

SUCELLOG: IEE/13/638/SI2.675535

D3.2c Summary of the regional situation, biomass resources and priority areas of action in Italy

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About SUCELLOG project

The SUCELLOG project - Triggering the creation of biomass logistic centres by the agro-industry - aims to widespread the participation of the agrarian sector in the sustainable supply of solid biofuels in Europe. SUCELLOG action focuses in an almost unexploited logistic concept: the implementation of agro-industry logistic centres in the agro-industry as a complement to their usual activity evidencing the large synergy existing between the agro-economy and the bio-economy. Further information about the project and the Partners involved are available under www.sucellog.eu.

Project Coordinator



Project Partners



About this document

This report corresponds to D3.2 of the SUCELLOG project - Summary of the regional situation, biomass resources and priority areas of action in Italy. It has been prepared by:

CIRCE-Research Centre for Energy Resources and Consumption
C/Mariano Esquillor Gómez 15, 50018, Zaragoza
 E-mail: sucellog@fcirce.es
 Tel: +34 876 555 511

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1. Introduction

SUCELLOG focuses on the implementation of biomass logistic centres into agro-industries as complement to their usual activity with minor investments. Agro-industry facilities can be utilised in their idle periods to handle and pre-treat biomass feedstock (mainly from their own residues or agricultural residues nearby) to produce solid biomass to be introduced into the market.

This document shows the results of the work carried out within SUCELLOG WP3-“Regional framework and stakeholders’ engagement” in Italy. During this WP, four main actions were carried out in the project target regions (Emilia-Romagna, Marche, Puglia, Sardegna and Toscana):

- Allocate biomass resources.
- Evaluate with the stakeholders both the technical and the non-technical barriers of the implementation of SUCELLOG concept in the agro-industries.
- Determine the potential areas for the development of agro-industry logistic centres.
- Engage agro-industries to the project.

For the first action, an evaluation of the real potential of primary agrarian biomass has been carried out inside Task 3.1. The methodology selected corresponds to a “Resource focussed approach”, as described by BEE standardised classification (project Biomass Energy for Europe), which starts with statistical data from agrarian inventories. This data has been complemented with the real availability indices (the share of biomass that is not currently being used for other aims including soil sustainability issues) gathered in the regional workshops with the agrarian sector during Task 3.3. As a first result, primary biomass resources have been firstly catalogued according to existing competitive uses and relevance in terms of current unused quantities. This assessment has been performed in by country level since no regional differences has been observed. Secondly, a map of the distribution of real available primary resources and a table of the available tons per year in dry base were built per target region. Even though the use of agro-industry residues is a target of SUCELLOG, the data of the inventories was not sufficient to produce a reliable inventory of the biomass residues produced in the agro-industries processes. Therefore the maps and tables presented do not include this type of resources, which will be deeply assessed for particular cases of logistic centres monitored or audited during in WP4-WP6.

As a second action, an assessment of the barriers and opportunities for the development of logistic centres was carried out through personal interviews with each target sector in Task 3.2. Existing agro-industries from the potential sectors (those owning compatible equipment for the conditioning and storage of raw material) were asked about: idle periods, residues produced in their facilities and upstream in the crop cultivation, the economic situation of the sector and possible upcoming changes

due to the Common Agricultural Policy, practical and legal incompatibilities in using their facilities for the production of solid biomass, social barriers for the development of this new activity and, finally, opportunities detected. Section 2 presents the situation of the country since no regional differences were appreciated. After this analysis, target sectors were identified per region and specific agro-industry locations were included inside the biomass resource map.

To determine the potential areas inside each target region for the development of agro-industry logistic centres, it has taken been into account the diversity and quantity of available agrarian resources (both woody and herbaceous) and of agro-industries present in the region as well as the compatibility among them. Compatibility has been defined according to their seasonality (matching the months of biomass production with the idle period of the agro-industry) and their technical compatibility of use. Logistic issues such as good communication networks and proximity to consumption areas has also been taken into consideration. Potential areas have been identified per region and are shown in this document. However, it is important to highlight that the selection of a potential area does not mean that an agro-industry non belonging to it could not start a new activity and the opposite. The size of the future logistic centre has not been a limiting factor for the selection of the potential area (even if SUCELLOG target is a production of 10 kt/yr per centre) since no data of the total amount of biomass is available (agro-industry residues missing as mentioned before).

The following sections show the results obtained about the above mentioned issues (passing from a country to a regional perspective). A summary of the situation in Italy is included in the last part.

As a last activity belonging to this WP, workshops and personal contacts were carried out with agro-industries in Task 3.3 with the aim of engaging them to the services offered by the project (technical and decision-making support to become biomass logistic centres). The result of this action is shown in the document “D3.1-Report on engagement actions”.

2. Agro-industries: profile, barriers and opportunities

The main potential agro-industry sectors to become a solid biomass logistic centre in Italy have been evaluated in the following lines, describing the equipment they usually own and their idle period, as well as the residues produced both in the agrarian practice and the production process. Finally the barriers and opportunities they would face when thinking to start this new activity have been identified. The information has been provided through interviews with representative industries of the sector and agrarian experts.

Forage dehydration:

Forage dehydration sector in Italy has an important idle period of 5 months (from November to April approximately) and owns compatible equipment (horizontal dryers, pelletisers and silos). From the 5 regions evaluated in SUCELLOG, they are only sited in the regions of Emilia-Romagna and Marche and normally linked to cereal dryers.

The forage dehydration facilities do not produce any important biomass residue, either in the agrarian or processing phase, meaning that the raw material for the production of solid biomass should be acquired.

Dehydration sector is not really familiar with biomass issues and, although the sector does think that there are no technical barriers to start this new activity within their installations, there is a lack of knowledge on finding possible financial schemes.

Cereal dryers:

This sector shows an interesting potential to become a solid biomass logistic centre from a technical point of view, offering a long idle period of around 7 months (from October to May approximately and depending on the crop) as well as proper equipment such as vertical dryers, screening equipment, silos for storage and transport means. In Emilia-Romagna, some of this type of agro-industry is dedicated to dry seed for sowing, with an idle period from January to May.

Regarding the raw material available for a possible logistic centre, farmers supplying the grain to be dried in the facilities produce important quantities of straw which main market is the livestock feeding or bedding. Depending on the year, a considerable amount of straw is not able to enter the market.

The agro-industry itself produce residues such as the grain that for some reasons do not satisfy the quality /aesthetics requirements to be sold in the market or silo dust (although normally are sold for animal feeding).

In some regions like Marche, the sector reaches high profitability, which together with the natural resistance to innovation and lack of pilot initiatives to demonstrate the feasibility of this kind of projects, the result is a complete lack of interest to start this new activity. In general they situation of the sector in Italy is not the best, not being able to afford large investments in the next years.

It should be highlighted that the vertical dryers of this type of facility are not as versatile as the horizontal dryers that some other sectors own. More concretely they are only compatible with granulated products (as olive pits, milled almond husks, grape pits or any other product with this kind of format).

Rice dryers:

The rice dryer industry has an idle period of around 9 months (from December to August approximately) and counts with vertical dryers presenting an interesting synergy to become a logistic centre. From the 5 target regions in Italy, only Emilia and Sardegna have rice dryers.

In what concerns the residues associated to this type of agro-industry, the straw is not harvested due to the technical difficulty of working in waterlogged areas in which rice is produced, being normally burnt or left on the soil for the conservation of their physical and chemical fertility. Regarding the residues from the agro-industry, husks are normally burnt due to the disposal cost associated. Broken grains obtained during the rice processing are sold as feedstock for animals.

Although no technical barriers for the development of a logistic centre in a rice dryer has been detected, the resistance to innovation and the extreme reluctance to perform investment from the agro-industries should be overcome to start this new activity in this sector. As it was mentioned in the case of the cereal drier, the vertical dryers that rice sector owns are only compatible with granulated raw material.

Tobacco dryers:

The agro-industry of the tobacco remain open the whole year but their dryers have an idle period of 7 months per year (from January to August approximately) presenting a good opportunity to become a biomass logistic centre from the technical point of view.

From the 5 Italian regions studied in the project, the sector is on present in Toscana region with small and medium producers that own dryers. Generally there are two kinds of producers: bright and black tobacco. The dryer devices are really different between the two kinds of tobacco: Black tobacco is dried with wood fired dryers while the bright virginia tobacco (cigarette tobacco) with gas-fired dryers. The idle period of the plant is from and the plants size are small-medium.

The agrarian practice of the tobacco generates residues that are left on the soil and which could be studied as a possible biomass source.

The tobacco producers showed interest in the project but they have some restrictions from main buyers of tobacco which are big international companies. They do not allow the tobacco industries to use dryers for different purpose, therefore they will not be considered as a target industry of the project.

Wine sector:

The wine sector includes the cellars and the distilleries, the latter processing the residues obtained from the cellars. From both, it is only the distilleries the ones owning equipment (horizontal dryers) compatible with the production of solid

biomass. The idle period of these dryers in the distilleries is approximately from April to December (8 months).

The most important opportunities in the wine sector are the availability of biomass and their problems on disposing their residues.

Regarding the residues produced in the field, grape stems are mulched and spread on the soil. Prunings are most commonly burnt or left on the soil although some new initiatives are starting to use it as biomass source. Actually, from June 2014, the Decreto Sbloca Italia allows the burning of prunings of any crop (selecting the dates each municipality). The main barrier the sector appreciates when trying to make profit of their prunings is the high investment costs for harvesters, not sustainable from a single farm and the lack of a proper structure (consortium or association) responsible for the collection. In many situations, it is impossible to perform a mechanized harvesting due to the high slope of the land.

The residues produced in the cellars are sent to distilleries according to Italian laws. The residues from the distillation process are used for biodigestion or energy combustion.

The sector does not appreciate a technical barrier but investments should be carefully studied.

Olive oil sector:

The olive oil sector includes oil mills and oil pomace extraction industries. Similarly to the wine sector, the latter is processing the residue obtained in the oil mills owning horizontal dryers and pelletisers for this purpose. Even though the idle period is reduced, it is considered an interesting sector to develop a biomass logistic centre due to the capacity of using its own residues and to the idle period of 8 months approximately (from April to November).

