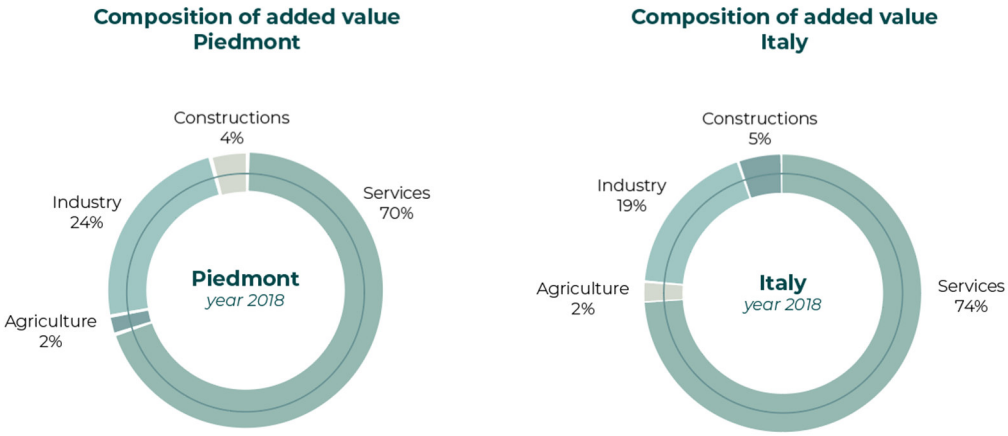


Fig. 13 *Retrieved from http://www.politichepiemonte.it/images/pdf/archivio/59_PolitichePiemonte_rivista.pdf*

The service sector has the highest revenue reflecting the contemporary trends. Nevertheless, the manufacturing sector has a significative revenue for the region with about 30,000 units and six areas of innovation or excellence in which the region is investing the most. The hugest area by unit reunites all traditional sectors "Made in Piedmont" that include big industries, especially related to the food transformation like Ferrero, Lavazza, and Martini which are worldwide well known. More related to the engineering vocation are the areas of Mechatronics, Automotive, and Aerospace, inside this sector there can be found key companies for the Piedmont's development, such as FCA and Comau. Other non-traditional industrial sectors that have gained importance are Green Chemistry and Life Science with relevant companies, such as Mossi Ghisolfi and Bracco Corporate. Piedmont has a large history of entrepreneurs that is still reflected nowadays on the majority of the industry, which is "Oneman Company". This vision is shown regarding the high number of micro industries within the territory, also being the largest employers in the region.

### 4.2.2.2. The number and dimension of companies

In the previous paragraphs, reference has been made to the territorial morphology of the Piedmont region. It is clear that the territorial

characteristics also have repercussions on the economic sector. In fact, ISTAT national statistics show how industries are not evenly distributed over the territory (see Fig.14), causing imbalances in terms of economic development. The economically strongest areas are those in correspondence with the largest urban centres, to the disadvantage of rural and mountain areas.

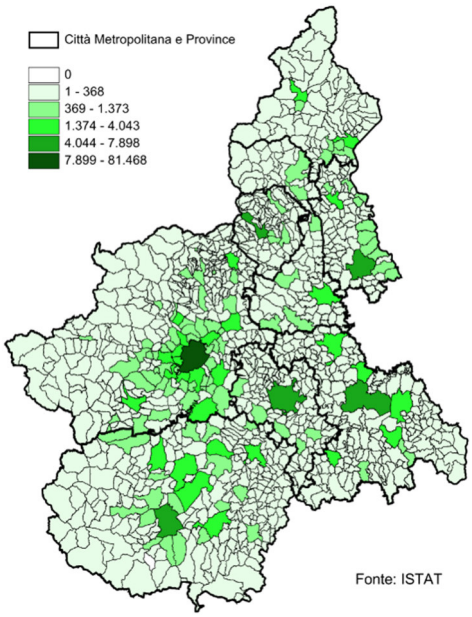


Fig. 14 *Number of companies in Piedmont. Arpa Piemonte (2015) http://www.arpa.piemonte.it/reporting/indicatori-on_line/uso-delle-risorse/industria/industria_unita-locali*

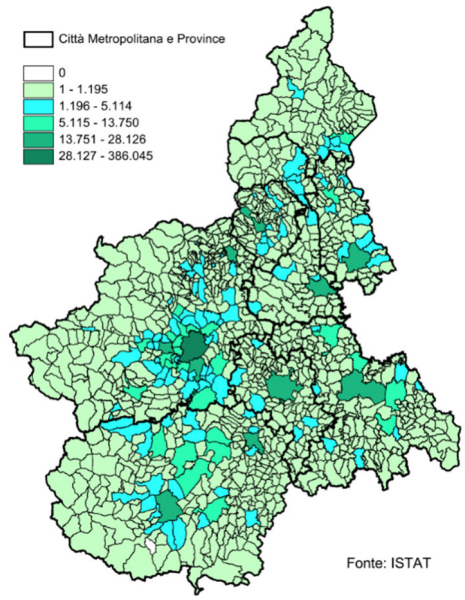


Fig. 15 *Number of employees in the companies. Arpa Piemonte (2015) http://www.arpa.piemonte.it/reporting/indicatori-on_line/uso-delle-risorse/industria/industria_unita-locali*

Turning, however, to more specific data relating to the economic sector, it is easy to see that the economic difficulties of recent years have had an impact on the number of enterprises. Analysing ISTAT data from 2016 to 2018, a decrease in the number of enterprises was recorded: in 2016, the total number of active enterprises in the Piedmont Region was 325,839; in 2017, it rose to 325,169, and in 2018, to 324,359. However, at the end of 2018, Piedmont is on the seventh position among the Italian regions, with over 7.1% of national enterprises.

