

1. Introduction

CirculAlps is a project co-funded by the European Union in the context of the Alpine Region Preparatory Action Fund (ARPAF) that is part of the EU Strategy for the Alpine Region. CirculAlps aims at promoting a circular economy and bio-economy throughout Alpine wood-based value chains. Forestry, wood-working and associated value networks are recognised to be of structural importance for the social, ecological and economic wellbeing of remote Alpine areas. Therefore, the members of the CirculAlps project investigate the material flows and value chains of forestry and wood-based sectors of five remote Alpine areas in four Alpine countries: Austria, Germany, Italy and Slovenia.



The five research areas differ in their size; however, all have in common that their local economy is characterised by forestry and wood-based value networks. The research areas are typified as follows:

- Lungau (Salzburg, Austria)

The Lungau area lies in the region of Salzburg and it covers an area of 1,019 km². The biggest urban settlements are Tamsweg, Mariapfarr and Zederhaus. In total, 20,341 people live in Lungau. Of its total area, 38% of

Lungau is covered with forest. Four species of coniferous trees are represented in the Lungau with an annual growth rate of 6 m³/ha, with spruce accounting for 80.6%, fir for 0.1%, larch for 16.0% and Swiss pine for 0.7% (bfw.ac.at). The main deciduous tree species is birch.



- Adelegg, Ravensburg, (Baden-Württemberg, Germany)

Adelegg is part of the Baden-Württembergisches Allgäu that lies in the district of Ravensburg in the most south-eastern part of Baden-Württemberg. The Adelegg region covers 112 km². Adelegg lies within the communities of Isny and Leutkirch. The mountain range Adelegg is close to Isny and Leutkirch. Adelegg is characterised by the strong presence of spruce, with more than an 80% share of the total forest area. Other tree species include beech with a share of 10-20% and individual occurrences of fir and other trees.



- Val d'Ega, Eggental (South Tyrol, Italy)

This is a 245 km²-wide area located in the south-eastern part of the autonomous province of Bolzano. It comprises four municipalities: Cornedo all'Isarco, Nova Levante, Nova Ponente and Tires. The population amounts to 10,000 people and the forest covers 12,600 ha (~52% of the whole territory). In the autonomous province of Bolzano, the main forest types are spruce forests (~60%), European larch forests (~19%) and Scots pine forests (10%), followed by Swiss pine (~6%), silver fir (~3%) and other broad-leaved forests (~2%).

- Non valley and Fiemme valley (Valsugana/Trentino, Italy)

The study area is located in the north-east of Italy. The province of Trento covers an area of 6,212 km² with a population of 538,579 inhabitants. Forests cover approximately of 3,900 km² (around 63% of the total area). The main tree species in the autonomous province of Trento are spruce (31.7%), beech (16.8%), larch (15.4%) and silver fir (11.2%).

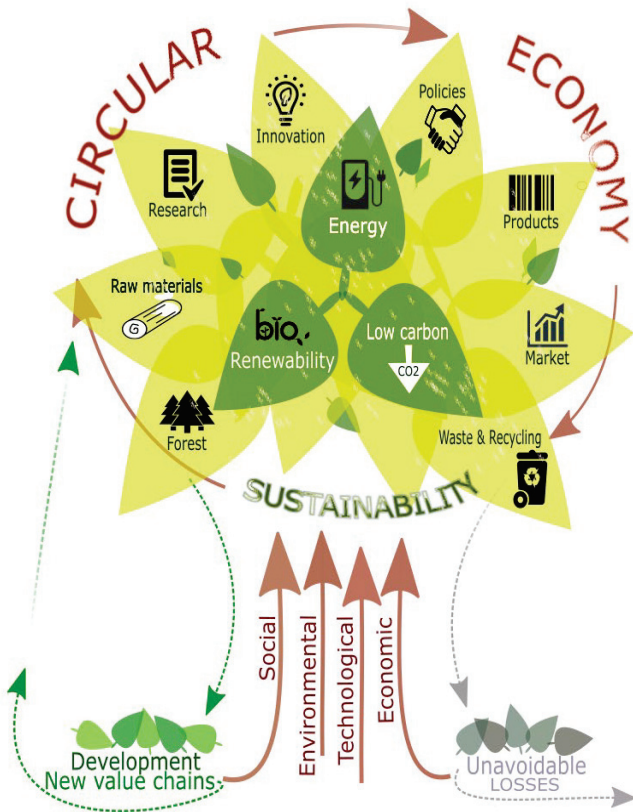
- Upper Savinja valley (Nazarje, Slovenia)

The municipality Nazarje (part of the Upper Savinja valley, which measures about 508 km²) lies in the north-eastern part of Slovenia, with an area of 43.4 km² and a population of 2,652 residents. The landscape is characterised by a diverse subalpine flora, 73.6% of the area is covered

by forests (mostly mixed), with tree species such as spruce and European beech having a share from 10% up to 60%, depending on the individual forest owners, and individual occurrences of silver fir, larch, maple, oak and chestnut.