Regarding the residues produced in the oil mill: the olive pits are currently being sold as solid biomass and the olive pomace is used for biogas production or as animal feedstuff. In some cases the latter is sold to the olive pomace processing industries, which after the extraction of the remaining oil produce also a residue (used for animal feeding or biogas production).

During the agrarian phase, the olive orchards produce important amounts of prunings to be transformed in high quality biomass enforcing this sector as a potential solid biomass logistic centre. The sector has shown a high interest due to the high costs for disposal of cultivation residues and sees no technical obstacle in the implementation of a logistic centre. However, the high investment cost for harvesters is the main barrier to deal with, fostering the creation of a structure responsible for the collection. Actually, from June 2014, the Decreto Sbloca Italia allows the burning of prunings of any crop (selecting the dates for this burn each municipality).

Technically they do not see any trouble for initiating a new activity as logistic centre. Additionally, it should be pointed out that the oil pomace industries are not currently in their best moment, due to the economic profitability of the extraction. There are also important social problems linked to the smell of the pomace. Therefore, SUCELLOG can be a good opportunity for the sector to know their possibility to diversify their activity.

Sugar industry:

The sugar industry presents, on the one side, an important idle period of 8 months which goes from November to July approximately and, on the other side, compatible equipment for the production of solid biomass such as horizontal dryers and generally also pelletizers. From the 5 regions evaluated by SUCELLOG in Italy, sugar industries are only present in Emilia-Romagna and currently are closed due to the fact that sugar beet cultivation is no more competitive with the brown sugar.

In the sugar industry, dryers and pelletiser are used in the production of beet pulp cake, a by-product from the sugar production, which is highly appreciated by the livestock sector. The sector does not produce residues during the agrarian practice to be taken into consideration.

Even if there is not activity in this sector at the moment, SUCELLOG considers that it can be a good opportunity for these companies to replace their activity and become a logistic centre and therefore have been included in this report.

3. Evaluation of available biomass

SUCELLOG considers that the development of agro-industry logistic centre should rely on agrarian biomass coming both from the agrarian practices (like straw or prunings) and from the agro-industry process (for example distilleries residues). The fact is that, for the first case, agro-industries have already a network with farmers providing the raw feedstock to be processed. For the second case, the use of their own residues is the opportunity to reduce their fuel consumption or avoid the cost of disposal if there is no market for it. Quantifying the biomass resources up-stream and down-stream the agro-industry is the object of this section since it is strategic for establishing new commercial relations with usual providers and clients.

A study about the available biomass resources has been performed, focusing in the agrarian biomass since it was not possible to have data about the production of agro-industries residues per region/country. When talking about availability of the residue, it is meant the amount of resources that do not have a market or that is not left on the soil to improve organic content, therefore having the opportunity to be used for energy purposes. Three examples to explain what availability is (see more detail about the methodology of work in section 3.3 and availability percentage in Annex I):

- If a farmer, after taking the wheat grain, leaves the straw on the soil due to agrarian recommendations then availability should be considered 0%.
- On the contrary, if the farmer leaves the straw on the soil just because the cost for harvesting does not cover the value in the animal feed market then availability is 100%.
- It can also happen that in one region the 40% of the straw is commercialized for animal feed (so it has a market), a 20% is left on the soil as a recommended agrarian practice. Therefore, 40% of the straw is available for other uses like the production of solid biomass.

3.1. Agrarian residues

Biomass resources can be catalogued in several groups in the Italian target regions, according to next two criteria:

- Competitiveness: existing competitive uses
- Amount of available biomass: relevance in terms of current unused quantities

From this scope, agricultural biomass resources in Italian target regions can be catalogued in average as next:

Table 1: Classification of biomass resources in Italy.

Criteria		Biomass resources
Competitiveness	Available unused biomass	
Competitive uses make biomass unavailable for energy	None	Fibre crops
Many competitive uses	Some source still available	Wheat and barley straw in Emilia-Romagna and Marche Fruit tree pruning wood.
Some competitive uses	Important source still available	Rest of cereal straw, maize and sunflower stalks. Pruning wood from rest of fruit types, nuts, cherry, citrus, olive. Vineyard pruning in Emilia Romagna.
Few or non-competitive uses	Relevant resource available	Pruning wood from vineyard except Emilia Romagna.
Some or few competitive uses	Marginal local amounts (may play a role in a singular facility)	Tobacco stalks, rape straw.
None due to preferred integration as soil input for organic matter	None	Leguminous plants
None due to technical barrier to be collected	None	Rice straw

As observed, in general, the resource with lowest risk derived from competitive uses is vineyard pruning wood in all regions but in Emilia Romagna, where it is reported to be already part of this wood in use.

There is a group of agricultural residues which are still available in important amounts and which still have not many competitive uses: the agricultural prunings. Woody biomass has been reported to be usually used for energy, and so considered that half of the potential is available for new uses. This biomass without use is currently burned or left in field due to management difficulties (distance from roads, slopes, poor accessibility). Integration into the soil is done more rarely, and in some crops like vineyard in Emilia Romagna, Marche, Puglia and Toscana integration into the soil is avoided to preserve the propagation of some plant diseases. Regarding energy use, its woody structure is an advantage for the preparation of solid biomass commodities, usually with better quality in terms of quality composition and suitability for existing energy conversion systems compared to herbaceous residues. However, starting new chains from prunings may involve the challenge of local farmers to start a new logistic chain, even though, as said, some of them are currently running.

In general, other group with important resources and with only moderate competitors for the resources are maize, sunflower and soya stalks. Maize is currently used for cattle bed, animal feed and incorporation to the top-soil as source of organic matter. Sunflower is mostly being utilised for the top-soils. In contrast, soya is being used for animal feeding. Integration into the top-soil is voluntary and/or done in ecological farming but in some areas it is just the way to manage the residue in the easiest way.

Rest of herbaceous biomass is comprised by cereals. In case of oat and wheat straw, it is usually also utilised for cattle feeding, and therefore is less available in few regions like Emilia Romagna and Marche. Wheat also is demanded in some areas by the pulp and paper industry. When biomass is not utilised it is just bunt on the fields to be disposed in forms of ash. Sorghum is a similar case to winter cereals in terms of management, and can be locally of relevance.

There are other minor residues like tobacco stalks that can be locally interesting for future logistic centres as complement to the main feedstock, as it has been seen in Toscana.

In the group of not principal crops, and no availability of resources, two main cases have been observed: leguminous plants and fibre crops. In the case of residues from leguminous plants, they are usually integrated into the top-soil because they provide nitrogen to the soil, so farmers can save money on fertilizers (nitrogen supply is used for the rotation with winter cereals). About fibre crops like hemp and line seed (flax), they produce very little significant straw (short fibre and shaves). In the past was used for domestic heating, now has a market for many uses, including green building.

Rice straw shall not be considered as a possible resource due to its difficulty to be harvested in waterlogged, being usually integrated into the field as amendment or even burnt.

3.2. Other residues:

Even though in SUCELLOG a comprehensive list of agro-industries has been compiled by region, the data of the inventories was not sufficient to produce a reliable inventory of the biomass residues produced in the agro-industries processes. Agro-industry residues are interesting in the case of the oil, wine and nut fruit sector because of their amount, while in the case of the cereal, rice and feedstuff sector, for example, these residues could be a complement in the production of the solid biomass since their production is not of significance in amount. The use of agro-industry residues is a target of SUCELLOG, but its actual use will be decided for the particular cases of logistic centres monitored or audited during WPs 4, 5 and 7. There, the local reality and capacity of neighbour facilities to become reliable biomass suppliers will be assessed.

Even though the potential has not been estimated, a general idea of the possible key residues from agro-industries is presented in the next lines at a country level since no data about availability can be provided by region.

In the wine industry it has been identified that grape stalks and skins are fully available and can provide important amounts in Puglia, Sardegna or Toscana. Competitors are currently biogas plants (grape skins), cosmetics (skins and grape seeds) and pharmaceutical industries.

Agro-industry residues still with not much competitive uses (it can be considered that half of the potential is available), is olive pomace, reused as a fuel (only cake from oil mill three phases) for biomass power plants, soil amendment (seldom) and livestock feed.

There are other residues from the agro-industry that, even they have already a market, some amounts are still available. So, they may be a source locally, and contracts may be feasible. Rice husk is used for poultry bed but some part is also burnt due to the lack of alternative market. Fruit kernels and shells can be locally important, but they are as well quite utilised.

Other residues have been observed to be fully utilised by other sectors. In the sugar industry, sugar beet molasses and pressed beet pulp is mostly used for animal feed, or inside the industry, as a source of energy to supply energy demands.

With respect to forestry biomass, SUCELLOG has not carried out any specific assessment since the project is focused on fostering agricultural residues as a source of solid biomass. However, the feedback obtained from the target regions shows that forestry residues may be at the reach of future logistic centres, and can

be an option in few provinces for upgrading the properties of biomass mixtures to be commercialised. Biomass directly from forestry exploitation for energy purposes can be done under the framework of regulated forestry management plans but it has been considered that it is not a source for the short-time term in SUCELLOG. Residual biomass from sawmills can be considered in the very local scope, since usually is completely sold for other existing uses.

3.3. Methodology

An analysis performed by regions instead of by resources is carried out in section 0. Biomass assessment in the present work involves the study of 5 regions of Italy, adding a total area of 98.234 km², about 33% of the total area of Italy. For this scale of work the use of existing data from inventories was needed as an input data source. The aim of the approach is to provide a framework of the available sources in the region. It is not aimed to be the specific biomass assessment for a facility, which will be object of task 4.2, and which requires other type of approaches.

The methodology selected corresponds to a “Resource focused approach”, as described by BEE standardised classification (see project BEE). It starts with statistical data from agrarian inventories, and complemented with the availability indices and utilization for soil preservation leads to a technical potential, including soil sustainability issues.

The method followed is based on ratios of residual biomass production per hectare of cultivated area (tons of residue per hectare). The use of ratios is a widespread methodology for biomass assessments, appropriate for both large and small scale. The main issue is to account with reliable inventories and ratios. By multiplying the cultivated area (ha) by the ratios (t/ha) the theoretical potential is obtained:

$$\text{Biomass Potential [t]} = \text{Ratio [t/ha]} * \text{Area [ha]}$$

The methodology used here brings a step forward in the country analysis by including the competitiveness for biomass resources. For that purpose it is necessary to know the share of biomass that is currently being used for other aims, and that will be considered as not available for the present study. The availability index (I_{AV}) expressed as percentage is defined as next:

$$I_{AV} = 100 - I_{COMPET} - I_{SOILS}$$

Where :

I_{COMPET} : is the percentage of the total biomass in a region that other uses (power plants, cattle, industry) already are using.