In detail, ISTAT statistics report that among the 324,359 companies in 2018, 29,411 were manufacturing industries with a total of 386,668 employees. Analysing the number of employees and the size of manufacturing enterprises, the scenario is as follows:

- micro (0-9): 23,753 units with 63,741 employees;
- small (10-49): 4,663 units with 89,051 employees;
- medium (50-249): 843 units with 82,931 employees;
- large (>250): 152 units with 150,944 employees.

Specifically, the food industry has been affected by the economic crisis, going from about 7,000 units in 2007 to about 4,200 units in 2018. Likewise, the agricultural sector has been declining in recent decades.

According to the data of *Sistema Piemonte*, the total farms in agriculture sector are 45.221 in 2018, divided into:

- **Agriculture**: 44,683
  - Breeding: 5,961
  - Support to agriculture: 462
  - Hunting: 2
  - Not permanent cultivation: 17,835 (mostly cereal, vegetables, rice, flowers and forage plant)
  - Permanent cultivation: 13,737 (pome fruits, nuts and other tree fruits)
  - Mixed activity: 6,274
  - Plants: 342
  - Others: 70

- **Aquaculture**: 18
- **Forestry**: 520

#### 4.2.2.3. The social environment

The total resident population in Piedmont is over 4 million people (4,356,406 in 2019). The 51.4% of the total population is female, while the male population is 48.6% (in 2018). In the last 56 years, from 1961 to 1981, the population has grown a lot, while in the 1991 and 2001 censuses show a decline in population.
In 2018, the population density is 171.6 inh/km$^2$ and the highest density is found in correspondence with the provincial capitals of the region, in particular Turin. The average age of the Piedmont population is 46.5 years, actually the 35-54-year-old group is the most populous (16.3%). There is a low nativity rate (the average index of regional birth is 6.7% - the 14°/20 place in Italy) and a high mortality rate of 12.3% (the 2°/20 place in Italy). There is a high presence of single and couples, and the family units are 2,007,627 in 2018 with 2.17 average people, lower than in the regions of the South and Central Italy (18°/20 place in Italy). Regarding the marital status in 2018 in Piedmont, 47% of the total are married, 40.6% are unmarried, 8.3% are widowed and 4.2% are divorced. The average age for weddings in Piedmont is 39.13 for men and 34.57 for women in 2016.
Young people leave their parents' house at an average age of 30.1, in fact, the youth still living with their families are 428,000 of which 210 are workers.

Piedmont is a country of immigration and emigration. Immigration has increased by 5% in the last 30 years, and in 2018, in Piedmont there were 9.2% of the total population of the region. They come mainly from Europe (Romania, Albania) - 58.7%, Africa (Morocco, Nigeria) - 23.6%, Asia (China, Philippines) -10.4%, America (Peru, Ecuador) - 7.1%. Emigration is also relevant, in 2019, the net migration was of 3.5 (for 1,000 inhab). The main reason can be related to the 'millennial' generation which may have the highest level of education, but they suffer the highest unemployment levels and they look for other places to live and to find job opportunities.

In terms of education, the region counting 4,369 institutions is a reference point at the national level due to its 4 prestigious higher education institutions: Politecnico di Torino mainly based in Turin, Università degli Studi di Torino, mainly based in Turin, Università del Piemonte Orientale in Alessandria Novara and Vercelli, and University of Gastronomic Science in Pollenzo (Cuneo). The enrolled students in 2017/2018 were 118,212. The most important areas are engineering (more than 26,000 students) and economics (more than 14,000 students), being relatively influenced by the massive automotive industry and the tertiary sector.

Regarding the unemployment rate, it has grown from 5.5 in 2000-2007 to 8.2 in 2019. There was an increase between 2004-2013, but a deceleration between 2016-2019. It mirrors the level of education: 12.8 for the elementary school diploma, 11.2 for the middle school diploma, 7.9 for high school diploma and 4.0 for higher education.
Regarding the employment rate, it has increased between 2004 and 2008, from 63.5 to 65.2, then decreasing until 2014 (62.4) and recuperating in 2018 with 65.9.

The average income in 2016 was of 28,060 euro/year, while in 2007 of 31,783 euro/year.

### 4.2.2.4. The existing workforce and the level of qualification

The estimates declared by ISTAT for 2018 show an increase in the number of employees compared to the previous year of 12,000, mainly involving men in the manufacturing industry.

