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Deliverable D2.6: Technical factsheets of forest and agricultural biomass, SRC and pruning supply chains, 2nd version

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Case Study

Business model keys of the composting plant in Alcarrás

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Content

CASE STUDY Business model keys of the composting plant in Alcarrás	
Creators	Maider Gómez Palmero
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1 Introduction

The BRANCHES project aims to promote the implementation of new cost-effective technologies, mobilize more biomass, and create innovative business opportunities in rural areas by improving and strengthening the links between bioeconomy practice and science. The project will ensure communication through the two-way flow of information for the transfer of ideas and technologies between scientists and professionals from agriculture and forestry in rural areas. The valuable knowledge produced by research and development should always be shared far beyond the scientific community. BRANCHES will integrate selected knowledge on forest and agricultural biomass supply chains with available innovative technologies and best practice cases for bioeconomy solutions with bio-energy conversion systems in a wider bioeconomy context. In all EU countries, existing strategies and best available technologies will be presented in easily understandable formats through the national thematic networks launched by BRANCHES.

BRANCHES project will produce and share Practice Abstracts (PAs) from regional best practices useful for the bioeconomy. The selected best practices are summarized in Practice Abstracts (PAs) are shared through the project media and collected on the project webpage (https://www.branchesproject.eu/materials/practice-abstracts-and-factsheets). From these best practices, the most promising bioeconomy solutions are presented in Case Studies to further detail the value chain or technology characteristics.

2 Case description

Alcarràs is one of the municipalities in Europe where the cattle industry has the largest weight. Nearly half a million animals are bred there every year. In this area, over 150 family businesses of different sizes dedicated to this field are in operation. Due to their activity, a very significant amount of cattle manure is generated, and producers must handle it.

Figure 1. Alcarràs municipality

One of the key factors to put forward a collaborative model, in which different actors are involved (associated to the different steps and dimensions of the value chain), was the willingness to contribute to develop a circular bioeconomy system full of opportunities. For instance, farmers were able to improve the environmental sustainability of the farms and achieved an improvement in profit.

In 2022, a composting plant was launched as a test by SAT Alcarràs Bioproductors. It brought together 150 families who run cattle and pig businesses in the municipality, and who joined forces to collectively manage the manure generated. The composting plant boasts an area of 1.5 hectares (3.7 acres) in an estate of 17 hectares (42 acres) which has meant an investment of €1.5m.

Figure 2. Alcarrás composting plant

The plant in Alcarràs manages around 27,000 tons per year, the solid fraction of cattle and pig manure. The quality of the solid fraction collected in farms changes throughout the year because the humidity of the fraction is lower in summer. The amount to be composted accounts for 30% of the solid fraction that is collected in the associated farms, while the remaining 70% is handled by the businesses themselves through its use as fertilizers in fields.

The value chain starts at the farms, with the separation of manure to solid and liquid fraction. Next, a transport company hired by the plant collects the solid fraction and transfers it to the treatment plant in Alcarràs. The transport fee is the same for all farmers, regardless of the distance from the processing plant. As much as possible, the profit generated by the plant is used to pay for these costs.

Once the material coming from the farms reaches the composting plant, the solid fraction of manure gets mixed with the biomass originating from the cleaning of parks and gardens. The biomass used is stored indoors separately from manure and is ground in order to include it in the trench.

Figure 3. Biomass storage site

This mix, which is carried out depending on the features the client is looking for, means a significant improvement in the compost properties.

Figure 4. Piles mixing the solid fraction of manure and biomass

Figure 5. Piles at the site

Piles in the trenches are formed placing first a layer of ground biomass in order to prevent mouthpieces of the air circulation system from getting blocked. Around a month later, this mix is moved to another trench, and after another month, the procedure is considered to be finished. During the composting period, the sprinklers installed in the trenches moisten the material, while probes help monitoring moisture content and oxygen to control the composting process.

Figure 6. Mouthpieces of the air circulation system

Next, the material goes to a drum screening process. If it passes the screen, it is considered as final product and it is stored in a different place within the plant. If it fails to make it through this process, it goes back to the piles.

In order to carry out this operation, the plant owns a loader, a drum screen, and sensors for humidity, temperature and oxygen that monitor the composting process.

As a result, different kinds of quality organic fertilizers are obtained. Some of them are suitable for the organic production and are used either in the crop field or for sale, mainly for the French market.