I_{SOILS} : is the percentage of total produced biomass that remains in the soil. E.g.: if farmers prefer to leave part of the straw as soil organic amendment.

By using these indices it is possible to obtain the final biomass available by doing next operation:

$$\text{Available Biomass [t]} = \text{Potential Biomass [t]} * I_{AV} = \text{Ratio [t/ha]} * \text{Area [ha]} * I_{AV}$$

The data sources have been obtained as next:

- **Agricultural areas:** the biomass has been calculated on the base S2Biom project land areas (www.s2biom.eu) given by NUTs3 (Italian provinces), in order to have same base units than ongoing referential projects like S2Biom is. Since NUTs3 is a too large scale for the purposes of the SUCELLOG work, the biomass obtained by NUTs3 has been downscaled at LAU2 (former NUTs5) geographical resolution (Italian municipalities), by assigning each LAU2 unit a biomass share proportional to the area occupied by crop type.
- **Land distribution:** Corine Land Cover version 2006. Biomass per municipality has been allocated to land parcels actually used for agriculture
- **Ratios and availability indices:** a specific work has been carried out by region. For each region ratios have been obtained from direct contact with specialists and cooperatives, and in few cases, complemented with literature. The purpose of this effort has been to use ratios and availability indices representing the reality of the region, and not just ratios found in literature. The workshops done in task 3.3 have served to include the feedback from the sector to improve the final datasets. Ratio and availability percentage are shown in Annex I.

3.4. Results

In order to present a very fast scope of the situation and balance among woody and herbaceous biomass in Italy, next table shows where they are predominant or comparable in order of magnitude. It may serve as a very first fast feedback on the reality.

Table 2: Profile of provinces in Italian target regions according to the prevailing agricultural biomass

Region	Emilia Romagna	Marche	Puglia	Sardegna	Toscana
Herbaceous predominant	Bologna, Ferrara, Modena, Parma, Piacenza, Reggio Emilia	Fermo, Macereta, Pessaro e Urbino	---	---	---
Herbaceous similar to woody	Forlì, Secena, Ravenna, Rimini	Ancona, Acoli Piceno	---	Carbonia-Iglesias, Medio Campidano, Cagliari, Oristano, Sassari	Arezzo, Livorno, Lucca, Pisa, Pistoia, Prato, Siena
Woody predominant	---	---	ALL	Oligastro, Nuoro	Firenze, Massa Carrara

Next table classifies provinces according to the most strategic resources for SUCELLOG.

Table 3: Most strategic resources by target region.

Region	Cereal straw	Maize + Sunflower straw	Olive + Fruit + Vineyard prunings	Others
Emilia Romagna	Possible complement in all	ALL, but really significant resources in Ferrara (mainly), Bologna, Modena, Piacenza.	Ravea and Regio Emilia (as complement). Rest may be locally of interest.	Soya in Ferrara In Bologna possible complement
	Rimini and Forti Secena account with scarce resources, and so, are not considered in the analysis of biomass			
Marche	Macereta (Ancona and Pessaro e Urbino less than 6 kt/yr)	Macereta and Ancona (Pessaro e Urbino, as complement)	Ascona as complement. Rest only locally.	---
	Province with largest potential reaches a moderate value, about 17 kt/yr. The size of the biomass resources must be taken into account when reading this table for Marche. Fermo and Ascoli Piceno have total available biomass about 10 kt in total. They are not considered in the analysis for simplification			
Puglia	As complement in Foggia and Bari	---	ALL (mainly Lecce, Foggia, Bari and Brindisi)	---
Sardegna	Cagliari and Sassari	Oristano and Sassatri (as complement)	ALL	Rice straw in Oristano (only as complement)
	Province with largest potential reaches a moderate value, about 16 kt/yr. The size of the biomass resources must be taken into account when reading this table for Sardegna. Carbonia-Iglesias, Medio Campidano, Ogliastra, Olbia-Tempio and Nuoro account with scarce resources, and so, are not considered in the analysis of biomass.			
Toscana	Arezzo, Pisa, Siena (but not as sole main feedstock in logistic centres). Complement in Firenze.	Arezzo and Pisa (not as main unique feedstock in logistic centres). Firenze and Siena can be a complement	Firenze and Siena. In Arezzo and Pisa can be a complement.	Tobacco stalks (Locally in Arezzo and Siena)
	Several provinces with potential quite under 10 kt/yr: Livorno, Lucca, Massa-Carrara, Pistoia and Prato. They are not taken into account for the analysis			

4. Regional Framework of EMILIA-ROMAGNA

4.1. Identification of agro-industries in Emilia-Romagna

The interesting agro-industries to become a logistic centre in Emilia-Romagna are:

- **Cereal dryers:** There are around 100 agro-industries belonging to this sector spread in the whole region.
- **Forrage dehydration:** 12 industries in the territory of Ferrara, Bologna and Ravenna.
- **Rice industry:** only 3 industries located in the region, being the main one located in Ferrara province in the most important rice production area of the region.
- **Sugar industry:** 2 agro-industries in Bologna province stopped their activity since last year. Even though they are considered as target industries for SUCELLOG.
- **Distilleries:** 27 sites spread in the whole region.

The agro-industries identified as biomass resources suppliers are, apart from the ones above producing residues, the oil mills (at least 6 in the region) and the cellars (264 sites).

4.2. Identification of biomass resources in Emilia-Romagna

Emilia Romagna is, among the target regions of SUCELLOG project in Italy, the region with the largest amounts of available biomass. It has been estimated that non-used agricultural biomass adds almost 300 kt/yr, 80% coming from annual herbaceous crops and 20% from permanent crops pruning. Emilia Romagna profile as region is as next: most of provinces the predominant biomass type is herbaceous, mainly from maize. In contrast, Forth Secena, Ravenna and Rimini the potential from herbaceous and woody biomass is similar in order of magnitude. However several provinces account with scarce resources, as Rimini and Forth Secena, and so, the possibilities to start logistic centres may be limited due to the quantity of biomass.

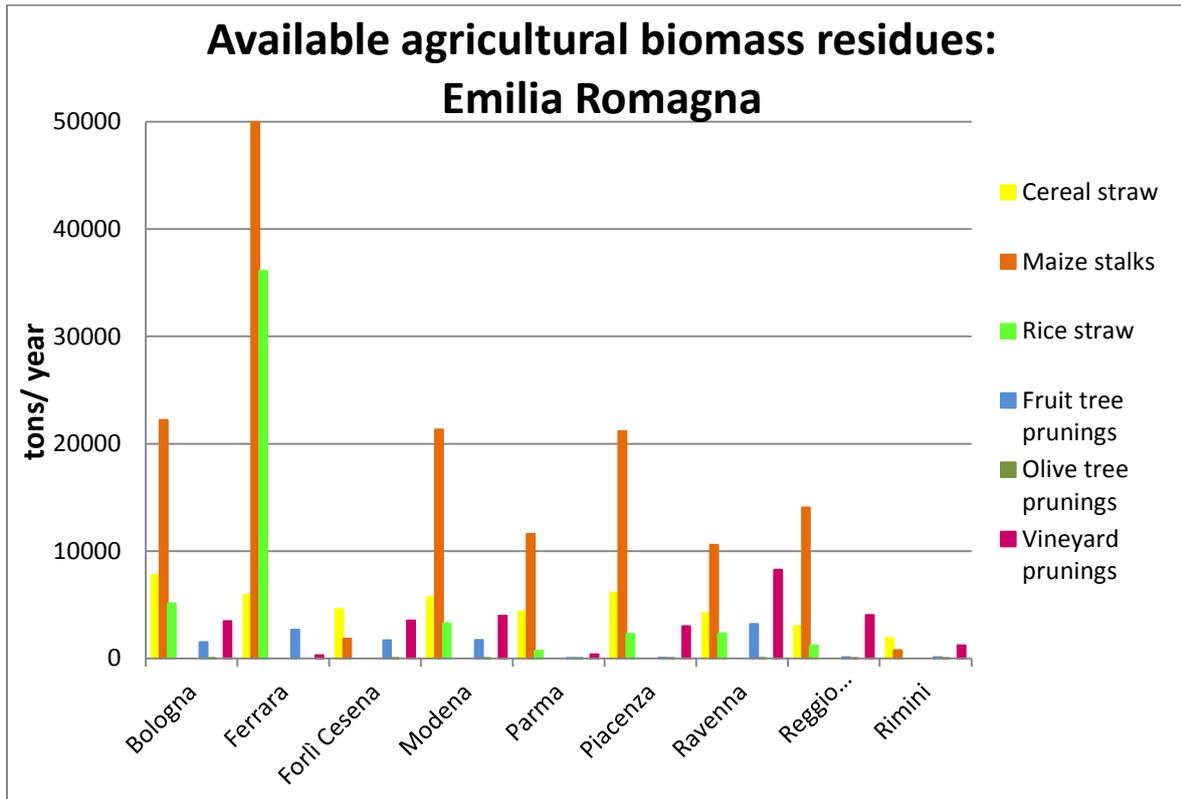


Figure 1: Summary of available agricultural biomass residues in Emilia-Romagna.

Main conclusions in Emilia-Romagna:

- The main resource of this region is the herbaceous straw, mainly maize straw available in large quantities and still with not major competitive uses. Cereal straw can be a complement to the production of solid biomass commodities, being the second resource in relevance in most provinces. However always with a provincial potential under 10 kt/yr.
- Remarkable is the straw from soya, which is quite relevant in Ferrara, and would allow new biomass chains based on it as main feedstock.
- Woody residues from vineyard and fruit tree pruning are available in interesting amounts in all provinces, even though always under 10 kt/yr, and so, to be considered as a possible feedstock to improve the properties of the biomass product prepared in the agro-industry logistic centre.
- Industrial by-products such as husks, broken grain and dust (from cereal and rice dryers) as well as distillation production residues, cellars and oil mills should be also taken into account. Grape stalk and skins are also available in the region, and may be locally interesting in areas with activity in wine production.

