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# **Policies for agroforestry and diversification of productions in Wallonia**

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Double master's degree in Agroecology



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## **Policies for agroforestry and diversification of productions in Wallonia**



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### **Résumé:**

Des pratiques comme l'agroforesterie et la diversification des productions font partie des stratégies utilisées par l'agroécologie pour une transition vers des systèmes alimentaires durables. Cette transition se heurte à des barrières politiques. Cette étude essaye de déterminer l'influence des politiques sur le développement de l'agroforesterie (AF) et la diversité des productions en Wallonie. Pour déterminer leurs influences, 48 interviews semi-dirigées ont été réalisées avec des agriculteurs et associations. À l'aide de ces interviews, les principales barrières face à l'adoption de l'AF et la diversité des productions ont été analysées. Le développement de l'AF en Wallonie est principalement lié à un effet de blocage technologique ainsi qu'aux lois et réglementations Wallonne. L'adoption de la diversité des productions est quant à elle principalement liée à la nature des sols, les règles sanitaires, le manque de connaissances des agriculteurs, le manque d'options phytosanitaires et de cadre légal pour certaines pratiques. Sur bases des barrières relevées par l'étude, des recommandations pour l'évolution des pratiques ont été proposées. Le développement de l'AF en Wallonie demandera un cadre légal adapté quant à la diversité des productions des supports aux systèmes polycultures élevages à l'échelle territoriale ainsi qu'aux cultures associées devront être créé.

### **Abstract:**

Agroecology is more and more acknowledged as one of solutions toward sustainable transitions of our food systems. Practices such as agroforestry and diversification of production are part of the strategies used within an agroecological approach. The transitions towards more sustainable food systems faces several barriers, in particular politics. This study investigates at the Walloon scale, how the policies influences the development of agroforestry (AF) and diversification of production in Wallonia. 48 semi-structured interviews with farmers and specialists in agricultural associations were completed and gave data to understand the main barriers for the development of agroforestry (AF) and diversification of enterprises on the farm. The AF development is mainly linked to a cognitive lock-in and the policies hindering its development linked to Walloon laws. The adoption of diversification of enterprises is mainly linked to lack of knowledge and phytosanitary options as well as a legal framework affecting some practices. Based on the barriers found, we propose recommendations to support in the future the development of AF and diversification of production. The development of AF in Wallonia would need an adapted legal framework. The development of diversification will need supports for integrated livestock-crop systems at the regional level as well as supports for intercropping and other innovative practices.

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**List of abbreviations**

CAP: Common agricultural policy

SRC: Short rotation coppice

FASFC: Federal agency for the safety of the food chain

COPV: Community plant variety office

FPS: Federal public service

LAG: Local action group

# 1 Introduction

From the 1960s to the beginning of the twenty-first century, crop yields per unit area in Europe have increased due to plant breeding, the use of external inputs such as fertilizers and pesticides, and the use of specialised field machinery (Burgess and Morris 2009). This change from traditional to modern agricultural systems has led to a simplification and standardisation of farming systems and a substantial loss of landscape heterogeneity (Dupraz et al. 2005). Traditional agriculture systems in Wallonia involved the presence of hedgerow networks as well as taller orchard crops, which we can today assimilate into agroforestry practices (Louah et al., 2017). At the same time, the area occupied by traditional agroforestry practices (mainly associated with the integration of trees and farming) has declined across Europe. However, agroforestry is still practised on 15.4 million hectares in Europe, about 3.6% of the total territorial area of the European Union (EU) (den Herder et al. 2017). Those agroforestry systems which were abandoned during the last decades are now gaining interest; they could be the solution to many problems linked to modern agriculture, increasing biodiversity, food and fodder production. These are some of the advantages amongst many that agroforestry could bring (García de Jalón et al., 2018). European policies and, more specifically, the standard agricultural policy (CAP) had essential impacts on agroforestry and diversification of crops throughout the last century and still has important effects today (Mosquera-Losada et al., 2016, Peyraud et al., 2014). During the second half of the previous century, agriculture was revolutionized, intensified, specialized and mechanized, leading to changes in the agricultural landscape (Lefebvre et al., 2015) and farms' production diversity (Peyraud et al., 2014). The creation of a more extensive and broader field led by land consolidation schemes promoted all over Europe resulted in removing numerous forms of woody vegetation (hedgerows, shrubs, isolated trees) (Santiago-Freijanes et al., 2018). Hedgerows, often used as boundaries between fields, were a clear obstacle to regrouping smaller plots. The creation of the CAP in 1957 directly accelerated those changes in the rural landscape and production diversity on farms (Lefebvre et al., 2015). The eligibility of agricultural lands to CAP subsidies was linked to land occupation favouring lands with low tree density, which directly promoted the farmers' removal of woody vegetation (Santiago-Freijanes et al., 2018). For example, grazed orchards represented one of the most important agroforestry (silvopastoral) systems in Wallonia (Belgium), occupying about 20.000 hectares in the '50s.

In contrast, it represents less than 2000 ha now (Coppée and Noiret, 2008). Regarding diversification of crops, as the surface dedicated to legumes was decreasing all over Europe, the 1992 reform of the CAP was highly favourable to cereals production and unfavourable to the legumes (Peyraud et al., 2014). To illustrate that statement, the example of France could be taken; in France, since the '90s, the surface dedicated to red clover and lucerne decreased by

75% (Peyraud et al., 2014). Moreover, the CAP and especially the first Pillar helped farmers modernize their farms; this modernization came with setting up irrigation on some farms resulting in the intensification and specialization of farms into cash crop production (EIP-AGRI, 2017). The intensification and specialization of productions in Europe also impacted mixed livestock-crop farming systems. This specialization leads farmers with pedoclimatic conditions suitable for cash crops to produce them and stop their livestock production leading to a decrease in the diversity of products on their farms (EIP-AGRI, 2017).

## **1.1 The development of agroforestry systems in Belgium**

Agroforestry has been present for hundreds of years in Belgium throughout different systems such as grazed orchards and hedgerows (Louah et al., 2017). However, as Louah et al. (2017) stated, the modern agroforestry systems, such as the plantation of trees on arable lands, are still very young in Belgium (Louah et al., 2017). In the literature agroforestry is often seen as an innovation (Louah et al., 2017, Meijer et al., 2015). It is shown in the literature that studying the adoption of an innovation is usually looked at as the characteristic of the innovation itself (Louah et al., 2017, Meijer et al., 2015). However, there is an increased interest in looking into the social aspects of the people to whom this innovation is applied (Kilelu et al., 2013, Louah et al., 2017, Meijer et al., 2015).

As explained earlier, Belgium has two different RDP (rural development programs), one for Flanders and one for Wallonia. In Flanders, the government decided to use measure 222 (first establishing agroforestry systems on agricultural lands) during 2007-2013 and then sub-measure 8.2 (support for establishment and maintenance of agroforestry systems) for the 2014-2020 period to support the agroforestry. In her study, Borremans (2019) explains that the Flemish government had the objective of establishing 250 ha of agroforestry with the support of measure 222 for the 2007-2013 period, which resulted in the plantation of only 32.2 ha (Borremans, 2019). During the last period (2014-2020), the Flemish government set the 300 ha of agroforestry plantation objective; in 2018, the sub-measure 8.2 supported the establishment of 94.4 ha, with a yearly increase in the number of farmers applying for the support to agroforestry plantation (Borremans, 2019). Even though the government supports the agroforestry plantation, its adoption is not strong amongst the Flemish farmers (Borremans, 2019). Borremans (2019) explained that other studies investigated how the farmers see agroforestry and the barriers to its implementation (Borremans, 2019, Camilli et al., 2018, Rois-Díaz et al., 2018, Graves et al., 2009, Louah et al., 2017, Sereke et al., 2016, Triest, 2014). Amongst those studies, three were done in Belgium (Borremans, 2019, Louah et al., 2017, Triest, 2014). Two of them were conducted in Wallonia (Louah et al., 2017, Triest, 2014). Both of the studies aimed to understand the barriers

to agroforestry development, but they focused on one or two specific areas(Louah et al., 2017, Triest, 2014).

## **1.2 Diversification of productions**

### **1.2.1 Diversification of productions and the CAP**

Concerning diversification of productions, the research for literature is complex, as often most of the literature found was related to farm diversification rather than diversification of productions. Its precise definition is broad and matters to discussions in the literature(Ilbery, 1991). For example, the European Parliament's definition is: “ *the creation of any gainful activities on the farm. These include ‘all activities other than farm work, directly related to the holding or having an economic impact on the holding’. ‘Directly related means that either the resources of the holding (area, buildings, machinery, etc.) or its products are used in the activity. Examples include tourist accommodation, handicraft, processing of farm products, and wood processing.’*”(Augère-Granier, 2016). As explained in Ilbery's paper which explains that Griffiths defines farm diversification as “*farm-based activities not directly concerned with producing crops of livestock, and which involves marketing contact outside the agricultural industry*” (Ilbery, 1991) this definition has some similarities with the definition of the European Parliament. Indeed, Griffiths claims that there are two types of diversification a structural diversification which is the closest one to his definition of farm diversification and agricultural diversification which includes the production of a diversity of products that are unusual to be produced on an average farm (wine, herbs,...)(Ilbery, 1991). Concerning the framework of this study we'll consider diversification of productions throughout three categories which are; mixed-farming, crop diversification and energy production. We could have added the agroforestry within the diversification of productions, but this topic is already reviewed above.

As explained earlier, the modernization, specialization and intensification of agriculture lead to a lower production's diversity on farms(EIP-AGRI, 2017, Peyraud et al., 2014). The set-aside scheme created in 1988 as part of the regulation 1272/88 helped to some extent favour mixed farming systems(Pierr et al., 2009). As explained by Pierr et al., the subsidies earned from side aside lands and lands under the cross-compliance rule of minimum care on grassland helped farmers to keep their activity alive and avoid structural changes(Pierr et al., 2009). The EIP-Agri focus group's report on live mixed farming systems also suggests that to favourize the implementation of mixed farming, a policy framework specific to good mixed farming practices should be elaborated (EIP-AGRI, 2017). Later on, in 2013, the CAP was reformed, and the EU wanted to work on the environmental impact of its agriculture and introduced the concept of “greening the CAP”(Louhichi et al., 2017). The greening of the CAP was based on three rules,

the conservation of permanent pasture, crop diversification and the respect of maintenance of ecological focus areas(Louhichi et al., 2017). To get direct payments from the first pillar, the farmers need to apply the three rules from the CAP greening(Louhichi et al., 2017). Suppose the crop diversification measure tends to directly preserve diversification of productions on-farm by forcing them to produce at least three different crops on their farm. In that case, it is inefficient because most of the farmers in Europe already grow three crops on their farms (Westhoek et al., 2012). Westhoek et al. estimate that this measure will directly impact only two per cent of the farmers in Europe(Westhoek et al., 2012). In the second pillar of the cap, the diversity of crop produced on farms is helped by the rural development program, especially by the measure 10.1 (payments for agri-environment-commitments), in Wallonia's rural development program 2014-2020 measure to promote the favourable crops for the environment are set up(Service public de Wallonie, 2017). Amongst the eligible crop to this measure, crops such as hemp or legumes are found(Service public de Wallonie, 2017).