Figure 7. Final product

At the moment, taking into account the good results achieved so far, the farmers themselves have promoted an expansion and diversification of the current procedures.

On the one hand, an expansion of the composting plant is being planned, and on the other hand, installing a biogas plant is being processed by the local administration. This would enable SAT Alcarràs Bioproductors to have the energy community status, turning farmers into their direct managers.

The electricity generated would go to both, the electricity network, and farmers. Furthermore, thanks to the conversion process, denitrified water would be obtained, which could be used for irrigation.

3 Practitioners' feedback & motivation for development

The project of a bio-based products plant in Alcarràs was raised 17 years ago, aiming to guarantee a treatment for the effluent generated in cattle and pig farms. This common need prompted the two main associations of stockbreeders in the municipality to unite.

The project in Alcarràs is part of the BIOHUB CAT initiative, which is part of a joint effort of several administrations and institutions to develop bioeconomy. BIOHUB promotes the development of bio-industrial estates, among others. In these spaces, synergies between different processes are sought after to add value to local and renewable organic resources, such as manure, but also other surplus resources coming

from farming and agro-industrial activities. The initiative of farmers in Alcarràs has prompted them to be the top bio-industrial estate in Catalonia.

One of the main obstacles faced relates to the social acceptance. At the beginning of the project, there was some opposition from neighbors, because they did not exactly know how a composting plant works, and what activities will be performed in the facility, etc. The strategy adopted to overcome it included the organization of countless meetings with the local communities and the local council to explain the aim of the project, the benefits, the activities that would be performed at the plant, etc.

Nowadays, they have been able to turn the situation around and most of the originally opposers are now backing the initiative. It was very helpful to open the plant's doors so that people could visit and learn how the plant works and what materials are treated.

Additionally, the initiative had to deal with the bureaucracy associated when implementing this type of project, which is quite challenging. It implied to submit an endless number of templates and documents, review from experts, and significant resources allocated to the documentation planning and processing. In some cases, the responsibility was shared between different administration departments overlapping over a certain topic, which contributed to increase the difficulty. Therefore, it is quite relevant to be aware of the investment needed in terms of time and economic resources.

Lastly, from the technical side and considering that the initiative was launched 16 years ago, when the project was approved the technology chosen needed to be upgraded since new and more efficient technologies were available.

4 Trade-offs between economic, energy and environmental effects for conventional and improved biomass handling approaches

This value chain allows to strengthen the link between rural environment and circular economy through the utilisation of by-products to obtain an organic fertiliser while giving the treatment needed to the manure.

The main benefit of this system that stands out is having found the way to manage the material in the farm correctly and sustainably to use it in the fields. The combination of the composting plant and the use of the liquid fraction by inserting it through the drip irrigation of the fruit trees, as well as the sprinkling of cereal crops has allowed an effective management plan of the by-products obtained from the livestock activity.

Various benefits arose associated to the initiative implementation. The most relevant is to guarantee a treatment for the effluent generated in cattle and pig farms but also the improvement from the environmental and economic point of view related to the use of the liquid fraction as fertilizer thorough the irrigation system or the organic fertilizer used.

In summary, the initiative in Alcarràs has permitted to launch a circular bioeconomy at a local scale and generate new opportunities locally. It has helped reaching a real solution to the need to handle the effluents in farms and has done it in an environmentally sustainable way.

5 Knowledge transfer potential to other regions

These different aspects should be considered if the model of this initiative is copied:

- having a high density of farms in the area.
- high degree of partnership among the sector so that they can cooperate.
- willingness and motivation to set it up.

Also, in this case the initiators had to go abroad to learn about different ways to work and different technologies available, but potential replicators could come and visit this plant.

6 Summary

In conclusion, the value chain model based on the development of a composting plant to manage the manure produced in the farms is a model of circular economy that consists of the use of by-products from the cow and pig farms as a source of organic fertilizer. By doing so, the circle is closed, and manure is managed in a sustainable and local way while contributing to grow a green local economy in line with the EU's climate and sustainable goals.

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Case Study

Pozyskiwanie i logistyka biomasy z terenów marginalnych, w tym z gruntów rolniczych porośniętych samosiewami drzew i krzewów

Acquisition and logistics of biomass from marginal land, including agricultural land overgrown with self-seeding trees and shrubs.