The graph in Fig.16 shows the average trend in employment, where the first half of 2018 follows a dynamic trend, but it stops in the next period.

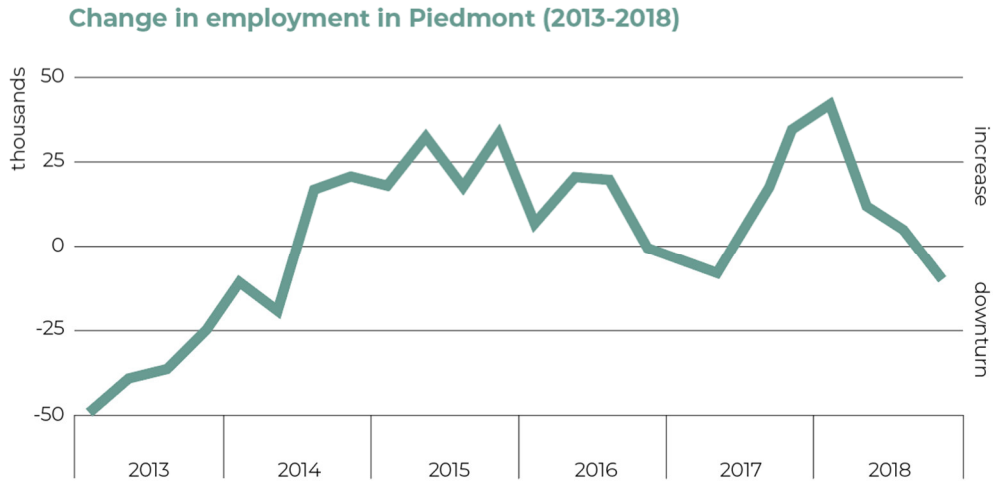


Fig. 14 *Retrieved from https://www.ires.piemonte.it/relazione2019/RelazioneAnnuale2019_Capitolo02.pdf*

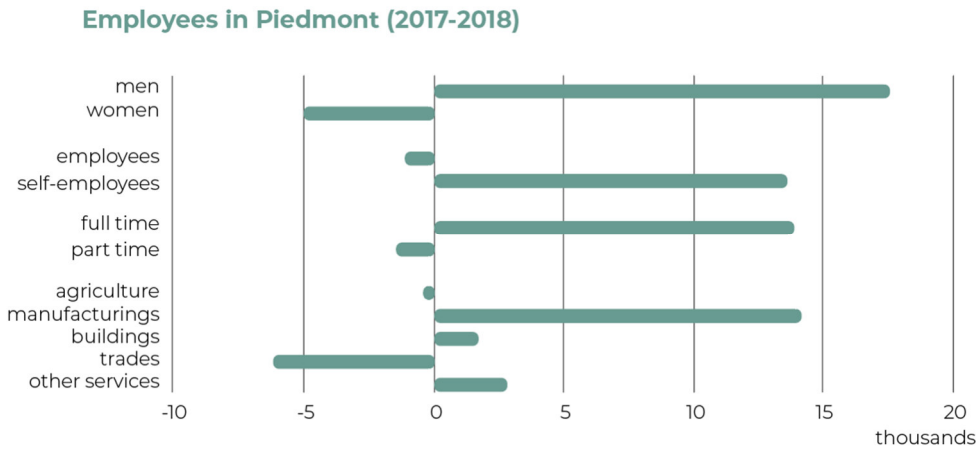


Fig. 15 *Retrieved from https://www.ires.piemonte.it/relazione2019/RelazioneAnnuale2019_Capitolo02.pdf*

Specifically, there have been changes in the area of employment by gender, age and schooling in recent years. In the data for 2018, there is an increased demand for the most qualified components, especially graduates. The employment rate in 2018 is of 65.9. It changes according to the levels of education: 40.3 for the elementary school diploma, 53.1 for the middle school diploma, 71.6 for the high school diploma and 83.4 for higher education.

As far as the age group is concerned, the ISTAT data show an increase at both ends of the age scale, with a higher rate for the young people up to 24 years of

age than for the adults over 55 years of age. This phenomenon is closely connected to the change in the pension system and the decrease in the young population (corresponding to the intermediate age group) in the Region.
In general, **the employment trend is increasing** and is in line with the national average. As a result, there is a decrease in unemployment of about 10%, with a greater prominence among women, who are mainly employed in the services sector.

Regarding the employees in **industry and service sectors**, according to Istat, in 2017, the total working force is of 941,383 people, 345,075 working in manufacturing industries (mostly in food industries).

In the **agricultural sector**, the number of employees is about 70,000 people. This sector employed only the 2% of the total employed people (IRES Piemonte, 2018).
The decline of the agricultural farms has led to an increase of their dimension and of the need of workers, who are mainly seasonal or precarious. A positive data is the surge of managers under 40 years old, thanks to the rural development plan in 2016. Therefore, they reached to 13.4%, having 6,656 enterprises in 2018. According to the data of the national census in 2010, 97% of the agricultural farms are mainly family managed, in fact, there is no big corporate predominance on cultivation.