Moreover, other European policies exterior to CAP could also impact the production diversity, such as the directive 2000/60/CE, which provides a water quality framework in Europe. The 2000/60/CE directive created Wallonia's program for sustainable nitrogen management in agriculture(Vandenberghe et al., 2016). These programs force farmers to introduce cover and catch crops in some conditions to prevent the lixiviation of the nitrogen to underground water(Vandenberghe et al., 2016).

### **1.2.2 Strategies for diversification of productions**

Diversification of productions could be implemented on farms through different strategies. We choose to investigate diversification of productions through two main topics: crop diversification at a farm level(intercropping, cover crops and longer rotation and legumes integration in livestock systems) and integrated crop-livestock farming systems at a farm and regional level. The intensification of agriculture in Europe simplified the cropping systems(Landis, 2017) as farmers produce the most valuable crops. This simplification of cropping systems negatively impacted the environment and biodiversity(Firbank et al., 2008). As explained by Rodriguez et al., diversification of the cropping systems has increasingly gained interest for its opportunities in terms of environment and biodiversity positive effects and reduction of fertilizer needs(Rodriguez et al., 2021). Increasing crop diversity on farms could be achieved using intercropping(which is the cultivation of at least two crops at the same time on the same plot(Rodriguez et al., 2021), longer crop rotation and integration with the integration of new crops, including cover crops(Wezel et al., 2014, Rodriguez et al., 2021). Another principle was investigated in this study within the frame of diversification of productions: the introduction of legumes within the grasslands. As underlined by Rochon et al. the common agricultural policies set up during the past decades and the low price of synthetic nitrogen decreased the number of legumes present in European

grasslands(Rochon et al., 2004). But the integration of legumes within the grasslands has significant potential regarding a sustainable intensification of the livestock systems(Lüscher et al., 2014). Amongst all the positive impact that the introduction of legumes could bring, we can underline that the integration of legumes within the grasslands could help mitigate the greenhouse gas emission of livestock systems, improve forage production, and increase livestock performance(Lüscher et al., 2014).

The second topic investigated for the development of product diversification was the integrated crop-livestock farming systems at a farm and regional scale. The integrated farming systems are systems where crops and livestock are integrated within the same farming system. In our case, this could be done at a farm and regional level. Lemaire et al. explain in their study that the integration at those two levels of cropping and livestock systems can help make farming systems more efficient in nutrient cycling, ecosystems services given, and soil quality improvement(Lemaire et al., 2014). Sometimes at a farm scale, some conditions make it impossible to integrate crop and livestock systems; thus, a landscape approach to integrating two specialized systems needs to be considered(Lemaire et al., 2014). This is especially the case about the territory studied under this study. As explained further in this paper, the soil quality in Wallonia is important, making some regions more specialized with either crop or livestock systems.

### **1.3 Research questions and objectives**

This research aims to understand the effects of European, national and regional policies on agroforestry and diversification of productions in Wallonia.

First, we investigated farmers' main barriers in implementing agroforestry and developing diversification of productions on their farms. Then the barriers were analysed to see how new policies would be able to overcome those barriers.

The study is undertaken with a systemic and holistic approach, including various stakeholders such as farmers association's, local action groups (LAGs), university teachers, advisory associations, syndicates, .... This will help get a better understanding of the situation and not rely on a farm-oriented approach.

The research questions for this study are:

- **RQ1:** What is the farmers' decision-making process of implementing agroforestry and diversification of productions in Wallonia?
- **RQ2:** What are the main barriers to the development of agroforestry and diversification of productions in Wallonia?

- **RQ3:** What are the policies that affect or affect the development of agroforestry and diversification of productions in Wallonia?
- **RQ4:** How do policies influence the development of agroecology and, more particularly, agroforestry and diversification of productions in Wallonia?
- **RQ5:**How can policies be improved in the future for better development of diversified production and agroforestry systems?

An objective of this work is also to provide recommendations for the evolution of policies and support the development of agroforestry and diversification of productions in Wallonia.

## 2 Methodology

### 2.1 Studied Area

The fieldwork was conducted in the Walloon region, which is one of the three Belgian regions. The Walloon region, also known as Wallonia, is located in the south of Belgium and represents around 55% of the Belgian area (Iweps, 2021).

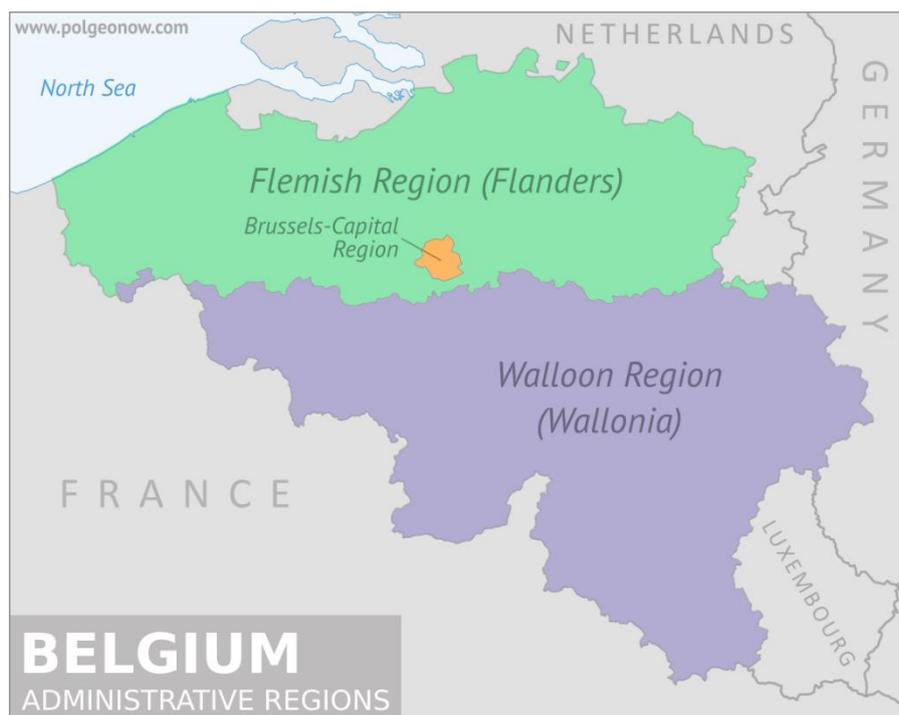


Figure 1: Belgium administrative regions. (Sources: <https://www.polgeonow.com/2016/12/what-is-wallonia-in-belgium.html>)

Belgium is divided into 14 agricultural regions delimited by their natural characteristics (pedology, geology, altitude, ...) and their agro-economical potential (SPW Environnement, 2018). Out of the 14 Belgian agricultural regions, ten are present in Wallonia. In this study, we choose to investigate the five major areas in terms of superficies (SPW Environnement, 2018). Those agricultural

regions are ; *La région limoneuse*(the silty region), *l'Ardenne*, *le Condroz*, *la Famenne* and *la région herbagère*(the herbageous region).

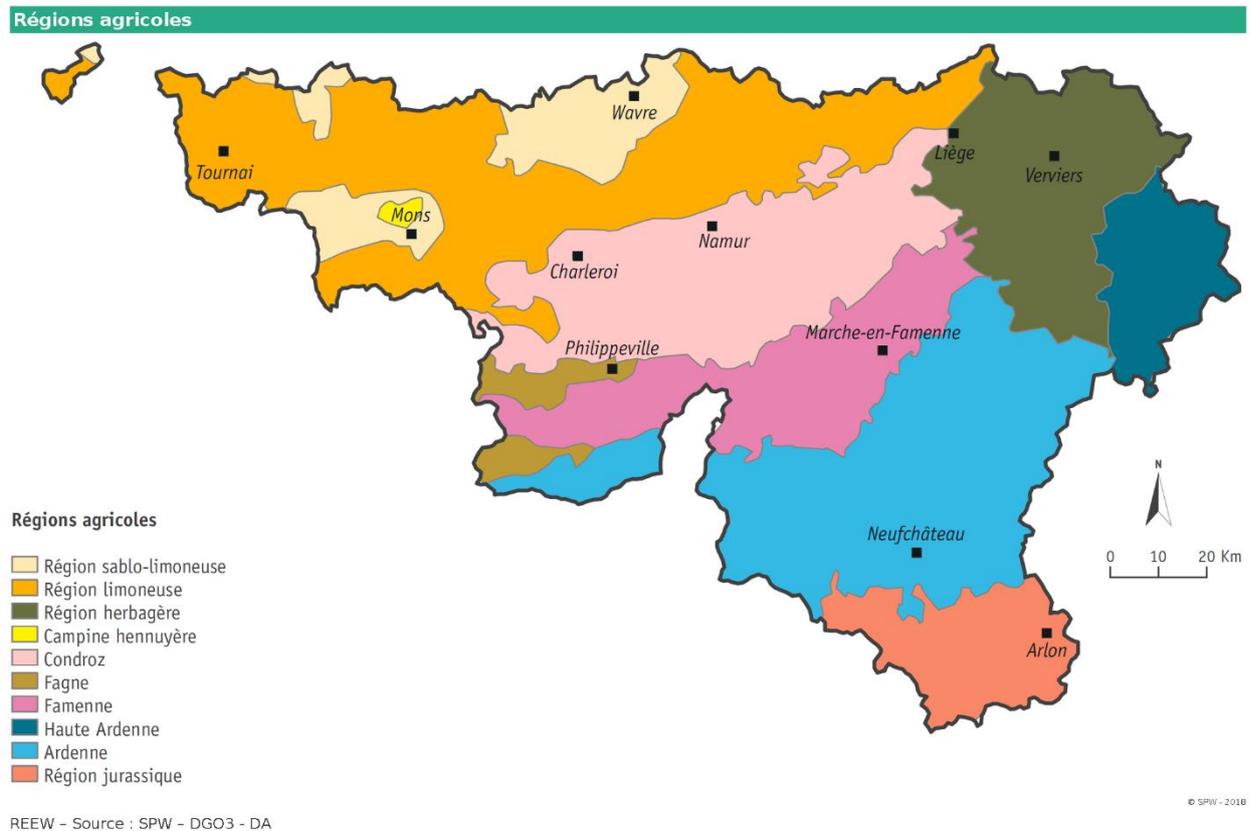


Figure 2: Walloon's agricultural regions(SPW Environnement, 2018).

Because of the natural characteristics and ago-economical potential specific to each region, there are various agroecosystems in Wallonia. This variety of agroecosystems could be explained by the fact that the natural characteristics of an area influence its land occupation; therefore, the agroecosystems present(Ferraton and Touzard, 2009).

For instance, the Limoneuse and Condroz regions are the most fertile region within the scope of this study. The good soil fertility of those two regions allows the cropping of a diversity of crops such as potatoes, sugar beet and most of the cereals produced in Belgium(Statbel, 2019). If those regions present a good soil fertility and have an important part of their surface dedicated to crops, permanent pastures and livestock are also present on 79% of the farms for permanent pasture for the Limoneuse region and on more than half of the farms (54%) for livestock in the Condroz region.

The Famenne, the Herbagère and the Ardenne region have a lower soil quality than the Condroz and the Limoneuse region. On agricultural land, pasture covers most of the farm surface and the best soils are used for cropping when possible. The herbagère region, translated in English the

“the herbageous region” is mainly used for milk production and as it’s name indicate mostly covert by grasslands, moreover this regions in also known in Belgium for its hedgerows network and was high stem orchards.