Case study Lead: Mariusz Stolarski

Case study date: 28 March 2023

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CASE STUDY

Pozyskiwanie i logistyka biomasy z terenów marginalnych, w tym z gruntów rolniczych porośniętych samosiewami drzew i krzewów

Acquisition and logistics of biomass from marginal land, including agricultural land overgrown with self-seeding trees and shrubs.

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Description	Paweł Stachowicz, Quercus
Contributors	Mariusz Jerzy Stolarski, UWM
Number participants	36
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1 Introduction

Primarily two different technologies (1,2) and one supply chain (3) have been selected to use solid biomass for energy purposes.

(1) Willow harvest with a biobaler;

(2) Production of pellets from different types of post-extraction biomass of agricultural origin;

(3) Harvesting and logistics of biomass from marginal land, including farmland overgrown with self-seeded shrubs and trees.

Short characteristics resulted from market analysis is provided below.

The completed evaluation demonstrated that technology (1) was addressed to a relatively narrow circle of users because the total area of land under willow grown for energy purposes was small in comparison with other types of agricultural plantations. It was therefore concluded that although this technology does exist and is used, it is unlikely that it will spread much in the future.

A similar conclusion was drawn regarding technology (2) although pellet is an attractive solid fuel and its production and consumption have been increasing dynamically over the past years, which is mainly stimulated by the growing prices of fossil fuels. Nevertheless, post-extraction biomass from perennial plants, e.g., willow, poplar, black locust, miscanthus, willowleaf sunflower, has always been a niche product, available in very small quantities. Thus, it has been concluded that although this technology does exist, its future development is unlikely to reach any larger scale.

In turn, the highest potential for application has been identified for technology (3), proposed by the company Quercus. The reason is that this technology is addressed to the broadest circle of clients, practically in the whole country. Moreover, there is an increasing number of areas where self-seeded shrubs and plants grow. It has been concluded that this technology is likely to be more and more useful, which has been confirmed by the completed evaluation.

The last one received the Polish award of BRANCHES for the best technologies in the framework of biomass supply chain.

2 Case description

Acquisition and logistics of biomass from marginal land is a mature technology (TRL 9) successfully serviced in the local area.

In recent years, vacant land parcels, including agricultural fields where typical crop production has been abandoned, exposed to the natural succession of various species of shrubs and trees, have turned into an important source of woody biomass. Such plants are known as self-seeded shrubs and trees, and the species composition in each site (e.g., pine, birch, spruce, willow, poplar and others) depends on the environmental conditions, including the habitat, climate, the vegetation growing around the site, and others. Harvesting biomass from such areas plays a dual role because firstly it is a source of woody biomass and secondly it enables the restoration of agricultural production or use for another purpose, for example development.

In areas overgrown with self-seeded plants, shrubs and trees may be of different age, from a few years up to a few dozens of years old, although most often they are around 10 years old. The harvest of self-seeded trees or shrubs is done on commission, depending on the ordering party's needs, and practically can be carried out continuously, regardless of the season. However, the optimal period is from 15 October to 1 March, outside the breeding season of birds, pursuant to the Regulation of the Minister for the Environment of 16 December 2016, on the protection of animal species. Because a land plot from which self-seeded trees and shrubs are harvested is most often restored to agricultural production or for other purposes (residential, recreational, commercial, industrial or transportation), all plants should be cut at the ground level, so as not to leave any stumps. Besides, depending on the age and number of self-seeded shrubs and trees, rootstocks can also be harvested (pulled out from the ground). Quercus offers a technological line, a set of machines and equipment, dedicated to this kind of work.

The first stage employs a hydraulic harvester head Westtech Woodcracker C450 or C350 mounted on a Volvo EC 250 or EW 160 excavator, which can cut trees with the diameter of up to 500 mm. The operator performs several operations at the same time – grasps the plant right above the ground, grips it and cuts it with the cutting mechanism. Next, using the gripper, the operator holds the cut tree, and then grips and cuts another plant. Once, the head container is filled with an appropriate amount of biomass, the operator unloads it in a regular row of heaps. Using this machinery, it is possible to clear completely an area of 1 ha in about 20 working hours on average, and obtain ca 100 Mg of biomass. Noteworthy, however, every site is different, and the above average value may differ considerably. This also depends on the atmospheric conditions, type of terrain, species structure and age of self-seeded trees as well as the experience of the harvester's operator.