#### 4.2.2.6. Rural area contribution to the regional economy

The Piedmont's agriculture is facing a period of renewing and changing due to the climate changes and the economic crisis, which are accelerating the transformations started in the last century. On the market, there is an increasing segmentation and qualification to valorise productions and the 'taste economy' has increased in the valorisation of some regional rural areas.

The agricultural sector, with forestry and fish, produces about 1.94 billion € and the food industry is about 5.33 billion. They are 4.53% of the regional added value altogether. Export for the food sector is a driving force. Thus, in 2017, it was more than 5.4 billion € with an increase of 500 billion (IRES, 2018). In 2018, it recorded 5.96 billion €.

Piedmont is mainly an importer of agricultural products (2.27 billions euro of import and 0.51 billions of export) and exporter of processed products (1.94 billions euro of import and 5.45 billions of export). The main products exported are apple, kiwi, wine, coffee and sweets.

In particular, drinks with 1,600 millions euro (29%), cereals with 540 millions

**Main categories of products exported by the food industry from Piedmont (in millions of €)**

| Products | total import value | first buyer country | second buyer country |
|---|---|---|---|
| Drinks | 1,603 (29.1%) | United States | Germany (15.7%) |
| Grains and starchy | 540.5 (9.8%) | France (21.8%) | Germany (17.6%) |
| Bakery products | 356.4 (6.5%) | France (27.5%) | Germany (11.1%) |
| Total | 5,503 | France (17.1%) | Germany (15.5%) |

euro (9.8%) and baked products with 365 millions euro (6.5%).

Fig. 16 *Retrieved from https://www.ires.piemonte.it/pubblicazioni_ires/Piemonte%20Rurale%202018.pdf*

The success in this region of the food industry is related to the quality of their products certified by PDOs and PGIs: 23 are represented by food (cheese, cured meat, fruits, vegetables, cereals) and 59 are represented by wines. 332 products are acknowledged as traditional (PAT).

The excellent products of this sector are the following:

- wine
- breeding
- fruits and vegetables

- cereals (wheat, corn and rice)
- hazelnut
- coffee processing, chocolate processing and sweets
- bakery
- farming machinery
- food machinery (process and packaging)

The organic production is increasing, with 2,256 enterprises and 65,000 ha which is 7% of UAA.

### 4.2.3 Natural resources for sustainable development

Thanks to the relevant presence of the mountains, which surround ⅔ of the region's borders, Piedmont can count on a large amount of natural resources, such as water and forests.
The surface of the lakes is about 14,440 ha and the rivers are 1,837. Moreover, in Cuneo, Torino and Biella province, there are 42 natural springs of mineral water, which created 14 bottling companies. There are also 10 thermal spring.
The biomass is another important resource for the broad forest area in the region. According to the data in 2016, the total forest area was 976,953 ha, the 38.5% of the total surface, divided into:

- 932,514 ha woods (36.7%)
- 35,065 ha arboriculture (1.4%)
- 9,374 ha other forest surface (0.4%).

The province of Alessandria, Torino, Verbania and Cuneo have more than 100,000 ha of forest area.

In 2017, in the region the production of energy from renewable sources were 9,716.90 GWh, composed of:

- 6,021.70 hydroelectric;
- 1,856.10 bioenergy;
- 1,811.70 photovoltaic;
- 27.40 eolic;
- 0 geothermal.

According to the data declared by Legambiente, in Piedmont, in recent years, the growth of renewable energies has been continuous. Today, 39.4% of total energy consumption is produced from renewable sources thanks to the 52,496 widespread plants. In particular, there has been a decisive growth in the production of solar photovoltaic energy, from about 122 GWh/year in 2010 to 1,688 GWh/year in 2016, which is confirmed as the most widespread technology. In terms of production, however, it is hydroelectric power that provides the greatest contribution of electricity.

The hydroelectric plants are 895 and the thermoelectric ones are 453 (in 2017); whereas, photovoltaic energy can count on a medium horizontal annual solar radiation of 1,317 kWh/m$^2$. Following a recent study, the energy from renewable source in 2020 will increase by 13.3%, in comparison to 2015, to reach 26.2% in 2030. There will be a reduction of fossil fuels of 243t in 2020 and of 494 in 2030, thanks to sustainable policies.

### 4.2.4 Secondary products and waste volume

As described in the previous paragraphs, the Piedmont territory hosts some of the main global industrial players in the agrifood industry. Here are three main sub-sectors of the agrifood sector, which will be described to provide an estimation of the key by-products and waste volume:

1. **Rice**: Piedmont is the main European producer of rice, with 121,421 ha cultivated. Rice farming produces a number of by-products/wastes (such as straw, husk and bran), with a wide range of recycling options under investigation;
2. **Grapes**: Piedmont has a longstanding tradition in grape farming (approximately 46,600 ha) and the production of renowned wines. By-products, especially grape seeds, have been and are currently investigated due to their valuable characteristics;
3. **Cattle breeding**: cattle breeding counts more than 800 thousands heads in Piedmont. Among the different uses of wastes produced, the production of bio-methane from slurry, manure and liquid manure is particularly important, linking agrifood and green chemistry sectors.