4.3. Localization of resources and agro-industries in Emilia-Romagna

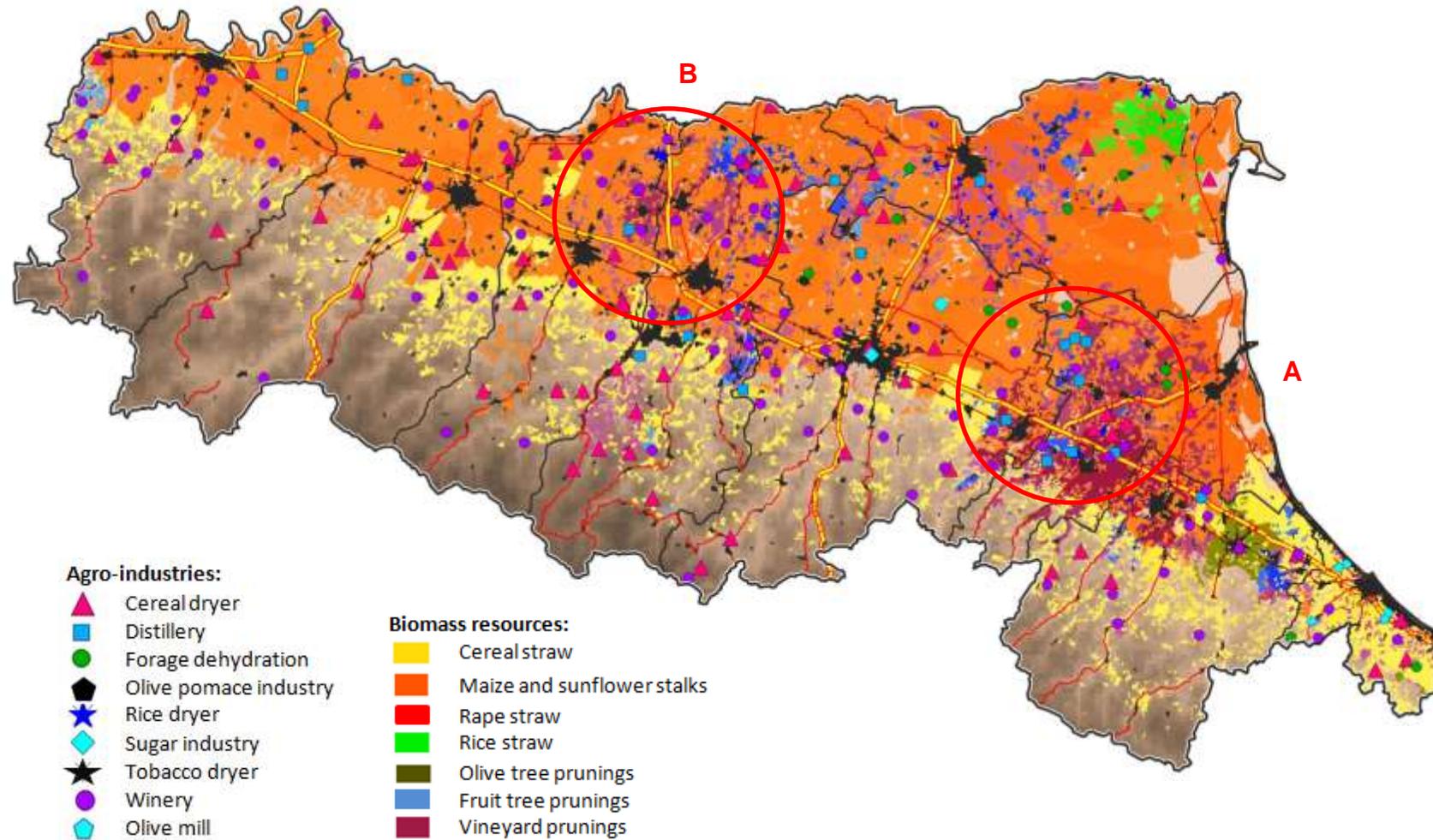


Figure 2: Localization and type of agro-industries and resources in Emilia-Romagna.

4.4. Priority areas in Emilia-Romagna

Potential areas for the development of an agro-industry logistic centre have been detected in Emilia-Romagna and are shown in Figure 2. As already mentioned in the introduction, these areas have been selected taking into account the diversity of resources (both herbaceous and woody) and agro-industries as well as the compatibility among them. Compatibility has been defined according to their seasonality, see Table 4, and their compatibility of use. Logistic issues such as good communication roads and proximity to consumption areas has also been taken into consideration.

Table 4: Availability of equipment and biomass resources in Emilia-Romagna.

	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Forrage dehydration												
Distillery												
Cereal dryer												
Rice dryer												
Sugar industry												
Cereal straw												
Maize straw and cobs												
Soya straw												
Permanent crop prunings												
Husks and silo flour from cereals												
Rice husks												
Grape marc and stem												
Grape pits												
Olive pits												

The possible synergies in this region are several and the network connection favours good logistic conditions. However, below are shown the most interesting potential areas of Emilia-Romagna and their main following characteristics:

- **Area A:** this area presents an important diversity of agro-industries and feedstocks as well as good transport connection. More concretely, the most interesting synergy has been found among the forrage dehydration industry and the processing of permanent crop prunings coming mainly from the vineyards. Maize and cereal straw could serve as a complement for a possible mixed pellet.
The distilleries in the area could also become logistic centre conditioning their own residues to reach quality standards or it could be acquired by the cereal driers for that purpose.
- **Area B:** this area presents more availability of herbaceous crops compared to Area A, specially maize straw that could be processed in the forrage dehydration and distillery to produce a pellet. For the upgrading of quality, woody resources from fruit and vineyard prunings should be considered since

their availability is important. Residues from cereal and rice dryers could also be considered as a complement.

5. Regional Framework of MARCHE

5.1. Identification of agro-industries in Marche

The interesting agro-industries to become a logistic centre in Marche are:

- **Cereal dryers:** 44 dryers are spread in the whole region being important the area of Ancona-Monte Conero.
- **Forrage dehydration:** there are 6 agro-industries developing this activity in the region located all in the province of Pesaro-Urbino.
- **Distilleries:** 6 industries are present in the region, being the most important located in Ascoli Piceno.

The agro-industries identified as biomass resources suppliers are, apart from the ones above producing residues: cellars (are centered in the area of Jesi-Manterata Spontini) and oil mills (78 industries, mainly located in the area of Fermo and Ascoli Piceno).

5.2. Identification of biomass resources in Marche

Available agricultural biomass is estimated in Marche to be about 70 kt/yr. Main sources for biomass are the annual crops, specially in Ancona, Macereta, and Pessaro e Urbino. Woody biomass is not relevant enough for establishing new logistic centres as some size running on them, but can be a good complement specially in Ancona and Acoli Piceno provinces. The balance between herbaceous and woody available biomass is, like in the case of Emilia Romagna, in a relation 80 / 20 % respectively.

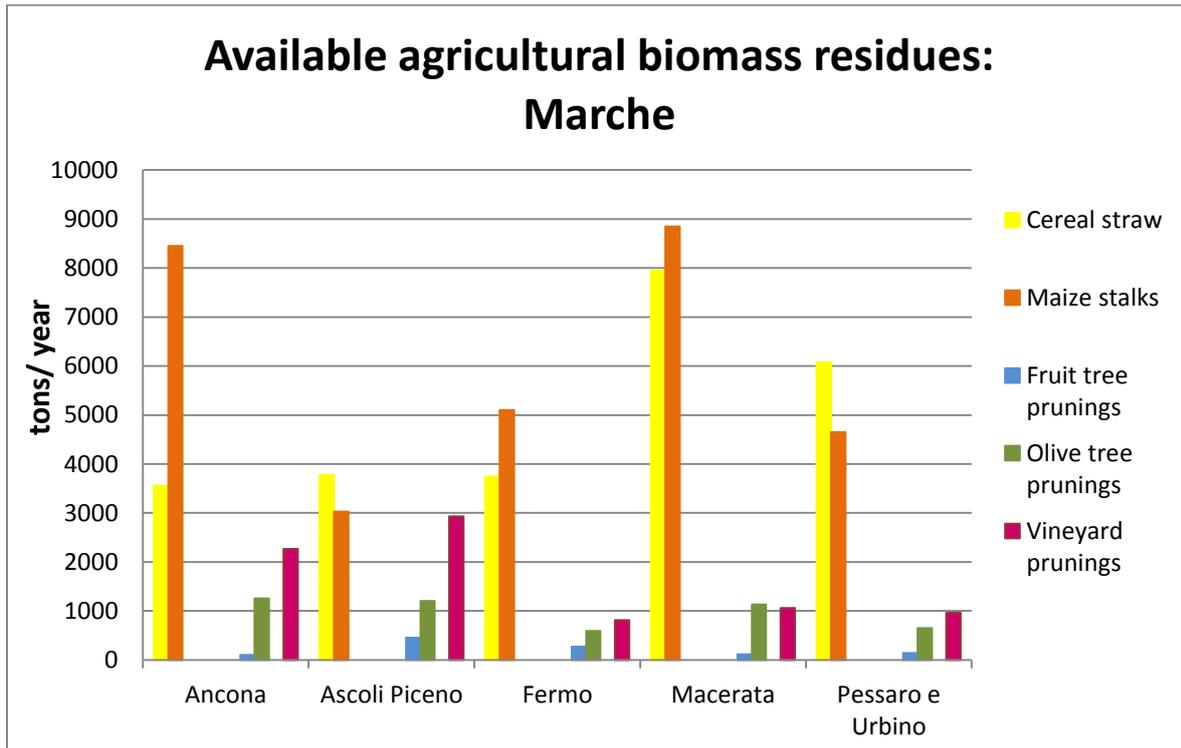


Figure 3: Summary of available agricultural biomass residues in Marche.