Once the whole area has been cleared, the biomass is most often transported to one site (heap, pile) using a forwarder or a tractor with a trailer and crane, to be stored and possibly air dry, which increases its calorific value. The biomass collected in piles, depending on its volume and the distance to the company's logistic facilities, can be shredded to chips using a mobile chipper type Bruks 805.2 STC mounted on a forwarder or Albach Diamant 2000. The chips are then transported in vehicles equipped with containers or moving floors to the end user.

Below there are photographs illustrating consecutive stages of this technology.

Felling trees, bushes using a Westtech Woodcracker hydraulic shear head



When the shear head's collector is filled up, the operator deposits the biomass in regular rows or load.

Chipping and transporting chips to the final destination.

3 Practitioners' feedback & motivation for development

The added value of the proposed technology for a variety of potential clients lies in the fact that:

- after cutting, plants are typically transported from the whole area and can be stored in heaps for as long as two years, and then can be processed to wood chips in batches, as the demand for solid fuel occurs.
- during the storage, depending on the season of the year, atmospheric conditions, size of the heap, and duration of this period, the moisture content in cut plants decreases from about 50-60% on harvest to about 30-40% after a few weeks, which means a rise in the biomass calorific value from ca 8 to 12 GJ/Mg.
- the wood chips produced in this technology are a valuable solid biofuel, which is most often used locally in district heat or heat and electricity plants.
- the technology enables the restoration of land to agricultural or investment use, while maintaining or improving the continuity of biomass supplies to the end user, irrespective of the time passing from the harvest of plants.

4 Trade-offs between economic, energy and environmental effects for conventional and improved biomass handling approaches

As regards this technology, it is not possible to talk about specific, repeating economic, energy or environmental effects, nor to compare it directly with the traditional methods of obtaining wood chips, for example from forest felling or sawmill residues. The reason is that every land parcel overgrown with self-seeded plants is unique. They can have different relief and location, area, age of self-seeded trees and shrubs, plant density per area unit, species composition of the plant community, morphology of the plants, type of soil, season of harvest, climatic conditions, time taken to harvest the plants, the required deadline for clearing the land plot, the way the harvest is carried out, only aerial parts or also roots of shrubs and trees, the intended use of biomass and the technology applied to process it, the availability of machines and human labour at a given time, etc.

The overall economic gains for potential clients consist of the income from selling the biomass and clearing of the land plot, which can be used then for agricultural, forest or development purposes.

The overall energy benefits for potential clients consist of the obtained biomass, which is a renewable energy source for local producers and recipients of heat energy or heat and electric energy.

The environmental benefits include the planned and targeted management of the land plots, which can correspond to the local policies of spatial management in a given area.

Economically, production of wood chips from self-seeded shrubs and trees is always an added value because this is an additional stream of biomass, which can be either occasionally or periodically used as supplementary to the traditional sources of wood chips from forest felling or sawmill waste.

5 Knowledge transfer potential to other regions

A direct transfer of the know-how and the entire technology proposed above to any region in Poland or in any other European country is possible. Obviously, the exact costs and benefits from using the technology will depend on the factors mentioned above and local economic factors as well as the logistics used in each case.

6 Summary

The proposed technology „Harvesting and logistics of biomass from marginal land, including agricultural land, overgrown with self-seeded trees and shrubs" is a fully developed and applicable technology with TRL 9. It is completely mechanized and practically applicable in different geographical and environmental conditions. The added value of this technology for potential clients, such as farmers, companies, and other land-owning entities, lies mainly in the possibility to restore land for agricultural or investment purposes while maintaining or improving the continuity of supplies of biomass to the end-user, regardless of the season of harvesting the plants. Moreover, once all cut shrubs and trees are transported from a given land plot for storage, they can be stored in heaps or piles for up to two years and then processed into wood chips as a demand for solid biofuels arises. Moreover, while being stored, depending on the season of the year, atmospheric conditions, size of a pile or heap, and duration of the storage period, the moisture content in the plants decreases from about 50-60% on harvest to around 30-40% after a few weeks, which means that the calorific value of the biomass increases from around 8 to 12 GJ/Mg. In consequence, the wood chips produced in this technology are a valuable solid biofuel, which is most often used for energy generation locally in distric heat or heat and electricity plants.

Annex 1.

Other sources in the framework of BRANCHES

PA – available at the webpages of the National Bioeconomy Network - Poland
https://nbnpl.uwm.edu.pl/en/nbn-pl/best-practices/

and the BRANCHES project

Video with comment of the company owner: https://youtu.be/kF2zuUBKc90