Due to the lack of regional data on total waste products, we will proceed with an estimation of the outputs produced by a company based on the hectares used.

## 1. Rice

**Number of companies:** 1,722

**Number of Employees:** 3,898

**Hectares:** 121,421 ha

**Input:** Seeds, Pesticides, Energy, Water (1,400 litres by evaporation and transpiration to produce 1 kilogram of paddy rice)

**Output:** Rice Straw (3 tons/Ha), Stock Seeds, Green Grain 4 kg, Rice husk 20kg, Bran 15kg, Broken rice 6kg, Non-Ferrous Metals

(data relating to 100 Kg rice)

Fig. 17 Rice paddies of Cavour canal. Province of Vercelli. *Retrieved from: https://www.piemonteorientale.it/canale-cavour-ovest-sesia-e-gestione-virtuosa-delle-acque/ Copyright Federico Ranghino*

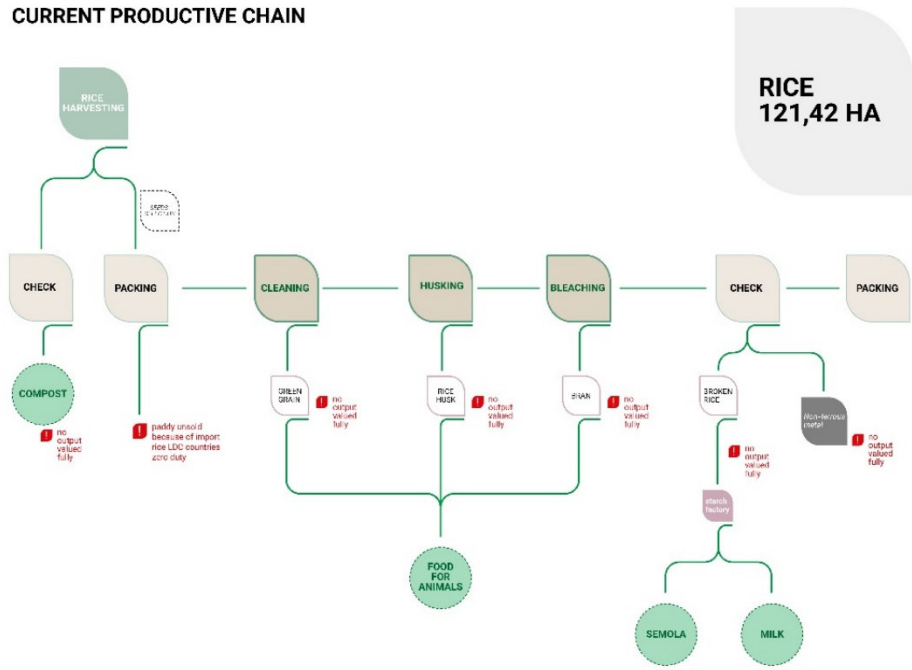


Fig. 18 *Retrieved from: Barbero, S (2017), Systemic Design method Guide for Policymaking. A circular Europe on the way, Turin.*

## 2. Grapes

Fig. 19 Langhe vineyards. Province of Cuneo. *Retrieved from: https://www.landmade.it/index.aspx*

**Number of companies:** 13,677

**Number of Employees:** 40,898

**Hectares:** 46,606 ha

**Input:** Grapes 70 ton, Energy, Water 1,980 lit, Acids, Tannins, Gelatine 2.4kg, Fertilizer

**Output:** Leaves, Vinegar, Scum 7 ton, Wine 49,109 lit, Seeds, Dreg 10 lit, Grappa 825 lit

(data for 70t of grapes)