## 2.2 A general methodology and data collection

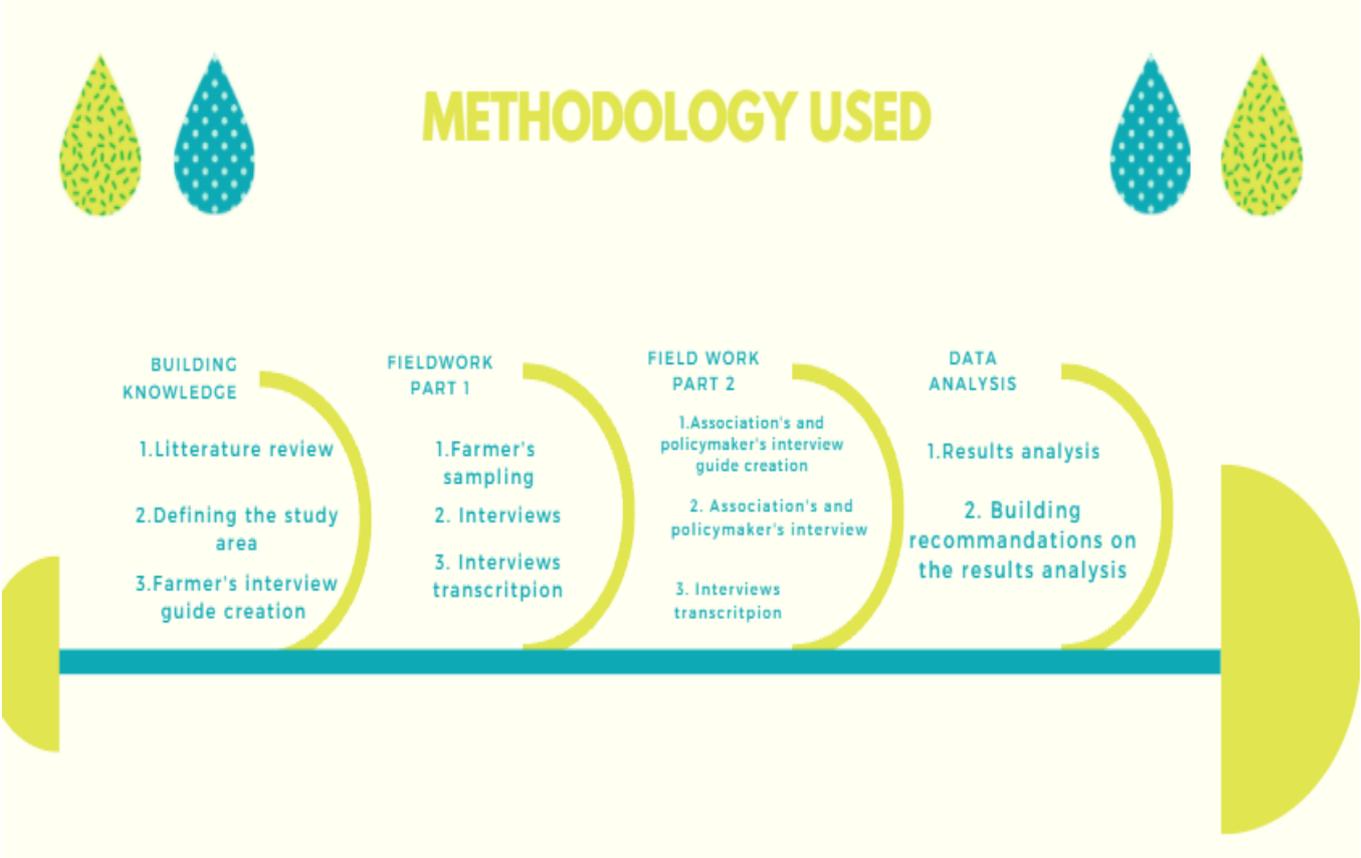


Figure 3: Methodology used

### 2.2.1 Building knowledge

The first part of this thesis was to investigate about the policies past and present policies that have influenced and are related to agroforestry and diversification of productions in the European Union and Belgium; this part was done throughout the literature review. The literature review helped to understand what was done concerning those topics and choose the right approach. Within the frame of this study, we needed to understand the reasons farmers adopt or not agroforestry on their farms and how new policies could support the adoption of it and how existing policies may deter farmers from developing agroforestry systems on their farms. As it is underlined by Rois-Díaz et al., the limitation of adopting such a technique relies on environmental and sociological factors(Rois-Díaz et al., 2018), which need to be understood by investigating the farmers perspective on it. The most appropriate way to examine the influence of policies on the

development of agroforestry and diversification of productions on farms in Wallonia, in our opinion, was to select a qualitative research approach.

To collect the data, we choose the semi-structured interviews method. This method helps the researcher stay open-minded about the interviewee's different topics and answers (Bryman, 2008). The semi-structured interviews were built upon the literature review; they were written first to understand the farmers' farming systems and which policies impact them; secondly, the interview aimed to collect data on their opinions on the different policies impacting them.

## 2.2.2 Selection of farmers

Farmers were sampled throughout research on the internet and personal contacts; after each interview, the farmers were asked if they knew any contacts that would suit the study. Once they were no more new topics revealed by the interviews, the sampling was stopped. Finally, 19 farmers were interviewed concerning the diversification of productions topic. Four farmers from the Ardenne region, five from the Condroz region, three from the Famenne region, four from the herbagère region and five from the limoneuse region.

*Table 1: Table representing the numbers of farmers, associations and experts interviewed for agroforestry and diversification of productions.*

	Agroforestry	Diversification of productions
Farmers	17	19
Associations and experts	5	7

Concerning the agroforestry part of this study, the sampling was done differently. Farmers participating in this study were divided into four groups; farmers who practice silvoarable agroforestry, farmers who practice silvopasture agroforestry, farmers who practice silvopasture and silvoarable agroforestry and farmers who do not practice agroforestry at all. Farmers were sampled in every of the five agriculture areas selected for this study when it was possible. Because of the relatively low adoption of silvoarable agroforestry in Wallonia, it wasn't possible to sample silvoarable farmers for the Famenne and Herbagère regions.

Farmers practising silvoarable agroforestry were found thanks to the AWAFF association, the association for agroforestry in Wallonia and Brussels. For the silvopasture agroforestry, other relevant stakeholders were contacted to get the farmers contacts. The final sampling for the agroforestry topic was; five farmers are practising silvopastoral agroforestry. Five farmers practising silvoarable agroforestry were interviewed. Four farmers who do not practice agroforestry were interviewed. Three farmers who practise silvopastorable and silvoarable agroforestry. Altogether, 17 farmers were interviewed for the agroforestry topic.

To have another angle on the situation, we decided to interview associations and experts in contact with farmers and have different views on the topics. Semi-structured interviews were

explicitly created for each of the associations/experts. The semi-structured interviews guide were based on the findings of the first data analysis from the farmers perspective. In total, 12 associations/experts were interviewed (five for the agroforestry and seven for the diversification of productions).

### **2.2.3 Associations**

As explained earlier, associations and experts were interviewed to complete the results collected from farmers.

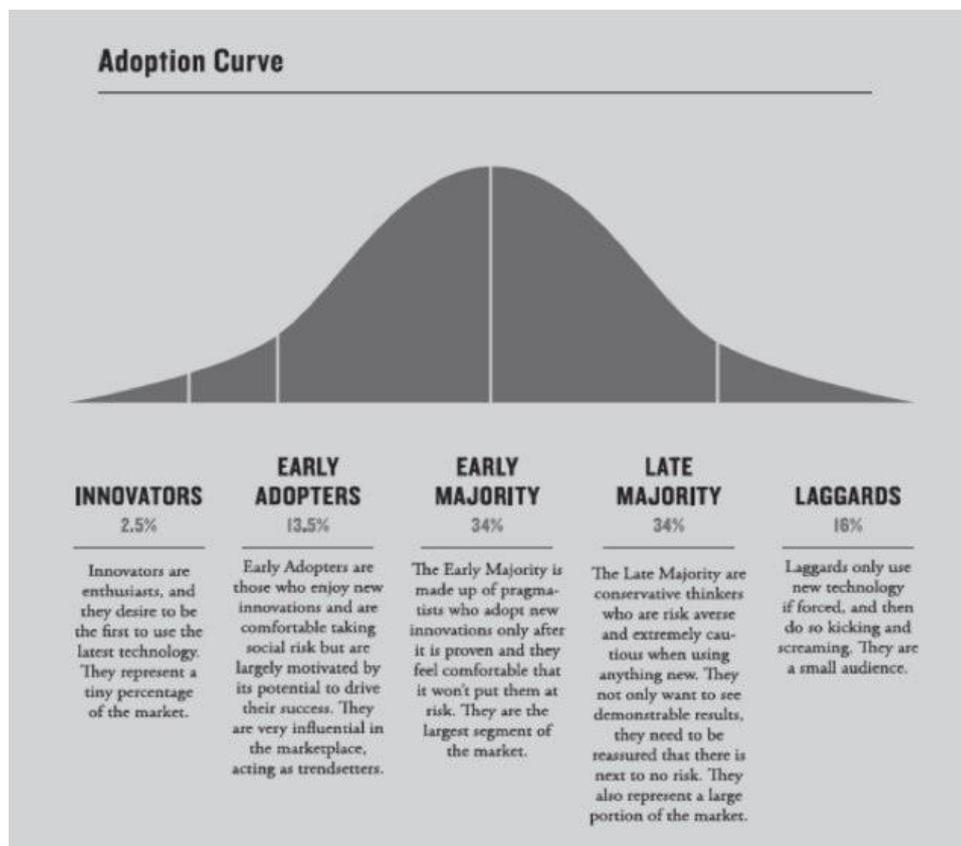
Among the five associations interviewed for agroforestry, two (the AWAF and CDAF) were directly related to agroforestry. Those associations aim to vulgarise, communicate, and develop agroforestry in Wallonia and advise farmers to create agroforestry projects on their farms. Among the three other associations interviewed in the agroforestry context, two of them are helping farmers develop agroforestry projects on their farms as one of their competencies. Valbiom is an association that facilitates the integration of sustainable biomass initiatives such as the plantation of short rotation coppice(SRC) systems on farms. In contrast, Natagriwal is the association responsible for the different agro-environmental measures(AEMs) in Wallonia. The last association interviewed is NFT, and its role is to represent the rural land owners in Wallonia. They are working on problems related to landowner right in different legal contexts.

Concerning the diversification of productions topic, two of the seven associations interviewed are the main Walloon farmer syndicates. They were chosen because of their knowledge of the farmers' situations in Wallonia. Associations and experts advising farmers on conservation agriculture, forage production, organic farming, and agroecology were interviewed. Moreover, one company that works in the agrobusiness and develops the wheat-peas association in Wallonia.

### **2.2.4 Data analysis**

The first step of the data analysis was the transcriptions of the interviews, then data from each interview were coded. Farmers were then classified in function of the diversity of their farming system for the diversification of productions part; three main categories were highlighted; *“specialized animals”, “specialized crop”, and “mixed livestock-crop systems”*. Concerning the agroforestry part, the farms were classified in function of the agroforestry type present on their farm; four categories were created, *“silvoarable agroforestry farms”, “silvopastorable farms”, “not practising agroforestry farms” and “silvoarable and silvoarable farms.*

Figure 4: Rodger's adoption curve. (Source: <https://medium.com/the-political-informer/the-rogers-adoption-curve-how-you-spread-new-ideas-throughout-culture-d848462fcd24>)



Because of the fact that agroforestry could be seen as an innovation (Amare and Darr, 2020), we also classified the agroforestry farmers in classes of the Rodger's adoption curve.