Main conclusions in Marche:

- The most important resources in Marche are cereal straw, and maize and sunflower stalks, accounting for more than 55.000 tons/year. This resource is predominant over the rest of agricultural biomass types in Fermo, Macerata, and Pessaro e Urbino. In these provinces the amounts range from 8 to 18 kt/year. Therefore there is not, a priori, much room for implementing several logistic centres running on this feedstock type
- Vineyard and olive tree prunings, although not so important in quantity, could be a good woody resource for an upgrading of the solid biomass quality. In general its amount ranges from 1.5 to 5 kt, and therefore to be used as complement, not as main feedstock.
- Residues from the agro-industry of the cereal dryers, cellars, oil mills and distilleries should also be considered. Also grape stalks and skins in the wine producing areas.

5.3. Localization of resources and agro-industries in Marche

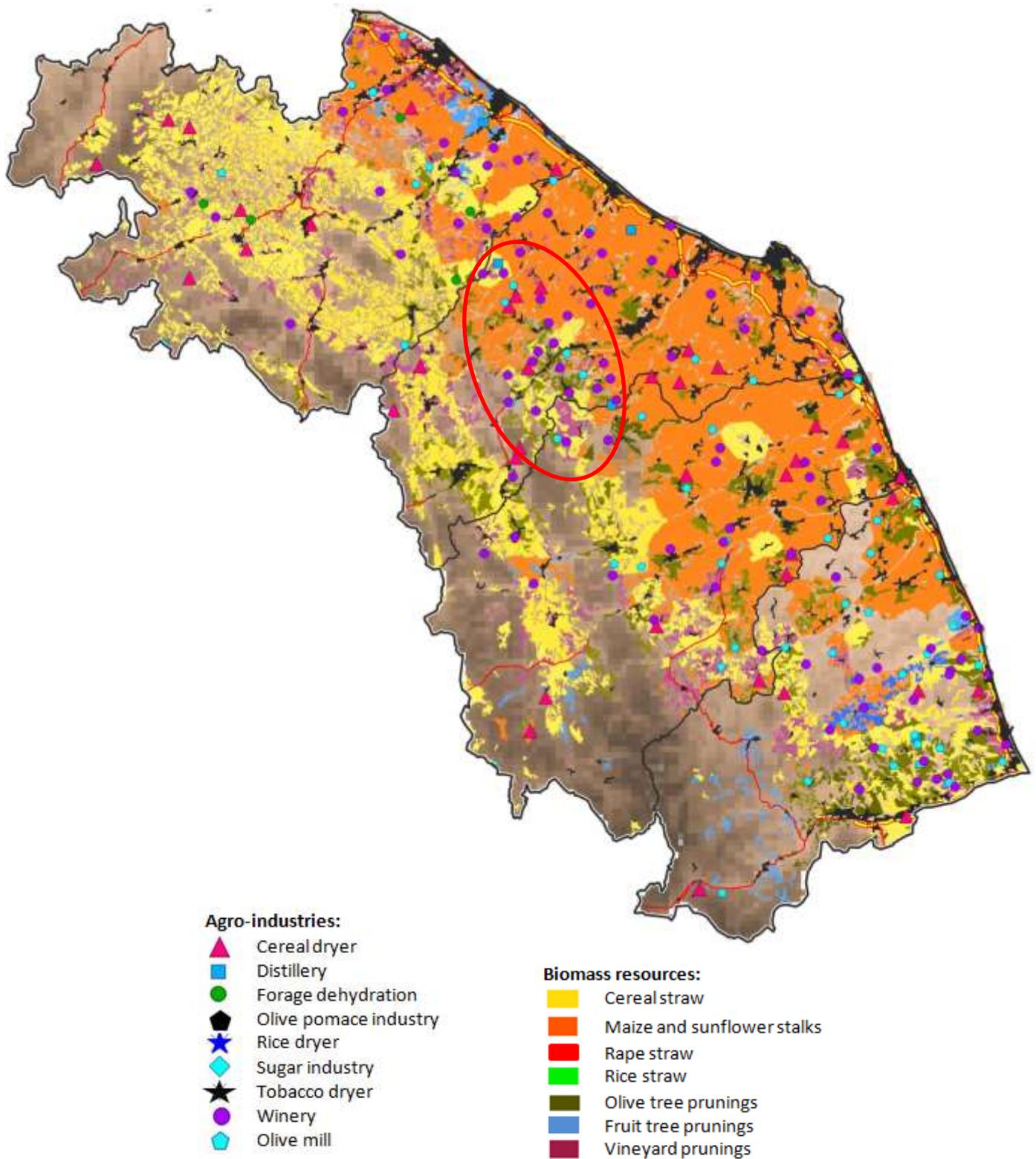


Figure 4: Localization and type of agro-industries and resources in Marche.

5.4. Priority areas in Marche

Potential areas for the development of an agro-industry logistic centre have been detected in Marche and are shown in Figure 4. As already mentioned in the introduction, these areas have been selected taking into account the diversity of resources (both herbaceous and woody) and agro-industries as well as the compatibility among them. Compatibility has been defined according to their seasonality, see Table 5, and to their compatibility of use. Logistic issues such as good communication roads and proximity to consumption areas has also been taken into consideration.

Table 5: Availability of equipment and biomass resources in Marche.

	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Forrage dehydration												
Distillery												
Cereal Dryer												
Cereal straw												
Maize straw and cobs												
Pruning from permanent crops												
Husks and silo flour from cereals												
Grape marc and stem												
Grape pits												
Olive pits												

In the region of Marche the area which shows the highest potentiality for the creation of the logistic centre has been detected. The area of Jesi-Manterata Spontini presents woody resources from the vineyard and olive tree prunings that could be processed together with the straw (from maize and cereal) in the distilleries of the zone. Cereal dryers could also condition the olive and grape pits produced in the zone. Although the area is small, the road network is sufficiently developed to supply to the agro-industries sited nearby which are potential biomass consumers.

6. Regional Framework of PUGLIA

6.1. Identification of agro-industries in Puglia

The interesting agro-industries to become a logistic centre in Puglia are:

- **Oil pomace industries:** even though there are around 600 oil mills in the region, only 4 oil pomace industries are present (2 in Bari, 2 in Lecce).
- **Distilleries:** there are 11 industries in the region being the most important the one located in the area of Foggia-San Severo.

The agro-industries identified as biomass resources suppliers are, apart from the ones above producing residues: cellars (a total of 218 in the region) and oil mills (being Bari and Lecce the most important region on olive oil production).

6.2. Identification of biomass resources in Puglia

Puglia is by far the region with the largest amount of woody residues available. As a matter of fact, in all of its provinces woody residues are predominant over herbaceous. The amounts are quite significant, meaning about 260 kt/yr in the region. Woody residues from prunings amount for 90% of the resources. The prunings of olive tree, fruit tree, vineyard and citric represents around 230 kt/year of biomass. All provinces have sufficient biomass potentials to allow the penetration of new biomass transformation and distribution activities. Since it has been stated that residues from the wine and olive production industries are quite available, it must be highlighted that residues like grape stalks and skins and olive pomace may be of relevance and should be taken into consideration.

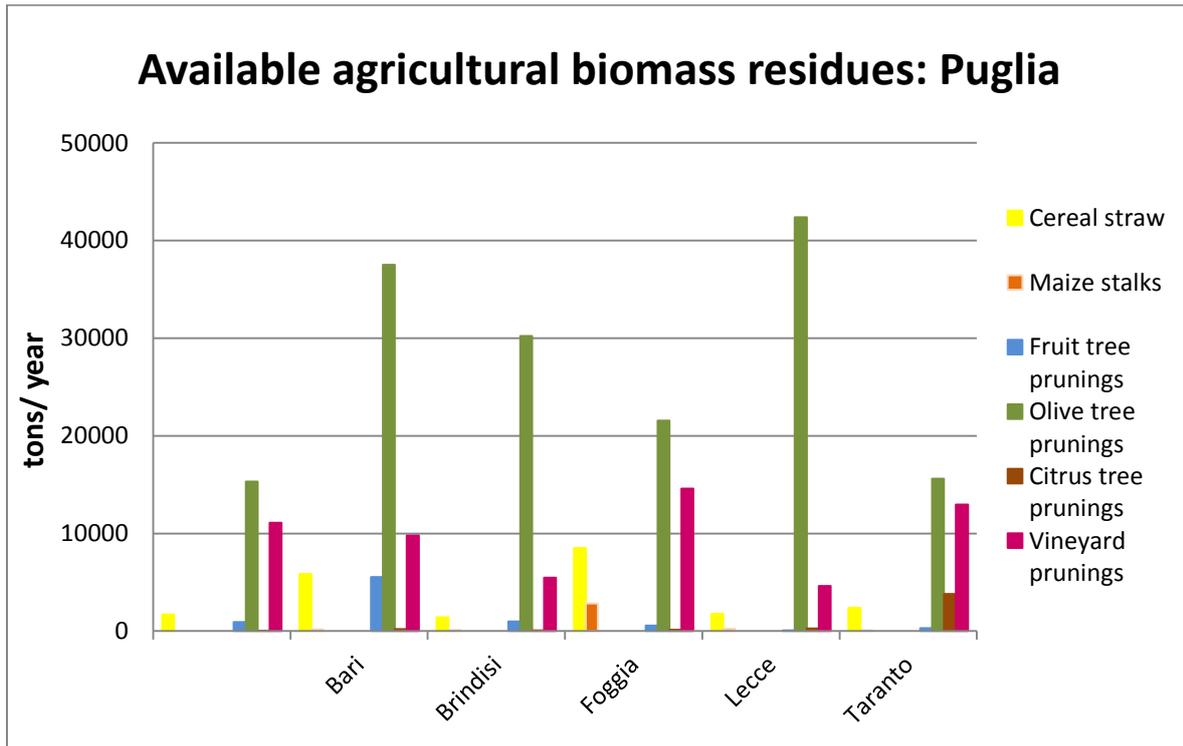


Figure 5: Summary of available agricultural biomass residues in Puglia.

Main conclusions in Puglia:

- Prunings from vineyard and olive tree becomes the most interesting raw material for the production of solid biomass. They are the largest source for biomass, and all provinces account with sufficient residues of this type.
- Residues from herbaceous crops (straw from cereals mainly) could be considered a feedstock to be evaluated locally, since in none of the provinces the potential gets over 10 kt/yr.
- Agro-industry residues from oil pomace industries, wine industries, cellars, oil mills and distilleries should also be considered as interesting biomass resources.