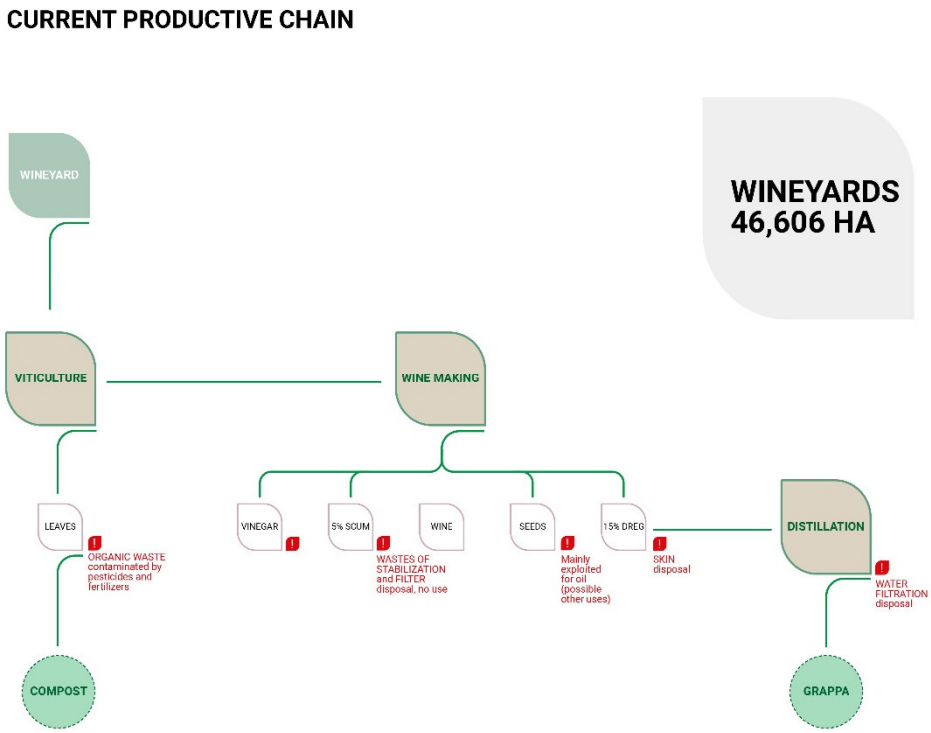


Fig. 20 *Retrieved from: Barbero, S (2017), Systemic Design method Guide for Policymaking. A circular Europe on the way, Turin.*

## 3. Cattle breeding

Fig. 21 Piedmontese cattle. Province of Turin. *Retrieved from: https://www.torinoggi.it/2017/04/06/leggi-notizia/argomenti/eventi-11/articolo/carmagnola-38-mostra-provinciale-dei-bovini-di-razza-piemontese.html*

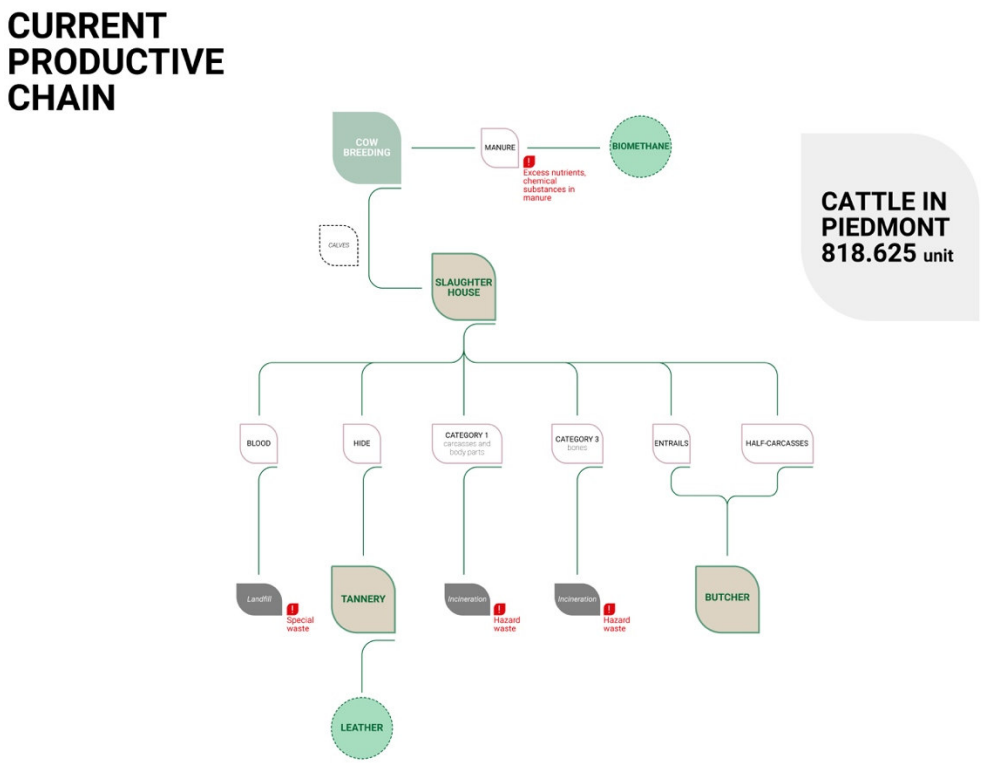


Fig. 22 *Retrieved from: Barbero, S (2017), Systemic Design method Guide for Policymaking. A circular Europe on the way, Turin.*

The by-products and wastes derived from the considered agricultural and agro-industrial activities could have various uses in different sectors, i.e.:

- by-products containing "noble" substances can be employed for functional food and for cosmetics/pharmaceutics (i.e. antioxidants and polyphenols from grape);
- production of pet food, which is an increasingly growing sector
- by-products from rice cultivation could be used in several sectors, for example bioplastics, biofuels, construction materials (bricks made of rice straw, with high insulating properties), animal bedding, filters;
- energy production: the most promising sector is that of the production of biomethane, by using slurry, manure and liquid manure from cattle breeding.

The data reported and the analysis of current productive chains show that

there are different strengths and that it is possible to start circular economy processes, if technical process improvement actions are carried out. Nevertheless, there are some (general and transversal) criticalities, which go beyond scientific feasibility and must be addressed.