A circular economy is an economic system of closed loops in which raw materials and products have only unavoidable losses, renewable energy sources are used and sustainability thinking is at the core (Figure 1). The concept transforms the linear economy-based model of the extraction chain of resources-production-consumption (take-make-dispose) to a better sustainable use of resources. The challenge is to think from the beginning of every process (e.g. production) about the integration of this process into circularity, renewability and sharing of materials, components and products. Some concepts are not entirely new: from eco-design, from cradle-to-cradle, reuse and recycling has been known for many years (Anonymous 2019a). Other concepts are being developed as central in the new paradigm, as a symbiosis of an industrial, remanufacturing and sharing economy (Balzani 2017).



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Figure 1. Overview of the circular economy concept.

The novelty of the circular economy concept lies in rethinking the whole system of all the actors: a prominent role is played by companies, but also institutions, associations and all citizens with their lifestyles are called to do their part and to be part of the change. Europe wants to be a leader of this revolution. The aim is to regain competitiveness through innovation that leads to economic growth and increases employment in compliance with environmental sustainability (Bompan 2018).

In fact, the great environmental and social challenges require a profound rethinking of the current business paradigm. This is why the circular economy has an important role which represents a new paradigm and may demonstrate, at every system level and in every geographical area, a



realistic solution to combine innovation, competitiveness and environmental sustainability. Applying the principles of circular economy implies a cultural change to reconsider the way of using raw materials and energy: from design to products and processes, from use to the management of the so-called "waste". All this is the circular economy. This concept was created to meet the requirements of sustaining the resources of the planet and it represents an opportunity for growth and development in terms of competitiveness, innovation, sustainability and employment.



The Alpine region includes sensible areas and delivers renewable primary resources, although these areas are under stress through taking over different functions and changing environmental conditions. These functions involve the sustainable use of natural resources like water, timber, fungi, food for animals and so on; the protection of humans, buildings and soil against debris flow, snowslide and erosion; as well as benefits for regeneration and sports through hiking, biking and so on. Tourism activities have increased in the last twenty years. Many people



love to use the forest and mountain areas for their spare time. Nevertheless, the forest areas are also production areas for renewable timber and the wood processing industry is important for the economy in different countries. Forest areas generate income for more than 16 million private forest owners, and forest activities have a financial turnover of almost €500 billion as well as employing 3.5 million people (Anonymous 2016). This should also be considered when discussing free access to all forest areas and for spare time activities at all times. On the other hand, the climate is changing and stresses the forest ecosystem, and also the mountain areas. Therefore, the main objective should be to use the natural resources from the forest for different products in an appropriate way to reduce the unavoidable losses. The circular economy can close the loop and is one approach to protect natural resources and foster innovation and competitiveness in remote areas.

2. Forest in the Alpine region in Europe

2.1. A general overview

In Europe, about 490 million cubic metres (m³) of round wood is currently being harvested from accessible and productive areas of forest (Vervek et al. 2019).

The data of Eurostat 2015 show that Germany has quite a high amount of land area classified as forests (more than 11 million ha, which accounts for 32.7% of the total land area), and also Italy (approximately 10 million ha, which accounts for 31.8% of the total land area) has a higher amount of forest areas compared to Austria (3.8 million ha, which accounts for 46.9% of the total land area) and Slovenia (1.2 million ha, which accounts for 62% of the total national land area). At the international level, the four countries involved in the project (Germany, Austria, Italy and Slovenia) have a total amount of about 16.0% of the forest area in the EU (Anonymous 2015). As for national levels, Germany has 7.1%, Italy 5.8%, Austria 2.4% and Slovenia 0.7 % of the whole European forest area.



Considering the values of harvested wood for industrial use and fuel wood, the results are quite different compared to the forest areas. Italy has a high amount of forest area but is last in the ranking of round wood production of the four involved countries. In this ranking, Germany harvested the biggest amount of round timber with approximately 52 million m³. Austria harvested 16 million m³ round wood in the year 2016 according to Eurostat (2016). Slovenia has an amount of sustainable harvested round wood for industrial use of 5.4 million m³. The results from harvested wood compared to that of forest areas is an index of a more intensive use of forests as a result of the forest management plans, more used species or different amount of timber growth stock. It is notable that, in Italy, fuel wood production reaches over 3.0 million m³, which is quite a high amount compared to round wood production.



2.2. Forest in the Alpine region in Europe

The Alps are a place of biodiversity with about five thousand species of vascular plants, which are only three-sevenths of the amount of the whole European flora, and fifty species of endemic plants that grow solely on the Alpine arc (Lasen 2012). Some of these plants are part of the forest ecosystem. The forest is a dominant landscape feature and economy sector in the Alpine region. Forests cover more than 40% of the Alpine territory and there are over three billion trees, which corresponds to about 270 plants for each inhabitant, distributed over an area of about 8.5 million hectares (80-90% usable forest area, while 10-20% are