6.3. Localization of resources and agro-industries in Puglia

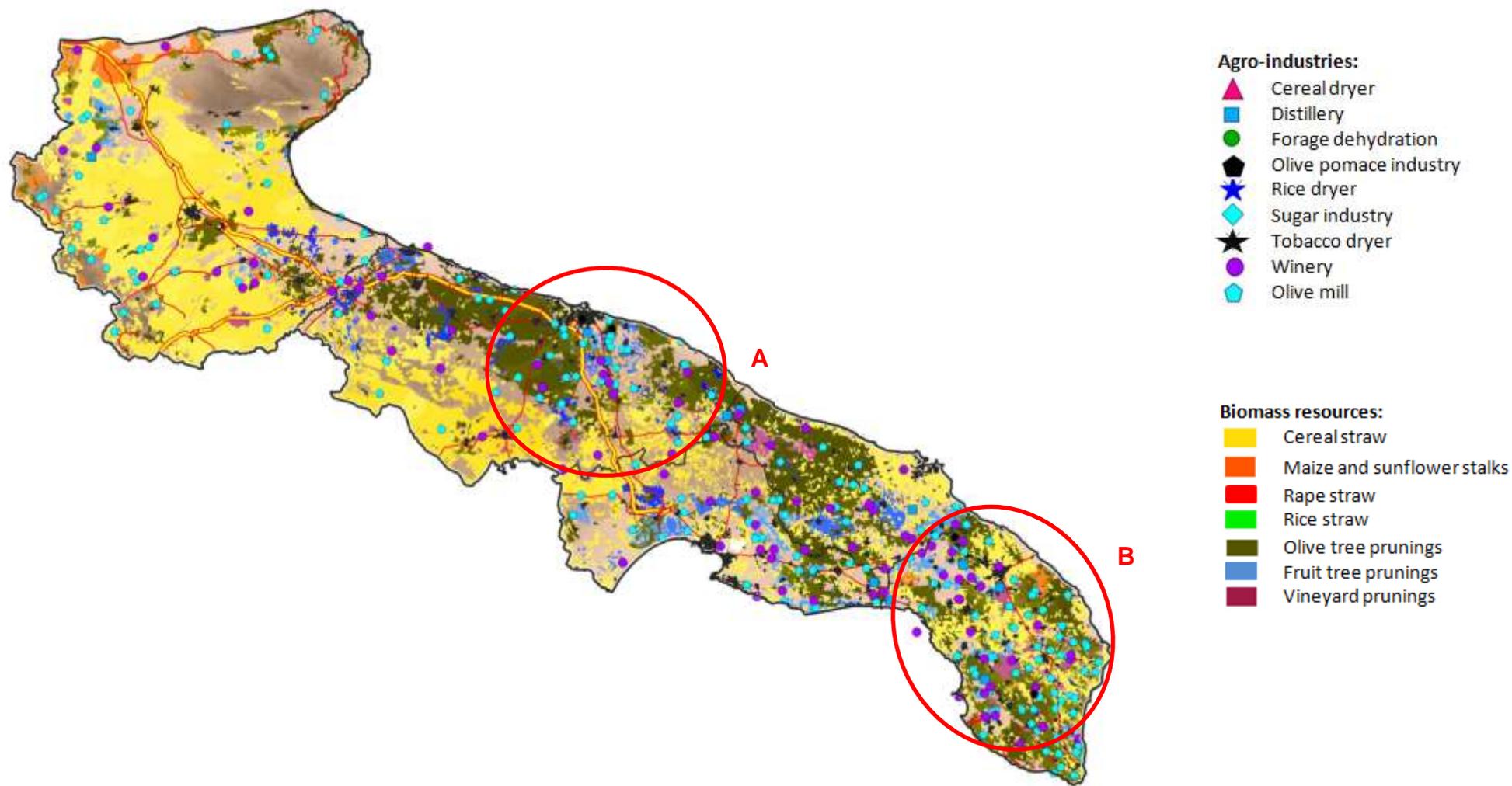


Figure 6: Localization and type of agro-industries and resources in Puglia..

6.4. Priority areas in Puglia

Potential areas for the development of an agro-industry logistic centre have been detected in Puglia and are shown in

Figure 6. As already mentioned in the introduction, these areas have been selected taking into account the diversity of resources (both herbaceous and woody) and agro-industries as well as the compatibility among them. Compatibility has been defined according to their seasonality, see Table 6, and to their compatibility of use. Logistic issues such as good communication roads and proximity to consumption areas has also taken into consideration.

Table 6: Availability of equipment and biomass resources in Puglia.

	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Distillery												
Oil pomace industry												
Cereal straw												
Maize straw and cobs												
Pruning from permanent crops												
Rice husks												
Grape marc and stem												
Grape pits												
Olive pits												
Olive oil pomace												

The two potential areas in Puglia present the same characteristics:

- Olive tree prunings is the main agrarian resource to be used when producing solid biomass (chip or pellet format). In the case of producing a mix pellet, straw can be used as a complement.
- Distillery and oil pomace industries could become an agro-industry logistic centre. Olive prunings should be stored till April, which seems not to be an inconvenient due to the favourable climate conditions of the region.
- Oil mills appear to be the best possible consumers of biomass and the road connection for their supply is optimum.

7. Regional Framework of SARDEGNA

7.1. Identification of agro-industries in Sardegna

The interesting agro-industries to become a logistic centre in Sardegna are:

- **Rice dryers:** There is only one big industry in Arborea region, where the production of rice of the island is located.
- **Distilleries:** Oristano area is hosting the majority of the alcohol production in the 23 distilleries of the region.

The agro-industries identified as biomass resources suppliers are, apart from the ones above producing residues: cellars (a total of 109 in the region) and oil mills (around 80 sites).

7.2. Identification of biomass resources in Sardegna

Sardegna total available biomass resources from the agriculture amount for 70 kt/yr. The resources from prunings and herbaceous crops are approximately the same in quantity, being the former slightly higher. When observing the amounts per province it is observed that only 3 of them have more than 10 kt of residues: Cagliari, Oristano and Sassari. The profile of the provinces is different in terms of the biomass. Whereas Oligastra and Nuoro have a predominant abundance of woody pruning biomass, in the rest the amounts from herbaceous and woody resources are of similar magnitude. For the analysis, the case of provinces with small amounts of resources is not considered.

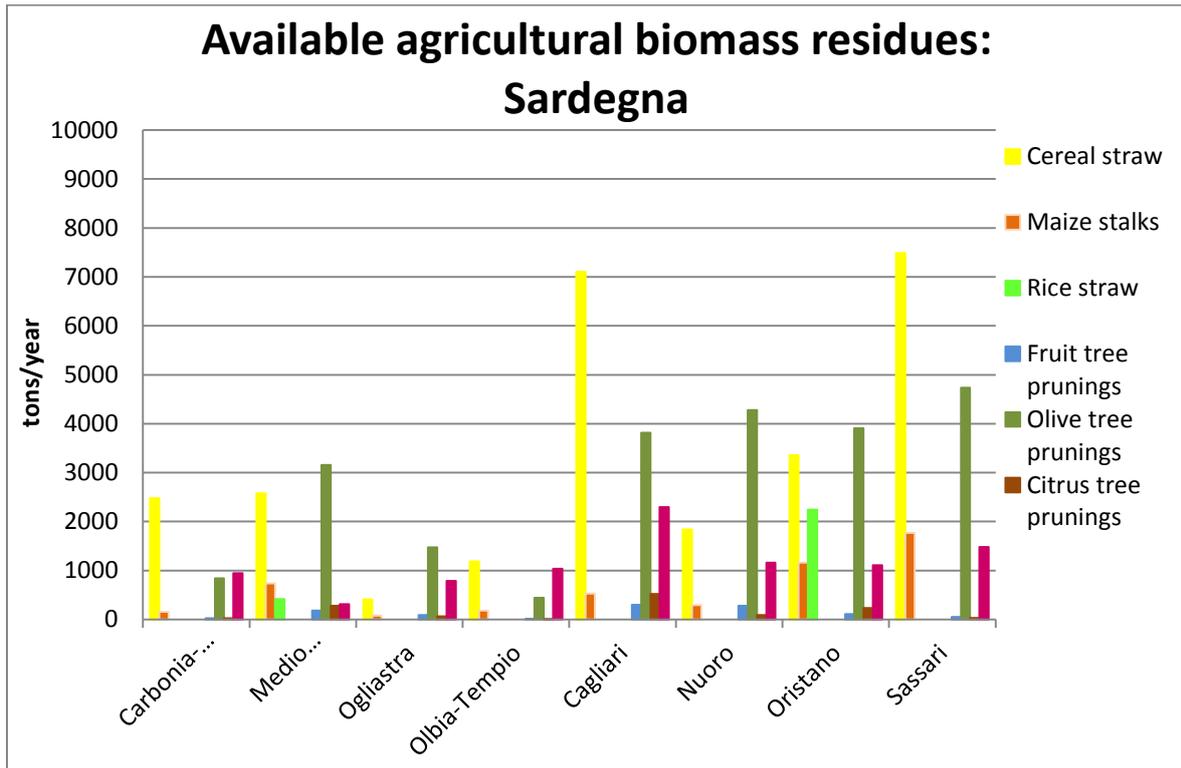


Figure 7: Summary of available agricultural biomass residues in Sardegna.

Main conclusions in Sardegna:

- From the herbaceous crops, is the cereal straw the one present in all provinces, being of special importance in Cagliari and Sassari. Even though, its potential is under 10 kt/yr, and so, starting new logistics centres may require support of other biomass types.
- Prunings from olive tree and vineyards are an interesting source to be taken into account when producing a logistic centre for the production either of woody chips or a pellet mixed with cereal straw. Olive tree resources are more abundant than those from vineyard, in general from two-fold to three-fold.
- Residues like husks coming from rice dryers, olive pomace, grape stalks and skins and distillery residues can also be a complement for the existing resources.