**General criticalities**

- Optimisation of collection, storage and supply;
- interconnecting effectively the main bioeconomy sectors (i.e. agriculture, agri-food, bioindustry/green chemistry) for creating a sustainable value chain;
- quality of the by-products;
- regarding functional foods: it is a promising and growing sector, and in Piedmont there are mature competences and companies, but currently ingredients derive mainly from "raw materials" and not from by-products, due to technical and legislative issues;
- regarding biomethane, the main critical issue concerns the upgrading of biogas plants;
- general legislative issues to be faced in order to foster circular economy processes;
- possible conflicts arising from different interests in the use of waste (food/non-food).

**Transversal criticalities**

- compatibility of waste legislation and REACH Regulation on chemicals: conflicts between the respective rules;
- review of national regulations to increase the valuable exploitation of waste;
- building a complete value chain and coordination of the actors involved, i.e. regarding questions related to supply;
- import-export of wastes: in some cases it is not possible to intervene as the global value chain is already firmly established, but in other cases some actions could be undertaken in order to reduce quantities (e.g. regulations, incentives, competences, establishing new treatment plants…);
- need to support a new ecodesign paradigm, that considers the whole

product life cycle (durability, maintenance, recyclability)

- environmental and societal issues: i.e. problems in creating new plants due to local communities' objection;
- lack of awareness of potential users of secondary materials, especially in certain fields (such as construction).

### 4.2.5 Assessment of the labour needs for circular economy specialists

In order to achieve the implementation of innovative models within the circular economy, it is necessary to pay attention to its real present and future needs. The main objective must be to interface with them, investigate them, so as to be able to define clearly and comprehensively which are and, at the same time, circumscribe the key competences a practitioner must possess and learn in order to respond to them.

It is precisely on this last point that the European project MULTITRACES devotes greater attention to: what are today and what will be in the immediate future the skills needed to become part of the world of the circular economy? What are the distinctive traits that future professional profiles must acquire, particularly in rural areas? The answer to these questions cannot be unequivocal and decisive, because we are dealing with a sector in continuous evolution, but it is possible to bring out those skills arising from matching the supply and demand on the circular labour market, from meeting professionals with companies.

In particular, it is possible to define **two different types of skills**: **acquired competences and transversal competences**.

The former, the acquired competences, are those that an individual is able to use in an autonomous and responsible way and derive from previous knowledge and skills, while the latter, the transversal competences, are those that concern the personal characteristics of an individual, essential characteristics to transform his/her knowledge into behaviour, which can also be defined as broad-spectrum skills.

Therefore, what are the most useful acquired and transversal skills to create and strengthen the curriculum of a potential professional circulating in rural areas?

As mentioned above, **the acquired skills** refer in particular to practical or theoretical knowledge future professionals must assimilate during their studies; it is that information which they acquire thanks to learning and which they will then apply on the labour market, transforming it into skills. They are based on certain macro-disciplines, as follows: agronomy, design, economics and management, engineering, but before being able to outline them in a precise way, it is good to describe where they derive from.

Among the interdisciplinary knowledge, we can mention the following: knowing the methodologies to enhance sustainable development within rural territories and supply chains; knowing how to map potential local actors and stakeholders for the creation of relationships; knowing how to communicate and be aware of the techniques for the dissemination and promotion of a project; knowing what are the technological innovations in the circular field, as well as the related processes of exploitation of by-products. It is also important to know what business management strategies and investment opportunities are in rural areas, as well as being aware of the existing rules and legislation in favour of protection environment and waste management.

Thus, such interdisciplinary knowledge is transformed into concrete actions, the recurring patterns relate to a better exploitation of any type of material resource: starting from the minimization of waste through recycling, reuse or sale actions, to the reduction of energy and water consumption, to the use of renewable energy, up to the redesign of products and services.

From this information, it is possible to derive some of the so-called acquired skills, which are functional for the curricular training in rural circular economy and in particular, refer to the following areas:

- sales/marketing: knowing the reference market for the circular economy, knowing how it interacts with the market;
- communication: knowing the methodologies to communicate a circular project, through promotion and dissemination;
- agronomy: knowing the physical, chemical, organoleptic properties of a product and its by-products in order to be able to enhance them (the importance of considering an output not as waste, but as a resource, an input for a new process);
- environmental engineering and energy management: know the main technologies and methodologies for an efficient management of energy and environmental resources.

The **transversal skills** - can be defined as the personal abilities that characterise each individual, namely cognitive, behavioural and socio-emotional skills. In order to outline them more precisely, it is useful to divide them into **three main groups**.

The first group is generic and consist in the ability to: relate with others, make decisions autonomously, organize one's work and its timing, adapt to different situations and contexts, rationalize events, know how to manage one's emotions, stress.