Table 2: Table representing the numbers of farmers in each of the Rodger's curve category applied to the farmers sample for the agroforestry topic.

Rodger's curve category	Number of farmers
Innovators	5
Early adopters	8
Laggards	4

Table 3: Table representing the numbers for farmers sampled for each category of the agroforestry and diversification of productions topics.

	Categories	Number of farmers
Agroforestry	Silvopasture agroforestry	5
	Silvoarable agroforestry	5
	Silvopasture and silvoarable agroforestry	3
	No agroforestry	4
		Total= 17
Diversification of productions	Mixed crop-livestock	11
	Specialised crop	3
	Specialised livestock	5
		Total =19

Then tables were designed to list all the barriers towards diversification of productions and agroforestry in function of the farm category. All the barriers were then categorized into five themes. We considered in this study mixed farms as the farms that produce and sell both cash crops and at least one animal product(eggs, milk or meat). We considered as specialized crop, farms which only produces cash crops and do not have any animal production on their farm. Concerning the specialized livestock farms category, we considered farms that sell and produce only animal products and non-cash crops. This means that under the specialized livestock category farms producing silage corn and/or grass could be found.

### 3 Results

#### 3.1 Diversification of productions

##### 3.1.1 Farm categories

*Table 4: Table representing the characteristics of the farms interviewed for diversification of productions.*

Category	Charasterisics	Minimum	Mean	Maximum
Mixed	Size (ha)	50	136	320
	Number of crops	3	7	10
	Number of animals	1	2	3
Specialised crop	Size	167	181	200
	Number of crops	7	8	9
	Number of animals	/	/	/
Specialised livestock	Size	60	89	112
	Number of crops	1	2	3
	Number of animals	1	1	3

Table 5: This table summarizes the reasons for diversification of productions adoptions between the three categories which have implemented agroforestry on their farm.

Category	Reason	Percentage
Mixed farming	Diversify the income	100%
	The soil quality	80%
	Agronomic	70%
	Market opportunities	30%
	Animal feed	30%
	Subsidies	10%
	Curiosity	10%
Specilized crop	Diversify the income	100%
	Agronomic	100%
	Market opportunities	33%
Specialized animal	Diversify the income	100%
	Agronomic	100%
	Forage autonomy	33%

## Mixed crop-livestock farms

The first category is the mixed crop-livestock farms, they represent 11 farms. Cattle are present on all of the farms and the dominant livestock system on the sampled farms. Six farms have only one animal production, one farm produces two animal productions, and four farms produce three. The other animal production farms were sheep(meat), pigs and poultry (meat and eggs). Farms with three animal production were found in the most fertile Walloon's region and the less favourable cropping regions. Out of the five farms with more than one animal production, four sell a part of their production through direct selling or short market channels.

Concerning the crop species diversity on farms, it varies between three and ten crops per farm, with in average nearly seven crops grown on farms. Surprisingly, farmers from the Herbagère region and Famenne regions were found with nine and ten crops on their farm. The main factor is that those two farms have relatively good soils for their area. Moreover, another reason could explain the fact that the farmer from the Herbagère region has a high diversity of crops in his farms because he is organic and has achieved proteic and forage autonomy. The mean farm size is 116% higher than the average farm size in Wallonia.

The reasons why mixed farmers wanted to diversify are mainly for animal feed and to diversify their incomes. 80% of the farmers explained that they choose to diversify their productions because they have a good soil quality allowing them to crop a variety of crops and still have good yields. Agronomic reasons (long crop rotations, reduce the pest impact,...) were also mentioned in 70% of the cases. Only ten per cent of the farmers explained that subsidies drove them for try new crops.

## Specialized crop farms

Three farms could be classified as specialized in crops. All of them are located in the Limoneuse region and have a size between 160 and 200 ha. Because of the good soil quality, the farmers interviewed grow between seven and nine different crops. The commercialization of their products is done throughout the classical long market chains, they sell their crops to a company or cooperative. The average farm size in the study is 213% higher than the average farm size in Wallonia.

Regarding the reasons why the farmers chose to diversify their system, they were mainly driven by the a will to diversify their income and not rely on one speculation. Moreover all the farmers in this category explained that they also did it for agronomic reasons. One third of the farmers explained they were driven by market opportunities for some specific uncommon crops such as Quinoa or durum wheat.

## Specialized livestock farms

Five specialized livestock farms were interviewed, all of them are in the less favourable cropping regions of Wallonia( the Herbagère and Ardenne regions). The farms are of a size between 60 and 112 ha. Farms in this category also grow crops; however, the crops grown on those farms are corn and grasslands, which we do not consider as cash crops and therefore couldn't be defined as mixed farms in the context of our study.

When it comes to the number of animal production present on the farms, Two farms have more than one animal production. The SA2 farm located in the Ardenne rear mainly sheep and use them to maintain natural reserve; the farm also sells some lamb meat and just bought a few pigs. The three remaining farms produce only one animal production (either beef or milk). The milking farms two farms are intensive farms with the primary objective being to produce as much as they can. They sell milk to a cooperative and do not transform any of their products. Moreover, both are not fully autonomous in protein and heavily rely on soja and other protein correctors.

### **3.1.2 Barriers towards diversification of productions**

#### Barriers towards diversification of productions explained by farmers

The barriers towards production diversification are classified in five main categories. The table below provides all the barriers identified by farmers. Three categories cover most of the barriers identified by farmers. Altogether, cultural, legislative and socioeconomic represents 39 of the 45 barriers identified by farmers.

Table 6: Table representing the barriers identified by farmers towards diversification of productions. The percentages represents the proportion of farmers which identified each barrier.

Agronomic	Soil's nature	36,8%
	The low protein content of some legumes compare to soja	5,3%
	Manure limits	5,3%
	Lack of adapted varieties	5,3%
Cultural	Lack of competencies for transforming, selling,...;	21,1%
	School's education system	21,1%
	Knowledge	21,1%
	Lack of farmers open-mindedness	15,8%
	Farmer's individualism	15,8%
	Lack of data	10,5%
	Lack of continuous education	10,5%
	Traditions	10,5%
	The inefficiency of the associations' cooperation	5,3%
	Low-cost food demand from the consumers	5,3%
	Environmental	Climatic
Wild animal pressure		10,5%
Legislative	CAP subsidies system(dependency, retired farmers,)	52,6%
	Administrative low adaptability /flexibility(legumes, cover crops destruction, ....)	42,1%
	FASFC low flexibility and advisory	26,3%
	Administrative burden	21,1%
	Lack phytosanitary options	10,5%
	Access to seed	10,5%
	Associative world (too many services), low efficiency	10,5%
	Actual politics	5,3%
	Lack of communication about the new AEM's	5,3%
	Rules for legumes composition in the cover crops	5,3%
	Lack of communication about the rules	5,3%
Socioeconomic	Income insecurity	42,1%
	Lack of facilities	36,8%
	Pressure on land price from compagnies(land management companies)	36,8%
	Land access	31,6%
	Machinery price	26,3%
	Goods import competition with different standards	21,1%
	Time	15,8%
	Finding the markets	15,8%
	Workforce	15,8%
	Low protein price	10,5%
	Non-objective advises	10,5%
	Farm surface	10,5%
	Seeds cost	10,5%
	Power of the food companies	10,5%
Farmer's age	10,5%	
Cheaper to produce elsewhere	5,3%	

	Cities vicinity	5,3%
	Lack of time	5,3%

The same table would be made to show the barriers highlighted by the associations and experts.

## Agronomic barriers

Some farmers complained about the low protein content of legumes they would produce in Belgium compared to the amount in the soja they are buying. For them, it's an essential barrier towards diversifying more their crop productions with legumes. It seems less economically efficient for them to plant legumes than to buy soja. Another barrier mentioned by a small number of farmers was the manure spreading limits. This barrier was discussed mainly by intensive milk farmers who had the most considerable proportion of their lands covered by pastures and which have stables build with gratings and leaving them with liquid manure. If the farmer would like to plough some of his pasture into crops, this would decrease the amount of available sprayable lands and quickly, the farmer would have some troubles with storing all this manure. Moreover, the lack of adapted varieties is another problem encountered by the farmers wanting to diversify with new crops.

The soil's nature was the most important barrier expressed by the farmers within this category. Often farmers who were specialised in livestock explained that they would crop more different crops if they could, but the soil doesn't allow them to.

## Cultural

This category represents all the cultural barriers highlighted by the farmers against diversification of productions on their farms. Some of the cultural barriers are embedded deeply in the culture, such as the traditions, the farmer's individualism or the lack of farmer open-mindedness. The weight of traditions prevents the farmers from trying new crops or changing their minds about new practices, which could increase the production diversity on farms.

*"I think that many farmers are trapped within the traditions, they have been taught from a young age by their parents about one way of farming, and for them, there is only one way of doing it, this something very present. I often had other farmers mocking me about the new practises and crops that I was trying to implement on my farm."*

The farmer individualism was highlighted by the farmers in cases where new practises were tried to be implemented. Still, they needed specific costly machinery that farmers couldn't afford, or they would be challenging to amortize because of insufficient hectares. In some cases the farmers

would buy a powerful tractor for specific cropping practices such as ploughing but the farmers do not need such a power on an everyday basis. This kind of machinery could be bought by a farmer group with the costs shared amongst the group. Especially with the increasing price tendency of the machinery (Farmer 2).

Some farmers complained about the Walloon agriculture education system, which does not incite farmers to try new crop productions or new practices.

*“When I was in school, we only learned about industrial agriculture, what chemicals to use and how to apply them. We only had five pages about organic farming at the end of our syllabus on which the teacher didn’t say almost anything apart from denying its relevance; they just trained us to fit in the mould of conventional and industrial agriculture.” A farmer who studied agriculture in college.*

Even at higher levels of education, such as the university level, some farmers feel that the education system didn’t give them all the tools and knowledge to diversify their production systems. And after leaving the school, they can’t find the knowledge or any courses/formations to help them with their lack of knowledge. A farmer explained that even though she did bio-engineer studies, she did not know how to implement no-till farming on her farm or choose the right species for a cover crop mix. This is especially problematic when she finds it difficult to get information and knowledge after school.

One of the solutions for farmers to be educated on the topic they didn’t learn at school is to consult associations that are competent in the domain they want to be helped. However, when farmers ask for help concerning a complex situation requiring several associations to cooperate, the situation could come to the point that the cooperation between the associations is not efficient because they can not agree on the path the farmers have to follow.

In some cases, the farmer's diversification of productions comes with a will to transform this new product and sell it directly to generating a more important income from its production. Transformation and direct selling require new competencies that the farmer may not have; 21,1% of the farmers mentioned this lack of competencies.

EnvironmentalTwo environmental barriers were found. The major one being the climate. Farmers complain about climate change and the uncertainty of being able to crop all the plant species they want.

*“With the climate change, you never know if you’re going to have a drought or a very rainy season. During the past three years, we had important droughts, impacting the yields; this led us to buy*

*feed for our animals, adding financial pressure. In this context, for me it's difficult to think about diversifying my productions."*

Wild animal pressure was also a barrier that hindered some farmers from trying new productions. The farmers underlined this barrier were from the Ardennes region known in Belgium for its forests and wildlife. Farmers mentioned mostly wild pigs as a problem; they found that even with the compensation given for wildlife damages, trying new crops is not worth it for them because of the wild pigs.