7.3. Localization of resources and agro-industries in Sardegna

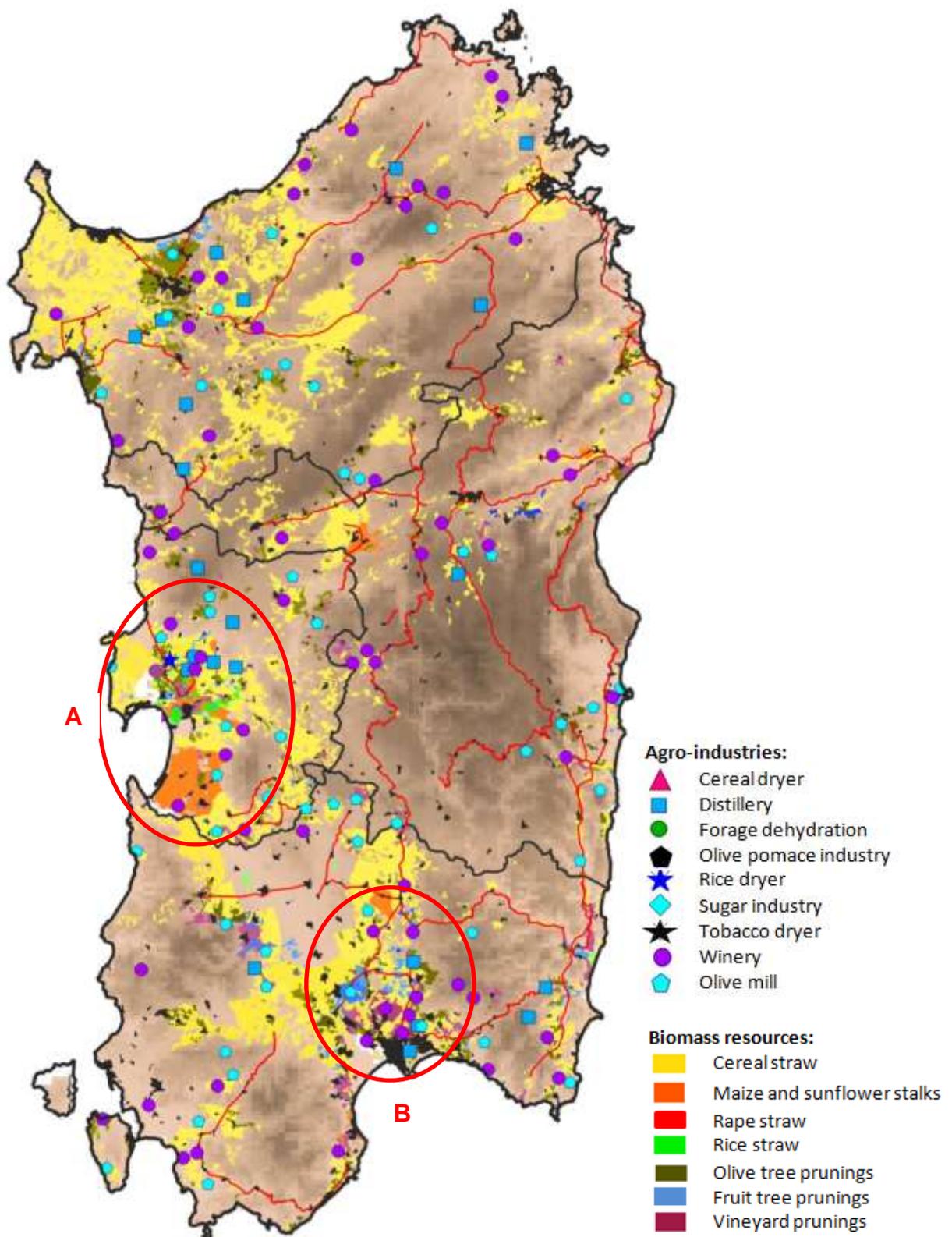


Figure 8: Localization and type of agro-industries and resources in Sardegna.

7.4. Priority areas in Sardegna

Potential areas for the development of an agro-industry logistic centre have been detected in Sardegna and are shown in Figure 9. As already mentioned in the introduction, these areas have been selected taking into account the diversity of resources (both herbaceous and woody) and agro-industries as well as the compatibility among them. Compatibility has been defined according to their seasonality, see Table 7, and to their compatibility of use. Logistic issues such as good communication roads and proximity to consumption areas has also taken into consideration.

Table 7: Availability of equipment and biomass resources in Sardegna.

	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Distillery												
Rice Dryer												
Cereal straw												
Maize straw and cobs												
Pruning from permanent crops												
Rice husks												
Grape marc and stem												
Grape pits												
Olive pits												

The potential areas to develop a logistic centre in Sardegna are very influenced by communication network and morfology in comparison with other regions, therefore it has been considered an important limiting factor to take into account.

There are two areas which presents the following characteristics:

- **Area A and B:** The flat morphology of Oristano and Cagliari favours both crop productivity and ease of collection and the costs of transport. The most interesting synergies found has been the possibility of distilleries to use their facilities for processing the straw (of cereal or maize) and the prunings (from olive tree and vineyard) into a mixed pellet. Rice husks and the own distillation residues could be a complement for this product. Distilleries could also be used for the drying and conditioning of the olive pits to be sold in bulk format. Rice dryers from Area A could also process the grape and olive pits.

The area of Sassari has not been elected as a potential area but only when a local logistic centre is planned. There are two reasons for this consideration: (1) Presents a good availability of residues (prunings and straw) but fragmented; (2) Even if there is an interesting amount of agro-industries (which could be consumers of solid biomass), the area is characterized by a less efficient road network and rough morphologies that determines high transport costs.

8. Regional Framework of TOSCANA

8.1. Identification of agro-industries in Toscana

The interesting agro-industries to become a logistic centre in Toscana are:

- **Cereal dryers:** 41 industries mainly located in the northern area.
- **Distilleries:** 41 facilities in the region.
- **Oil pomace industries:** 3 facilities in the region.

The agro-industries identified as biomass resources suppliers are, apart from the ones above producing residues: cellars (a total of 1409 wine producers, especially in Siena and Firenze provinces) and oil mills (141 sites spread in the whole region).

8.2. Identification of biomass resources in Toscana

In Toscana the agricultural biomass resources add up to almost 100 kt/yr of both herbaceous and woody pruning residues. Both resources amount for a share of about 50% of the total available resources. When observing the reality by province, it is observed that in Firenze the main predominant source of biomass are permanent crops pruning from olive groves and vineyards mainly). Rest of provinces show more balanced shares for herbaceous and woody resources. When regarding the total amounts per province, it is observed that some of them may account with scarce resources: Livorno, Lucca, Massa-Carrara, Pistoia and Prato. Therefore the analysis will centre in the rest (Arezzo, Firenze, Pisa and Siena) having all of them available biomass over 10 kt/yr.

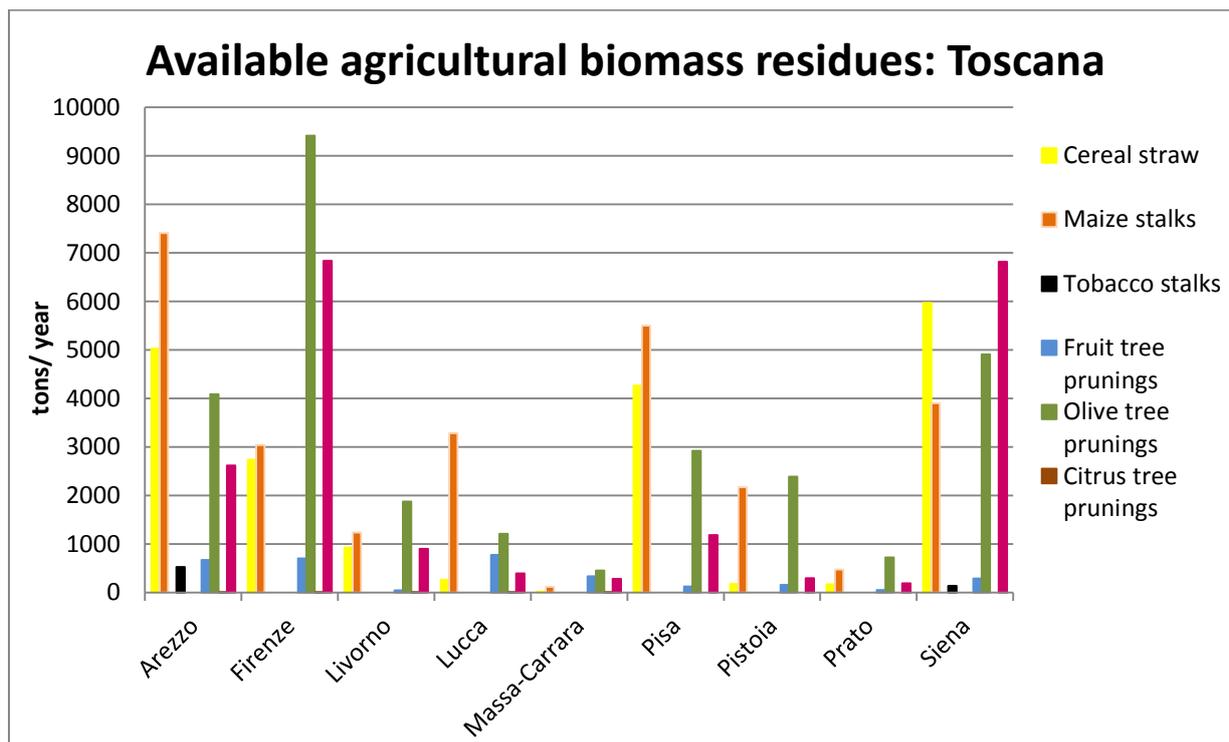


Figure 9: Summary of available agricultural biomass residues in Toscana.

Main conclusions in Toscana:

- The provinces of Arezzo, Pisa and Siena account with herbaceous residues larger than 10 kt/yr. There it is feasible to create new chains on herbaceous residues as a main feedstock. Both, cereal straw, and maize and sunflower stalks contribute to reach this figure.
- The prunings from permanent crops (vineyards and olive tree) are of importance in the provinces of Firenze and Siena. There new logistics centres can run on woody biomass as main resource. In Arezzo and Pisa woody resources can be a complement for the production of mixed solid biomass commodities.
- Agro-industry residues coming from the cereal dryers, cellars, wineries, oil mills and oil pomace industry could also be considered interesting sources.