The second group are the key competences for sustainability, which have been identified for the achievement of SDGs (sustainable development objectives) as follows:

- systemic thinking competence: the ability to understand relationships and analyse complex systems;
- anticipatory competence: the ability to understand and assess the future: risks and changes;
- regulatory competence: the ability to understand and reflect on sustainability standards and values;
- strategic competence: the ability to develop sustainability actions at the local level and beyond, collectively;
- collaborative competence: the ability to relate and solve problems in a participatory way;
- critical thinking competence: the ability to question and reflect on one's own values, perceptions and actions;
- self-awareness competence: the ability to reflect on one's role in the local community and society;
- integrated problem-solving competence: the ability to apply different frameworks in troubleshooting.

The third group refers to those skills more closely related to the circular economy and consist in: knowing how to manage and work in interdisciplinary teams with different professional profiles, having good communication skills to tell the projects and business activities, being able to observe and to be curious about innovative solutions, knowing how to manage changes in business activities and above all being flexible in managing new

tasks and new challenges related to the implementation of circular economy models.
These groups are the key competences to optimally approach the field of circular economy applied to the rural context.

In conclusion, it is essential to underline how the labour market and, therefore, the enterprises, should be aware of the importance of having professionals with specific curriculum and skills in order to achieve a healthy and fair transition to the circular economy.

### 4.2.6 Study case – implementation of circular economy in rural areas of Piedmont Region County

Starting from the considerations with respect to the current Piedmont's scenario and after having defined the importance of developing specific skills for the start-up of circular economy solutions, we are going to give a description of a virtuous case study located in the area of Cuneo, in the Piedmont region.

Agrindustria Tecco is a small company operating since 1985 and started from its owner, Giuseppe Tecco, who transformed secondary vegetable materials into industrial products useful for man. Therefore, the company was born from the idea of facing an unexplored problem, until then, namely recovering the by-products of several local companies and adopting an innovative and circular approach.

**The company started reusing local waste to produce new sustainable vegetable products, moving from the agro-industrial sector to other fields of application.** Today, Agrindustria produces various products, such as food flour, soft vegetable abrasives, bases for cosmetics, supports for the pharmaceutical and food industry, vegetable materials and additives for many other uses. It also

offers innovative services for other companies, such as grinding, micronizing, roasting, pre-cooking, drying and cryogenic grinding.

Fig. 23. Agrindustria plant. *Copyright 2020 by Davide Mercenati & Stella Bellisario.*

The company, strongly active in the territory, aims to treat niche products with the care and seriousness of an artisan's reality, boasting with customers in Italy and abroad, as well as a series of assiduous collaborations with universities, innovation poles and other national companies, always with a view to enhancing the products of the territory and in full respect of what nature teaches and makes available.


Fig. 24. Pellet produced by Agrindustria. *Copyright 2020 by Davide Mercenati & Stella Bellisario.*

In particular, for more than 10 years, Agrindustria has been dealing with **pelletizing**: the company has a wood pellet production line, operating 24 hours a day, 7 days a week. In addition, for the last 5 years, the company has had a smaller pelletizing plant for experimental and niche products, using a diversified range of materials. Agrindustria has the possibility of pelletizing on behalf of third parties, according to the parameters and needs of the customer in terms of size, materials, pressure, and humidity. This feature makes it possible to guarantee the sustainability of the project results through the creation of a supply chain that links farms and processing companies.

Another interesting aspect is the **production of energy**: the company has greatly reduced its energy dependence on the distribution network both in terms of electricity and heat, using renewable sources found directly within the company and on the local territory. The production of energy from renewable sources, such as biomass, not only adds value to the company but also to the surrounding area because it helps to preserve the natural heritage of the area.

The company has two photovoltaic plants with a total power of 725 kW, and it has installed an automatic dryer that consumes the energy surplus produced by the photovoltaic plants during weekends and holidays. Agrindustria has

biomass boilers that consume pellets produced locally from the waste from its own processing.

Moreover, a biomass power plant is being built to allow the company to be energy self-sufficient. In fact, according to preliminary studies, Agrindustria could find the materials to produce its energy within a radius of 45 km, selling the surplus and activating a series of positive economic results. The aim of the company is to create a model of innovative and sustainable energy production from biomass.

From energy production to the innovative reuse of agro-industrial by-products, Agrindustria aims to be an interface between agriculture and industry, between resources and uses that man is able to invent. Nature is, in fact, a partner of this company, because processes and products are obtained by observing and studying the functioning of nature. It tries to capture the quality of cereals, fruit and vegetables, as Nature has created them: the outer shell of dried fruit, bran cereals, legumes, the skin and pulp of vegetables and fruit, corncob grains, roots. Thus, nature and quality are a key combination for this company, which operates in accordance with the world of plants, taking the natural cycles and their results as a model. Agrindustria sees nature and learns from it to create products that are as simple as they are practical, useful and advantageous applications in the food, craft, and domestic industries.

Starting, therefore, from the model of Agrindustria and other similar realities, it is necessary to restart and rethink the evolution of manufacturing, which must be more flexible, innovative and sustainable, while preserving its identity. Companies will have to learn to work together with the territory, with other companies, with institutions and research centres, with a view to interconnecting and consciously exchanging resources.

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