LegislativeThe lack of communication about the rules, legislation or even the AEMs is a problem that farmers found frustrating. An important point to underline here is the barrier concerning the lack of communication about the new AEMs. When we look at the AEMs set up in Wallonia, some of them could incite the farmers to diversify their production financial support. In that regard, the AEMs "*MB6 crops favourable for the environment*" is very interesting. A diversity of crops are eligible within this measure. Within the list of eligible crops, most of the cereals could be found and legumes, hemp and cereals-legumes mixes.

*"I can tell you something, this year; my best crop is the faba-bean-oats-spelt mix. It has a reasonable yield, and if you add the MB6 AEM, which give you 240€/ha to it, it's perfect. I'm very pleased with it."*

Farmers also complained about the lack of phytosanitary options when pesticides are removed from the European official chemical list. A farmer explained this problem regarding sugar beet production, a crop that provides a better income for the farmer than other crops such as cereals; he complained that each year the list of chemicals allowed on this crop decreases, making it difficult to crop the sugar beet(Farmer 8)

Another barrier concerned the composition of the cover crops and particularly the problem of the legumes proportion in the catch crop mix. In the context of the Walloon nitrogen sustainable management plan, farmers who want to implement catch crops that include a mixture of legumes and other species can not exceed the proportion of 50% legumes of the total seeds weigh(Service Public de Wallonie, 2014). This is quite problematic for farmers who want to graze their catch crops by sheep during the winter, especially because the seeds of the legumes are bigger, and the 50% maximal proportion is quickly achieved.

Some farmers mentioned seed access as a barrier towards diversification of productions. Some species such as soja could be challenging to find, according to farmers.

Farmers who try to grow new crops but do not know how to set up the new crops may ask associations for advice. Some of them explained that they were lost in the number of associations specialized in farmer advising. Those associations that usually offer their services do not meet

the farmers' expectations in terms of accompaniment, discouraging them from sowing the new crops.

The farmers highlighted the administrative burden and its low flexibility when they are thinking twice before introducing another production on their farm. The low flexibility usually concerns specific dates related to cropping. What frustrates farmers is the fact that each year is not the same. Farmers can be not allowed to intervene in their parcels when the conditions suit the works they have to do in the field because of the fixed dates, and when they can finally do so, the wheater conditions do not allow them to work.

One of the ways to successfully diversify the productions on farms could be to transform the primary products produced on farms. Some farmers complained about the **Federal Agency for the Safety of the Food Chain(FASFC)** low flexibility and lack of advisory services.

The most critical barrier in this category explained by farmers is the CAP subsidy system. More than half of the farmers identified this barrier. They complain about the abuses of that systems(retired farmers and still earn subsidies, farmers who lease their lands and do not give the rights to the cap subsidies to the tenant,...). Those farmers are also heavily dependent on subsidies; they can not run their farms without them.

*"... Each year the subsidies decreases but the wheat price do not increase, I would like to not have any subsidies and get a fair price for my productions. In that context, there is no room for trying new crops..."*

## Socioeconomic

The socio-economic category is the most important one in terms of the barriers numbers found by farmers. Farmers often pointed to the worldwide economy and globalisation as barriers for diversifying in some specific productions. Some of them believe that the low protein price (mainly soja) is a barrier towards diversifying their productions with legumes; some of them underlined that it's more cost-effective to buy soja than to try producing a replacement for it in Wallonia. For farmers willing to produce soja that they would like to sell explained that the production cost here in Wallonia is too important and they would not be able to compete against the imports. They also underline the unfair competition with the imported products in terms of production standards compared to European production standards(allowed chemicals, nitrogen,...). Moreover, finding the markets to sell their product was also a problem that farmers worried about.

Barries more related to the farmers' situations were also mentioned, such as the lack of time and their age. The reason behind age being a barrier towards diversification of productions is that farmers explained that when they are at the end of their career, they do not want to change their farming system; they want to finish with a system they know.

Often it was encountered that farmers are advised by the same companies which are selling them the seeds, chemicals, animal feed, and fertilisers.

*« When I wanted to convert to organic agriculture and be forage and protein autonomous on my farm, I went to the companies that used to sell me the seeds and chemicals for many years and which had been advising me. I was surprised about their reactions; they told me that I'm going to destroy my farm, that I'll have weeds everywhere and that my animals will die from hunger. »*

Barriers related to the lands were identified, the land access is a known problem in Belgium, the land price is very high and increases fastly, between 2015 and 2019, the average land price increased in Wallonia by 41,8%(Notaire.be, 2020), making more difficult for farmers to afford for new parcels and to amortize them, the land access barrier was identified by most of the farmers. This financial pressure deters farmers from trying new productions for crops for a system they are used to. Another barrier related to the land is the farm surface; some farmers complained about the fact that they did not have enough land to try new crops because other lands were dedicated to a specific crop important in their system. In 36,8% interviewed farms, the land management companies were recognized to play a crucial role in the land pressure and private companies from the agribusiness sector. Land management companies are private companies that manage landowners' land; the problem is that noble people with large properties who have lent their land for decades are now taking back their land after their contract expiration and are letting the land management companies do it. Another problem is the speculation generated by private companies from the agribusiness. According to a farmer, there is also the problem that farmers and private companies do not see the agricultural land the same way; private companies and investors see the land as an investment, whereas the farmer sees it firstly as a production tool(Farmer 12)

Other than costs related to land price, other financial arguments deters farmers from diversifying. In some cases, the costs of the seeds are a barrier as well as specific machinery needed to take care of the new crops.

Farmers who tried to diversify also complained that there is a lack of facilities to support the diversification in Wallonia. Some speculations such as lamb meat in Wallonia have considerable potential; 91% of the Belgian lamb's meat is imported(Insert citation). Regarding that sector, the problem is that the slaughterhouses are closing in Wallonia, and not all of them are equipped to slaughter lambs(Farmer 9)

The most important barrier of this category is income insecurity. Farmers are under heavy financial pressure, trying a new production at the beginning my fail and this is a risk they do not want to take because of the financial stress.

“You know, if I earned more money from my production, I would try new crops, but my life is enough difficult and stressful. Everything is easier with a bit of money...”

### 3.1.3 Barriers towards diversification of productions as seen by associations

As explained previously, after interviewing farmers, relevant associations were interviewed to understand their point of view on the different barriers towards diversification of productions on farms in Wallonia and how an evolution of policies could help to overcome those barriers. A table with all the barriers was created. Some of the barriers explained by the associations were similar to the barriers presented by farmers; those barriers in each category were underlined in the table below.

Table 7: Barriers to the diversification of productions identified by associations. The common barriers reported by farmers and associations are underlined in this table. The percentages represents the proportion of farmers which identified each barrier.

Agronomic	Self-seed sufficiency	20%
	Uncertainty of the legumes quality produced at the regional level	10%
	<u>Soil's nature</u>	10%
Associative	LAG misuse	20%
	<u>Too many associations for the same topics</u>	20%
	FASFC lack of flexibility and point of view divergence	10%
Cultural	Advising	40%
	Complexity	40%
	<u>Knowledge</u>	40%
	Lack holistic advisory approach	40%
	Farmers mentality	30%
	<u>Education</u>	30%
	<u>Traditions</u>	30%
	<u>Lack of coherence between all the initiatives that support farmers</u>	20%
	Sociological	20%
Legislative	<u>CAP</u>	30%
	Lack of supports towards cooperative creation	20%
	Administrative controls process hindering the flexibility of the associations	10%
	<u>Association administrative burden</u>	10%
	European agreements (international)	10%
	Lack of support towards production diversity from the government	10%
	<u>Legislation not adapted to Conservation agriculture</u>	10%
	Lobbies	10%
	Regulation's complexity	10%
Socioeconomic	<u>Financial pressure</u>	30%
	<u>Machinery price</u>	30%
	<u>Time</u>	30%
	Lack of national/regional market	20%
	<u>Land access</u>	20%

Production diversity >< specialisation	20%
Simplification of the farming systems	10%
<u>Lack of facilities for production transformation</u>	10%
Legumes price	10%
<u>Market competitiveness</u>	10%
Research	10%
<u>Seeds costs</u>	10%
<u>Workforce</u>	10%

## Agronomic

Two new agronomic barriers were identified thanks to the associations. Firstly the uncertainty concerning the legumes quality was highlighted. According to one of the local action groups (LAG), it is difficult to predict if the legumes (because of the climatic and harvesting conditions), which could be used to diversify the farmers' production, would meet a good quality compare to other protein sources which could be found on the market. The seeds self-sufficiency is also problematic; this barrier was underlined mainly in the context of the legumes and catch crop mixes. Farmers cannot keep their seeds to sow them without paying royalties to companies deterring them from growing some of the species they would like to plant in their catch crop/cover crop mixes.

Associative This category represents all the barriers related to the associative world; thanks to the interviews with the associations, we had a better understanding of barriers directly related to the associations.

Barriers directly related to the FASFC were given. Their low flexibility, which was already explained by farmers and their point of view divergence towards the development of diversification of productions were pointed. As claimed by one of the associations, there is a will from the politics to support the short channels and the transformation on farms, which could to some extent help to valorise diversification of productions. Still, the FASFC do not help in this dynamic.

With both LAGs interviewed, we concluded that they are somehow misused in certain projects that could help diversification production. The LAGs that we interviewed did not always have the competencies for specific missions regarding farmer advising. Moreover, the LAGs budgets are voted for six years; after this period, the LAGs do not know their budget and if they'll continue to exist. This short term view is also a barrier when working with farmers on missions that would help them to complexify their production systems, which could take more than six years to set up.

Cultural The farmer's mentality came up amongst three associations as a barrier; by farmers mentality, the associations explained that the farmer's individualism and the fear of being judged

by their pairs are the most important barriers towards the diversification of productions on farms. Moreover, the lack of an open mindset was also underlined in this barrier. According to two associations, there is a lack of coherence between all the initiatives present in Wallonia that supports farmers. By incoherences, we mean that, for example; some of the associations are not used properly according to their competencies or that when there are diverging points of view between different associations advising farmers on the same farm.

The lack of a holistic advisory approach was highlighted by 40% of the associations; as reported by them the diversification of productions on farms need to be well thought to be successful, in a farming system when you add a new production it is always important to understand how this new production will fit in the system and how it can be implemented in a way that it would enhance the whole farming system. The problem is that there is a clear lack of advisors who will help farmers to understand which diversification suits the best for their system and what will be the consequences of the introduction of a product diversification in their system. This is linked to another barrier that was found, which is the complexity of the farming systems and a successful diversification of productions on farms. Associations reported that partly what deter farmers from diversification of productions in some systems is dealing with the complexity of farming systems.

## Legislative

In the associative world of the pilot centre in Wallonia, there is the problem of administrative control. Associations need to justify each of their missions; the missions need to be inline with the specific purpose of the association, in some cases associations have the skills and competences to advise farmers and would like to help them more with their questions but other missions are more important in an administrative point of view and the associations can not entirely answer the farmers demands.

The European international agreements were also mentioned as a barrier towards diversification of productions. Relating to the introduction of protein crops as a way to diversify the farm's productions, the Blair house agreements were discussed. This agreements limited the EU support for oil and protein crops which also impacted the research for varieties improvements(Westhoek et al., 2011).