8.3. Localization of resources and agro-industries in Toscana

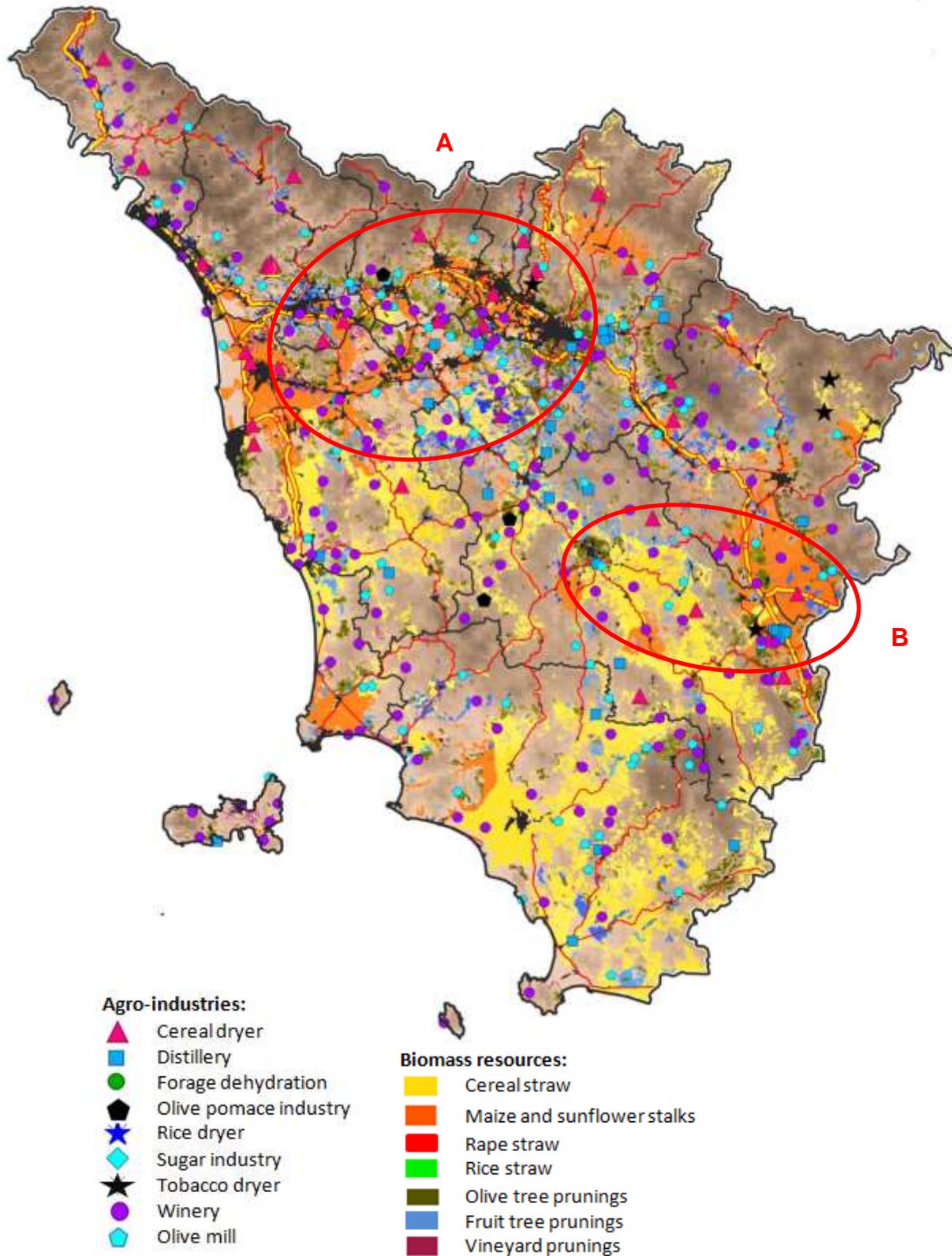


Figure 10: Localization and type of agro-industries and resources in Toscana.

8.4. Priority areas in Toscana

Potential areas for the development of an agro-industry logistic centre have been detected in Toscana and are shown in Figure 10. As already mentioned in the introduction, these areas have been selected taking into account the diversity of resources (both herbaceous and woody) and agro-industries as well as the compatibility among them. Compatibility has been defined according to their seasonality, see Table 8, and to their compatibility of use. Logistic issues such as good communication roads and proximity to consumption areas has also taken into consideration.

Table 8: Availability of equipment and biomass resources in Toscana.

	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Oil pomace industry												
Distillery												
Cereal dryer												
Cereal straw												
Maize straw and cobs												
Pruning from permanent crops												
Cereal husks and silo flour												
Grape marc and stem												
Grape pits												
Olive pits												
Olive oil pomace												
Tobacco stalks												

Toscana presents a high variety of resources, an interesting amount of agro-industries and good transport connection. However there are two main areas to be highlighted for the establishment of a logistic centre. Both areas, A and B, have synergies among the distilleries and the oil pomace industries with the production of solid biomass from a mixture between prunings and straw in a pellet format. Residues from cereal dryers could be a complement for such product. Apart from that, their logistic centre could only be focused on processing their own residues. Cereal dryers could condition the olive and grape pits to be sold as a bulk product.

9. Summary of the situation in Italy

The situation of the five target regions in Italy (Emilia-Romagna, Marche, Puglia, Sardegna and Toscana) have been analysed in order to evaluate their potentiality to set an agro-industry logistic centre. The evaluation has been carried out from the perspective not only of the available resources but also of the existing agro-industries compatible with this new activity according to SUCELLOG concept.

Regarding the resources, the potential feedstock are several: straw from cereal and maize mainly, prunings from olive tree and vineyards and agro-industry residues coming from the olive and wine sectors. A large number of types of resources do have not a market (or do not have a place in the market because there is less demand) and are left on the soil or burnt to avoid the cost of harvesting/disposal

The agro-industries evaluated by the project have been the following ones: forage dehydration facilities, cereal dryers, rice dryers, tobacco dryers, distilleries, oil pomace industries and sugar industries. They all own equipment that can be used for the production of solid biomass like dryers and/or pelletisers and idle period in their regular activity (not working the whole year). They have all been considered as target for the project since no important technical barriers for the development of a logistic centre in their facilities have been detected. More concretely, from all of them cereal and rice dryers are the less versatile installations because of their existing drying system, which can be only compatible with a granulated product (like olive pits, grape pits and crushed almond shells). The rest of sectors could be able to pre-treat a large variety of resources format (straw, chips or granulated) since they have horizontal dryers. Cellars and oil mills have also been considered as target industries since, even if not owning compatible equipment, their easy access to biomass residues (from the agrarian practice of from the industrial process) make them interesting for the project. Therefore, in their case, investment in a new pre-treatment line should be made. The tobacco dryers have been also considered for the project even though now they are not allowed to use their dryers with other resources due to commercial restrictions. Due to the fact that the sector is in decline and a restructuration will be needed, it can be a good possibility to include it as a possible new business line using existing equipment.

The situation of Italy is promising in terms of available resources and amount of agro-industries. However, it should be highlighted that there are still barriers to be faced when developing the project and which have come up during the interviews with the sector. The first can be the lack of trust that the society has in services that are provided for free (even if the project will not finance any investments or analysis, giving only technical support) which can lead to a lack of compromise. The second barrier is that, in some cases, the law is different according to the region and often differently interpreted in provinces. The best example is the definition of residue, whereas in Puglia the olive pomace is considered as by-product and it can be used as biomass, in other regions (i.e. Tuscany) it is considered as waste, and it can't be

used as biomass, because of the chemical treatment to extract oil using hexane. Different provinces can give an own more or less strict interpretation of the rule, allowing or not to consider the raw material as a by-product. The third barrier can be the target consumers since the main market for SUCELLOG, which is the agro-industry sector, is not really familiar with biomass being highly dependent on natural gas whose network is really developed in Italy. However, the project considers that these barriers will be overcome with a good pilot example that can show that developing a biomass logistic centre can be a good business line for the agro-industry to diversify their activity. Association among industries (even if from different sectors) can be a good option to avoid high investment costs that could discourage possible entrepreneurship.

Annex I: Table of ratios y availability percentage per region

Table 9: Ratios of biomass production (t/ha) in ITALY per region

Crop	Emilia-Romagna	Marche	Puglia	Sardegna	Toscana
Wheat	2,71	1,96	1,51	2,27	2,48
Rye	2,16	0	0,73	0	1,12
Barley	5,28	3,67	1,23	1,99	2,55
Oat	2,47	2,35	1,2	1,67	1,81
Maize	4,08	6,43	4,04	6,6	4,12
Rice	1,92	0	0	2,27	3,21
Beans	3,81	2,41	1,88	1,84	2,83
Pulses_oth	4,89	2,26	1,65	1,2	3,3
Tobacco	0	0	0	0	0,47
Hemp	0	0	0	0	5
Rape	0	0	0		0
Sunflower	2,75	1,15	1,52	1,54	1,57
Soya	3,75	0	0	0	0
Linseed	0	0	0	0	2,5
Seed_other	0	14,74	0	0	0
Fruit_temp	1,6	2,2	1,11	1,1	1
Fruit_subtrop	0	0	2	1,45	0,45
Berry	0,81	1,01	0,83	0,9	0,65
Nuts	1	1	1,45	1,38	0,96
Citrus	0	0	2,01	1,45	0,47
Olive	0,06	1,27	1,32	2,3	1,39
Vineyard	1,68	1,59	1,82	1,61	1,55

Table 10: Percentage of availability of biomass in ITALY per region

Crop	Emilia-Romagna	Marche	Puglia	Sardegna	Toscana
Wheat	10	35	35	25	25
Rye	40	0	40	40	40
Barley	10	30	35	30	30
Oat	40	40	40	40	40
Maize	50	45	45	50	45
Rice	40	0	0	40	40
Beans	0	0	0	0	0
Pulses_oth	0	0	0	0	0
Tobacco	0	0	0	0	85
Hemp	0	0	0	0	0
Rape	0	0	0	0	0
Sunflower	40	40	40	40	40
Soya	70	0	0	0	0
Linseed	0	0	0	0	0
Seed_other	0	0	0	0	0
Fruit_temp	20	20	25	20	20
Fruit_subtrop	0	0	0	0	0
Berry	40	40	40	40	40
Nuts	0	40	40	40	40
Citrus	0	0	40	35	40
Olive	47	47	55	45	45
Vineyard	50	90	90	90	90