The lobbies problem was also mentioned; according to one of the associations, there is a clear disadvantage for farmers in terms of their ability to being listened by the politics at the European, national and regional levels because of the industry's lobby power.

An association complained about the legislative's and regulation's complexity; those barriers can, in some cases deter farmers from trying new crops or introducing new animal production on their farm (especially in a context where farmers are willing to transform their production themselves).

Two associations expressed that there is a lack of supports for cooperative creation in Wallonia. They see the cooperative creation as a way for farmers to organise themselves and be able to sell their production for a better price, they are convinced that this would be an incentive for farmers to diversify their production because they'll be able to get a better price for their production and be sure that the new production would be profitable.

Furthermore, 30% of the interviewed associations explained that the CAP is not made in a way to support diversification of productions. However, new points of views emerged from those interviews, and it is important to explain them, such as the difficulty to have a radical change in the CAP because of the fact that a lot of farmers from a specific farming systems relies on those subsidies and if the way the CAP subsidies are distributed are changed, it will highly impact the majority of farmers.

## Socio-economic

The socio-economic barriers found in thanks to associations were similar to those found thanks to the farmers; out of 13 barriers, eight were identical.

One of the barriers mentioned was the simplification of the farming system. The associations explain that the farming system's simplification and intensification don't allow space for product diversification on farms.

*“The financial pressure generated by the loan taken by the farmers to intensify their system and to be as efficient as possible has gone through its simplification. Now that farmers have this financial pressure, it's difficult for them to look for new productions to introduce in their systems”.*

Furthermore, there is a need for research according to the associations; there is a lack of research in fields that could increase the production diversity on farms, such as conservation agriculture. The association mentioned a need for research to adapt the conservation agriculture technique to the different soils and Wallonia pedoclimatic specificities.

The lack of national and regional market was also underlined by two associations, as explained by those associations, some crops such as legumes need a market for them to be more developed, again one of the reasons behind this lack of market could be the import concurrence from countries outside the European union.

### 3.1.4 Policies influencing the diversification of productions in Wallonia

This section summarizes the policies which affect the diversification of productions in Wallonia according to the interviews with farmers and associations. The aim of this section is to answer the research question:

- *What are the policies that affect or affect the development of agroforestry and diversification of productions in Wallonia?*

Most of the farmers interviewed were depended on the CAP subsidies on their farms. As explained earlier, the way the CAP supports farmers (especially throughout the direct payments), favoured the increase of the farm surface and the intensification and specialization of their systems. Moreover, more than half of the farmers and one-third of the association interviewed for the diversification of productions explained that the CAP influence the diversification of productions in Wallonia. Apart from the direct payments, the agro-environmental measures from the rural development program can impact the farmers' crop choice.

The Federal public service and the European food safety authority (EFSA) also plays a role in the crop diversification in Wallonia throughout the authorizations of chemicals allowed at European and Walloon levels. As explained earlier, farmers complained about the increasing difficulty of growing crops such as the sugar beet because of the ban of some chemicals.

Farmers also complain about the rights to plant and sell their seeds, especially in conservation agriculture and cover-crop sowing. The agency responsible for the seed's regulation is the CPVO.

Figure 5: Figure representing the policies impacting the production diversification in Wallonia.



The European agreements such as the Blaire house agreements impact the diversification of productions regarding the protein and oil's seed crop productions.

Throughout the funding of the pilot centres and relay hall, the Wallon region indirectly supports the diversification of productions in Wallonia. The pilot centres advise farmers and research on topics such the forage productions, protein crops, ...

As explained earlier, the FASFC impacts the decision-making process of the farmer's diversification of production strategies. All the food safety policies in Belgium are written by the FASFC who interprets the food safety guidelines written by the EFSA.

## 3.2 Agroforestry

### 3.2.1 Farm categories

As with the diversification of productions, the first part of the analysis of the results consisted of categorising the interviewed farms depending on the agroforestry type they are practising and the Rodger's curve.

Apart from presenting the categories, the aim of this section is also to answer the following research question:

- *What is the farmers' decision-making process of implementing agroforestry in Wallonia?*

Table 8 below summarizes the main information related to the interviewed farms. At the same time, table 9 outlines the reasons of agroforestry adoption.

*Table 8: Table representing the characteristics of the farms interviewed for agroforestry.*

Category	Minimal surface (ha)	Mean surface (ha)	Maximum surface (ha)	Number of farmers interviewed
Silvoarable	100	225	300	5
Silvopastorable	50	93	150	5
Silvopastorable and Silvoarable	12	104	210	3
Not practising argoforesy	175	254	320	4

Table 9: This table summarizes the reasons for agroforestry adoption for the two innovators and early adopters categories from the Roger's curve.

Category	Reason	Percentage
Innovators	Biodiversity	100%
	Production diversification	80%
	Soil erosion	60%
	Animal welfare	60%
	Organic matter	40%
	Landscape	40%
	For agroecology	20%
	Sustainable intensification	20%
Early adopters	Production diversification	88%
	Soil erosion	50%
	Animal welfare	50%
	Biodiversity	50%
	Organic matter	38%
	Landscape	13%
	Subsidy	13%
	For agroecology	13%

## Silvoarable agroforestry farms

As shown within table 17 the farms interviewed for the silvoarable agroforestry were all in a specialised crop system, and their surface mean surface was around 224,8 ha. All the farms from this category are present in the limoneuse region, the region with the most fertile land and known in Belgium from the big open field plains with almost only cropland

## Silvopastorable agroforestry farms

The farms within this category are composed of two main farming systems having a livestock compound. Out of the five farms of this category, four are present in an agricultural region characterized by the important presence of pastures. The specialised livestock farms were, on average, half of the size of the mixed crop-livestock farms. The main reason for the farmers from this category to plant trees and hedgerows was animal welfare; 80% of the farmers explained this reason. More than half of the farmers within this category mentioned agronomic reasons such as organic matter and soil erosion.

## Silvoarable and silvopastorable agroforestry

Logically all the farms from this category conduct a mixed crop-livestock farming system. The farms were sampled from three regions that have different pedoclimatic characteristics (Ardennes, Limoneuse and Condroz regions). All farmers from this category were organic and sensitive to biodiversity. This could explain why they set up agroforestry on their farms for biodiversity

reasons. Moreover, all of them explained that animal welfare is very important for them, and implementing agroforestry, for this reason, was evidence. Two out of the three farmers planted threes and hedgerows to improve soil organic matter and limit soil erosion.

### Farms not practising agroforestry

This category is represented only by farmers who have specialised crop systems. The farm has a big size with a 253.8 ha mean surface. Any of those farms are organic, and three of them come from a cropping region.

### Innovators

The innovator's farmers are the farmers who were the first to start agroforestry in Wallonia many years ago and who deeply believe in it. The farmers in this category are very sensitive towards biodiversity, and 80% of them planted it for production diversification reasons. Agronomic reasons such as soil erosion and organic matter improvement were also mentioned. As well as animal welfare for farmers which had implemented silvopastorable agroforestry.

### Early adopters

The early adopters are the farmers who have implemented agroforestry recently on their farms. They are comfortable taking the social and financial risks of the agroforestry implementation on their farm and understand its potential. 88% of them implemented agroforestry for production diversification reasons. Half of them implement it for soil erosion, biodiversity and animal welfare reasons.

### Laggers

The lagger's category mostly represents the farmers who did not implement agroforestry and are not convinced about it.

## 3.2.2 Associations

### 3.2.3 Barriers towards agroforestry explained by farmers

The barriers towards agroforestry Wallonia which farmers explained are divided in six categories.

*Table 10: Barriers to agroforestry development identified by farmers. The percentages represents the proportion of farmers which identified each barrier.*

Agronomic	Trees and hedgerows decrease the productivity (divides the parcels, make shade, uses fertilizer and water)	35%
	Do not match with the farmer's system	12%
	Can bring some pest for the crops	12%

Cultural	Productivism mentality, psychological	47%
	Knowledge	12%
Economic	Lack of financial short term profitability of agroforestry	29%
	Land pressure (Agriland) and access to the land	29%
	Belgian wood industry not suited for small wood quantities (lack of sawmills, ...)	12%
Legislative	Administrative burden and lack of flexibility (controls)	41%
	Headgerows pruning date	35%
	Land lease low problematic	24%
	Lack of a long term view concerning the subsidies and regulations	18%
	No confident with the evolution of the subsidies	6%
	The slowness of the administration for the subsidies	6%
Sociological	Neighbours and the social pressure	29%
	Fear of not being to remove the trees later on (not being the master of our owns lands)	18%
	Do not see the advantages of agroforestry	18%
	Trees are for woodlands	12%
	The more important agroforestry project are done by nobles	6%
	Only profitable with the subsidies	6%
	Lack of objectivity from the agroforestry meetings	6%
Traditions	6%	
Technical	Maintenance	59%
	Machinery	47%
	Technical (tractors mirrors, sprayer dimension)	18%
	Difficulty to work with GPS and trees	6%
	Workforce	6%
	Waiting time for quality plants	6%
	Animal protection	6%

## Agronomic

According to farmers, three agronomic barriers hinder them from setting up agroforestry on their farms. The major agronomic barrier is that the farmers believe that trees and hedgerows will decrease the productivity of their land. The reason for this decrease in productivity is, according to farmers the fact that the trees alignments will divide the parcels into smaller plots which means that they would have to do more maneuvers and lose time; another reason is that the agroforestry elements would bring some shade to crops and will utilise the fertiliser and water that the crops need decreasing the yields.

*“My grandparents and parents work out hard to remove the hedgerows and trees to make nice fields which are easy to work on and they would like us to plant trees again. You can do anything but, when you have a lot of corners in your land and angles, you loose productivity because you’ll fertilise twice at the same spot, ...”*

Also the other barriers applies to the pest could come alongside the hedgerows and trees. One farmer explained that he has problems with the wood pigeon which eats the seeds after plantation.

According to him, planting hedgerows would make a habitat for this species which he is fighting against. Another farmer complained about the fact that hedgerows would bring unwanted insects near to his crops.

The last agronomic barrier explained by farmers is the fact that they believe agroforestry do not match with their farming system (conventional and specialised in crops). According to them agroforestry suits best for organic livestock farmers which would like to protect their animals from the sun and wind.

## Cultural

Two barriers represent this category. The first one is knowledge; the farmers explained to us that they know not enough about agroforestry to set it up on their farm and if they would hear more about the advantages that it could have on their farm, maybe they would start planting trees and hedgerows on their farm.

The second barrier is the productivism mentality; almost half of the farmers mentioned that the productivism mentality is a clear barrier towards agroforestry development in Wallonia.

*“Every centimetre count for some farmers; they would be sick to see hedgerows or trees alignments in the middle of crops”.*

## Economic

Three barriers compose this category. The land pressure and access were mentioned by 29% of the farmers. Because of the speculation on the agricultural lands by private companies and investors which see agricultural land as safe invest, the price increase to such a point that when farmers are able to buy it and want to amortize it, they want the land to be the most productive. Thus the farmers do not see agroforestry as a good solution since the place taken by the trees will not be cropped (farmer 20)

The lack of short term profitability also question the farmers. The farmers would need to wait several years before they manage to have an income from the agroforestry elements; the problem is that their financial situation often doesn't allow them for such conditions.

Lastly, the farmers explain that the belgian wood industry is not suited for agroforestry plantations. The low amount of trees planted per hectare and the cutting costs will be very important compared to the wood price, according to farmers who already have experience within the wood industry.

## Legislative

Farmers complained about the lack of a long term view concerning the subsidies and regulations; they explained that they see their CAP subsidies decreasing each year and are afraid that the

subsidies given for the agroforestry in Wallonia would decrease over time. Many farmers explained that many years ago subsidies were given for the hedgerows removal and now the fact that subsidies are given to bring back those hedgerows makes them feel uncertain about the agroforestry plantations.

The land lease law is also problematic that 24% of the farmers highlighted, most of the farmers interviewed in Wallonia lease land from a landlord. The problem here is that the farmers are not sure if they would be allowed to plant on the owner's property and how the agroforestry systems would be managed overtime on land under lease law contracts.

According to farmers, the administrative burden and the lack of flexibility from the administration is also a barrier to the agroforestry development in Wallonia. Almost half of them underlined this barrier.

*“You know, I don't want to declare hedgerows and get the subsidy because I'm afraid of the controls; if I plant a hedgerow and I want to remove a part of it to make more space to enter in the property I would like first to be able to do it and second I don't want to fill any forms to do it. If I declare it and get subsidies, I'm opening the door for controls, fines, and problems. I don't want that.”*

Finally, the dates between the farmers are allowed to prune the hedgerows was mentioned by more than one-third of the farmers. In Wallonia, farmers are banned from pruning hedgerows between the first of April and the 31st of July. Farmers explain that those dates are too strict and would like to have more flexibility.

## Psychological

Farmers explained several psychological barriers because of Walloon law protecting the trees and hedgerows; some farmers explained that they were afraid of not being allowed to remove the hedgerows or the trees when needed. Moreover, a farmer which had implement agroforestry explained that even though he knew planting the agroforestry systems on his property was the right decision, still it was psychologically difficult for him to plant and see the trees in his cropped lands. (Farmer 22)

Another barrier was the neighbours and social pressure. What other surrounding farmers may think and their sayings are concerns of farmers. Some farmers are also afraid about problems they may get with their neighbours if they plant trees and hedgerows alongside their properties.

Also, there are stereotypes such as that trees are for woodlands, some farmers deeply believe that planting trees only suits for woodlands and not for agricultural land or that agroforestry is only profitable with subsidies.

## Technical

The maintenance of agroforestry systems came up in 59% of the interviews. The farmers are aware of the possible maintenance costs of agroforestry systems and underline the fact that the subsidies for hedgerow maintenance are not sufficient to cover the maintenance. Some of them planted more than ten kilometres of hedgerows and are now looking to buy machinery for pruning them.

The machinery barrier was explained by almost half of the farmers, for them trees alignments are obstacles for their machinery and could bring some damages to their tractors (mirrors because of the branches).

*“When you have cropping systems, you need to design the agroforestry systems in terms of the machinery. But the machinery evolved in times and are always bigger and bigger. Moreover, I buy machinery in common with other farmers, and I won’t argue with another farmer if I need a shorter header to match the agroforestry display on my farm when the other farmer wants a longer header.”*

Another problem is that agroforestry may be not compatible with GPS systems on tractors. Farmers explained that the GPS systems tend to not work properly alongside forest strips.

There is also the problem of the waiting for quality plants; this barrier is more specific to the high stem orchards plantations. The problem is that the high stem orchards plantation gain in popularity in Wallonia because of the subsidies to the point that the waiting time to get the plants are at least a year.

### 3.2.4 Barriers towards agroforestry explained by the associations

The barriers towards agroforestry explained by the associations were divided into five categories. The underlined barriers are also present in the barriers explained by the farmers.

*Table 11: Barriers to agroforestry development identified by associations. The percentages represents the proportion of farmers which identified each barrier. The common barriers reported by farmers and associations are underlined in this table.*

Cultural	<u>Knowledge (about agroforestry, hedgerows maintenance,...)</u>	60%
	Lack of cooperation from the major wallon syndicat	20%
	<u>Productivism</u>	20%
	Schools	20%
Economic	Competitivity from the forest wood	20%
	Financial loss for farmers	20%
	<u>Short term profitability loss</u>	20%
	Wood price incertainty	20%
Legislative	<u>Lease law</u>	60%
	Agroforestry status not clear within the walse lease law	40%

	Trees and hedgerows law protection incompatible with agroforestry	40%
	AEM incomptability with some agroforestry systems	20%
	CODT specific barriers (definitions, ....)	20%
	Lack of subsidies for short rotation coppice	20%
	Legislative complexity	20%
	Low maintenance subsidy	20%
Sociological	Sociological barriers	60%
	Farmer's age	20%
	<u>Neighbours</u>	20%
Technical	Cartography problems when asking for CAP subsidy	20%
	<u>Maintenance</u>	20%

## Cultural

The lack of cooperation from the major Walloon syndicat concerning agroforestry is a barrier, according to the AWAF association. The syndicats have a communication and influence power on farmers and the politics, if they not believe in agroforestry, this will not help farmers to change their opinion about it. In the same way, during many years, agroforestry did not have any interest from the schools according to one of the associations, this do not help agroforestry to be more known and understood by the future farmers and agronomists, especially when 60% of the associations have identified the lack of knowledge as a barrier towards agroforestry development in Wallonia.

## Economic

One of the associations explained that the competitiveness of the forest wood could impact the agroforestry development in Wallonia because the forest is cheaper to produce and harvest than agroforestry produced wood. Another barrier was the short term profitability loss from agroforestry implementation, according to one of the associations the short term loss due to the agroforestry plantation is not compensated by the subsidies and this hinders farmers from setting up those systems.

## Legislative

The legislative barrier explained by the associations touch upon different levels of legislation. Apparently, at the European level, there is a lack of compatibility when the farmers want to couple agroforestry elements with some AEMs. For example, if a farmer wants to plant a landscape strip alongside a hedgerow and ask for the AEM "landscape strip" he is not allowed to drive with any motorised vehicles, creating a problem for the hedgerow pruning.

The land lease law was underlined at a regional level in 60% of the associations' interviews. According to NFT, in Wallonia, between 60 and 70% of the total farming surface is under lease low contracts. And within the land lease law, some specificities are hindering the agroforestry

plantations, such as the fact that the lessor is not allowed to make plantation on the leased land during the lease. This is an imperative disposition, which means that even though within the lease contract, there is a clause that stipulates that the lessor can plant trees on the property at any time during the contract, this clause could be overruled by the tenant because of the imperative quality of the disposition. Regarding the tenant-right, the tenant can not do any new plantation without a written agreement of the lessor. The deal could be included with a clause within the contract or a written agreement could be made during the contact.

At a territorial level, the code de développement territorial (CODT) or the regional development code set the rules for the plantation, removing and maintaining trees, hedgerows, and shrubs. This regional development code is a problem for farmers regarding their rights to remove and modify agroforestry plantation in their property. Until recently, there was no definition of agroforestry in this code, making it difficult for farmers who planted to know if they could remove or maintain their plantations without any problems. In Wallonia, if the hedgerows, trees or shrubs meet some characteristics, the owner needs to ask for an urban permit for their maintenance. The problem is that agroforestry elements could easily fulfil those characteristics increasing the administrative burden for the farmers.

Moreover, farmers need to respect some rules concerning the plantation distances from neighbours properties if he wants to do any plantations alongside the boundaries of a neighbour's property, those rules are written in the called rural code.

All those different legislation which the farmers needs to face when he wants to plant agroforestry systems on his farms are very complex and according to one of the associations this could be hinders farmers from planting agroforestry systems.

Agroforestry in Wallonia is not subsidised throughout the CAP but throughout the government. However, the problem is that some agroforestry systems with a higher short term revenue such as the fast rotation coppice are not subsidised. Having a subsidy regarding that agroforestry systems could be a solution against the problematic of the financial loss created by the agroforestry plantation.

Moreover, the lack of subsidy for maintenance was also highlighted; the plantation cost could be covered up to 80% thanks to the government "Yes we *plant*" program but the maintenance subsidy are too low, according to the AWAF that support would need to be six times higher to cover the maintenance costs. The amount of subsidies given by the Walloon government could be seen in the appendix V.

## Sociological

According to 60% of the associations, sociological barriers are one of the most important barriers to developing agroforestry in Wallonia.

*“For me sociological barriers play an important role in the slowness of agroforestry development, a lot farmers are against it and always will, those farmers do not have also an impact on the neighbour farmers around them, some farmers which would be keen on trying agroforestry are afraid about what the neighbours would say, the farmers’ age play also a significant role. The average farmers age in Wallonia is quite old, and those farmers are not keen on investing in something they would not have the fruits of.”*

**Technical**

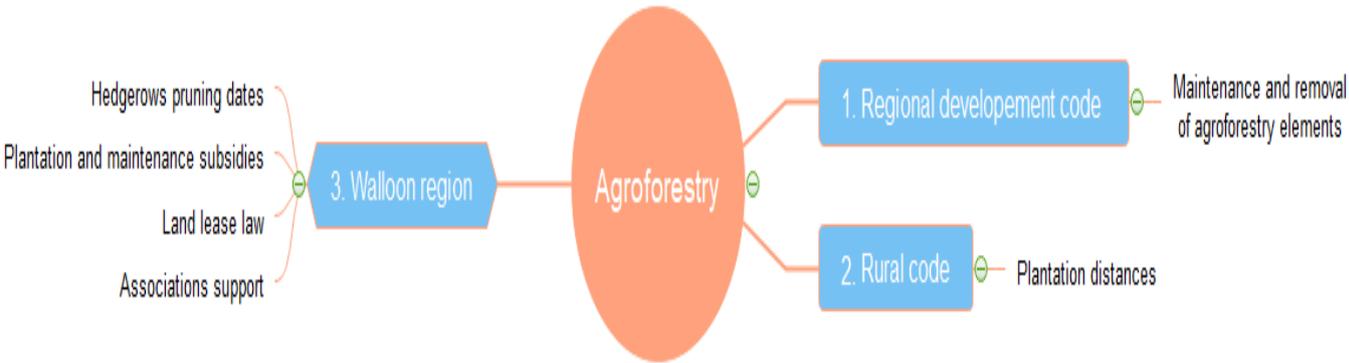
The maintenance barrier came alongside with the cartography problems when farmers fulfill their CAP declaration online. It is complicated to locate precisely the agroforestry elements on the map.

**3.2.5 Policies influencing the adoption of agroforestry in Wallonia**

During the interviews with farmers and associations, policies that affect the adoption of agroforestry were identified. Those policies are summarized in this section. This section aims to answer the research question:

- *What are the policies that affect the development of agroforestry in Wallonia?*

Figure 6: Figure representing summarizing the policies influencing the agroforestry adoption in Wallonia found during the interviews with farmers and associations.



**Regional development code**

As explained earlier, the regional development code set up the rules for the plantation, maintenance and removal of trees, shrubs and hedgerows in Wallonia. In some cases this code hinders the farmers from planting hedgerows or agroforestry elements because of their fear of not being allowed to remove those elements after the plantation.

**Rural code**

The rural code set up the rules for the plantation distance between two properties. If the farmers which has planted the agroforestry systems haven't followed the legal plantations distances it could be forced to remove the agroforestry elements.

## The Walloon region

The Walloon region influences the agroforestry adoption in many ways. Firstly the land lease law as state by farmers hinders them to set up agroforestry plantations on lease land because it is not adapted for agroforestry.

Secondly the Walloon region throughout different supports help the developement of agroforestry in Wallonia. The nature of the supports are various such as subsidies for plantation and maintenance of trees and hedgerows or the financial supports for the research and development of agroforestry project in Wallonia.

And thirdly the Walloon region influences influences the agroforestry adoption throughout policies such as the hedgerows pruning dates.

## 4 Discussion

- What are the policies that affect or affect the development of agroforestry and diversification of productions in Wallonia?
- How can policies be improved in the future for better development of diversified production and agroforestry systems?

### 4.1 Adoption of agroforestry and diversification of productions in Wallonia

In this section, we will discuss how the research answer the following research questions:

- **RQ1:** *What is the farmers' decision-making process of implementing agroforestry and diversification of productions in Wallonia?*
- **RQ2:** *What are the main barriers to the development of agroforestry and diversification of productions in Wallonia?*

Many barriers were identified in this study regarding the implementation of agroforestry and diversification of productions. In this section, the main reasons and barriers to production diversification will be discussed.

### **4.1.1 Diversification of productions**

First of all, we would like to underline that in Wallonia, farmers' farming system chosen by farmers would depend on the agricultural region (Ferraton and Touzard, 2009). The farms located in the area with the most favourable cropping conditions (such as the Limoneuse or the Condroz region) were usually the more diversified in terms of the number of crops present on their farm. In their study, McCord et al. concluded that the favourable growing conditions might positively impact crop diversification adoption by farmers (McCord et al., 2015). This was also highlighted in the barriers explained by farmers

Moreover, in their paper, Ridier et al. explained that the positive agronomic outcomes from crop diversification are highly appreciated by farmers (Ridier et al., 2021). In our study, this reason was mentioned in all the categories related to the diversification of productions.

Our study also showed that farmers mainly chose to diversify their productions to diversify the sources of their incomes. Ricome et al. suggested that there might be links between farmers' crop diversification choices and risk management strategies (Ricome et al., 2016, Ridier et al., 2021). This role of risk management within the farmer's decision-making process was also seen in the barriers explained by farmers throughout the income insecurity barrier, which was the most important socio-economic barrier.

Processing farm commodities could be a way to diversify their activities and increase the income from the primary product of the farm (Augère-Granier, 2016, Bachev, 2012). The farms with animals are more likely to set up production diversification activities than the specialized crop farms (Augère-Granier, 2016). Our study found that farmers, who wanted to add a new animal production on their farm, often had the plan to implement this new animal production alongside its process on the farm and its direct selling. And those farmers were the ones who complained about the FASFC low flexibility and the lack of facilities, deterring them in some cases to implement the new productions.

Crop diversification practises such as intercropping can be difficult to manage by farmers (Paut et al., 2020). Our study showed that the knowledge barrier was highlighted when it came to the diversification of productions. This was often the case when farmers wanted to implement crop associations such as wheat-peas or implement complex cover-crop mixes in a soil conservation approach.

### **4.1.2 Agroforestry**

As explained by Baret et al., to understand why the agriculture transition towards more sustainable farming systems is so slow, we need to understand the concept of socio-technical lock-in (Baret et al., 2013). In the same way, Louah et al. explain that the development of agroforestry is hindered by a cognitive lock-in and path dependency (Louah et al., 2017). Path

dependency consist of the concept that farmers do not accept new technology because of the old one, hindering them from adopting new technologies(Csonka et al., 2019). In many cases this path dependency causes a cognitive lock-in(Stassart and Jamar, 2008). Moreover, we suggest that agroforestry could be seen as an innovation whose adoption follows Rodger's adoption curve (see figure 4). Even though agroforestry was practised for centuries in Wallonia by farmers throughout the hedgerows networks and grazed orchards(Louah et al., 2017) before the concept of "agroforestry" was defined agroforestry and more particularly silvoarable agroforestry could be seen as an innovation since this practice relatively new for farmers in Wallonia. Agroforestry in Wallonia is still at its early stage as explained by Louah et al; there is still no "*mature*" agroforestry plantation in Wallonia(Louah et al., 2017).

According to this fact and what we saw on the field with farmer, we think that within Rodger's adoption curve, we are at the very beginning and that most of the farmers interviewed which had planted many years ago agroforestry systems are in the "*innovators*" section of Rodger's curve whereas the other interviewed farmers which have agroforestry systems recently are within the "*early adopters*" section. What comforts us in the fact we consider all the farmers that has adopted agroforestry systems on their land is that when the farmers told us that even without the subsidy given by the Walloon region for the plantation, they would have done it anyway, they are convinced about agroforestry and nothing would have stopped them from setting it up on their farm. It is important to precise that three farmers interviewed who set up agroforestry on their farm came from noble families, helping them overcome the economic barrier. However, the rest of the farmers explained that the subsidies given by the Walloon region helped to achieve faster their agroforestry project on their farm.

Because of this lack of "*mature*" agroforestry plantation, we believe that there is still no farmers in the "*early majority*" section of the curve. Regarding that aspect, we think that agroforestry has still significant development potential in the coming years. The interviewed farmers who didn't implement agroforestry on their farms could be put in the "*laggards*". Suppose the laggards do not represent an important part of the possible adopters of agroforestry; their inputs were not meaningful regarding the development of agroforestry in Wallonia. However, some of the farmers from this category could be put in the late majority, depending on how influential they are.

## **4.2 Policies influencing the development of agroforestry and diversification of production in Wallonia**

In this section, we will discuss how the research answered the following research questions :

- **RQ3:** *What are the policies that affect the development of agroforestry and diversification of productions in Wallonia*
- **RQ4:** *How do policies influence the development of agroecology and, more particularly, agroforestry and diversification of productions in Wallonia?*

### **4.2.1 Diversification of the productions**

Numerous policies influencing the diversification of production in Wallonia were found. As explained earlier, the CAP works to support specialized and intensive agriculture (Emmerson et al., 2016). However, our research found that specialized farming such as the specialized crop could also be diversified; when we look at our study, the specialized crop farmers could crop up to ten crops on their farm. The only CAP policy from the first pillar that could impact the production diversification in Wallonia could be the crop diversification rule for the greening payments. Still, any farmer explained that this measure had affected their cropping choices in the past when the greening of the CAP was set up. All the sampled cropping either more than three crops or having an important proportion of their lands covered by pastures. The low potential effect of the crop diversification rule was already mentioned by Louhichi et al., who estimated that this crop diversification rule would affect only five per cent of the EU farmers (Louhichi et al., 2017). In 2015 only one percent of the farmers in Wallonia did not meet the requirements to comply with the crop diversification rule (Burny and Gaziński, 2018). The only CAP policies which seemed to foster crop diversification were the AEMs throughout the subsidies given for legumes-cereals crops and LAGs throughout some of their missions which help farmers set up projects on their farms.

Policies related to the seeds regulations were also identified in our study. Farmers and associations explained a need for adapted seeds varieties to diversify crop production towards grain legumes. Magrini et al. explain in their study that there is an important problem regarding the low number of available legumes varieties compared to cereals (Magrini et al., 2019).

The lack of authorized phytosanitary products for minor crops could be a barrier to the diversification of crop production (Meynard et al., 2018). In their paper, Meynard et al. explain that the path to register a pesticide for a crop costs a significant sum of money. In some cases, the companies producing those pesticides do not want to invest because of the possible low returns (Meynard et al., 2018). Regarding our study, we had the same problem with the chemical which needed to be used peas-cereals mixes, and the necessary chemical to be used on those crops was only registered for one of the species in the mix. Moreover, we identified that the decrease of authorized chemicals on crops could make the farmers to stop cropping some specific crops such as the sugar beet. However, we think that if the relevant agencies ban those chemicals, there is a reason for it and that farmers should find new ways of fighting the diseases.

## 4.2.2 Agroforestry

As explained earlier, agroforestry adoption in Wallonia mostly depends on the cognitive lock-in linked to innovations. Policies impact agroforestry development in Wallonia in lower case, and they are mostly related to regional law and institutions. Moreover, Wallonia does not support agroforestry throughout any CAP policies, apart from the ecological focused area, which the Walloon government chose to consider some agroforestry elements(see APPENDICE XX).

The more important policy that we found which impacts the agroforestry development is the lease law. This was also the case in other studies in Wallonia(Louah et al., 2017) and Flanders,i.e the northern part of Belgium(Borremans, 2019). In their research Louah et al. explain that the farmers interviewed in their study would be keener on planting trees on the lands they own rather than on the leased land, which is problematic when we know that 75% of the Walloon agricultural land is under the lease law(Louah et al., 2017). Moreover, Borremans explains in his study done in Flanders that Flanders' lack of legislative framework is one of the major obstacles towards developing agroforestry in Flanders(Borremans, 2019); in our case, we found the situation similar in Wallonia. The regional development code, land lease law and the rural code are still not adapted for agroforestry in Wallonia and can deter farmers from adopting it.

Louah et al. explained in 2017 that the cognitive lock-in might underlie political and institutional barriers(Louah et al., 2017). Regarding that fact, we think that the situation has evolved in Wallonia since the Louah et al. research. Since 2020 the new Walloon minister for the environment doubled the subsidies for plantation of hedgerows and trees alignments in Wallonia, resulting in horticulturalists being out of stock of high stem old fruit varieties (which are the only fruit tree varieties eligible for the plantation subsidies). Moreover, the same minister gave fundings for a plan to create a Walloon nuts market.

Relating to the pruning dates, which seems to be a problem for many farmers in our study, according to associations, those pruning dates are not restrictive and will be a no-sense to subsidy hedgerows plantation for biodiversity without creating a framework for a sustainable hedgerows maintenance.

## 4.3 Recommendations for policies improvement to supports the diversification of productions and agroforestry in Wallonia

In this section, we will suggest what policies improvement are needed to supports the diversification of productions and agroforestry in Wallonia. This section will answered the following research questions :

- **RQ5:** *How can policies be improved in the future for better development of diversified production and agroforestry systems?*

### **4.3.1 Frame a legal framework for agroforestry**

The first recommendations would be to create and adapt the Walloon legal framework for agroforestry. By that we mean, clear definition in the rural code and regional development code as well and adapt the legal framework to agroforestry specificities as well as recognise it for its wood production use. Regarding the lease law, agroforestry should be defined as a practice which maintains the quality of the property to help tenants and landlords to implement agroforestry freely.

### **4.3.2 Continue to support the farmer's cooperative creation**

We suggest that supporting the cooperative creation would be a good solution for overcoming the barriers of income insecurity, subsidies dependency, market creation farmers individualism.

Regarding to the nature of the supports for cooperative creation, we mainly think that human resource supports is necessary, as explained by Bijman et al. the cooperative creation requires several social, economic, organisational and legislative competencies which farmers may not have (Bijman et al., 2012). If in Wallonia, we are lucky to have support for the cooperative creation, there is a need for this support to be continued. The Walloon region is supporting the producers groupements and cooperative creation throughout the "agricultural hall". Supports for this kind of initiatives need to be maintained.

### **4.3.3 Enhancing the diversification of productions in the function of the farming system**

As explained earlier, we found that specialized crop farming systems, although specialized could have a high crop production diversity; on the other hand, specialized livestock systems generally have a low crop diversity mainly because of the soil's nature. If we want to increase the diversification of productions, the challenges would be different depending on the farming systems. The best leverage to increase production diversity to the specialised systems is to try to integrate them at a regional level rather than at a farm level, the aim would be to create integrated crop-livestock systems at a regional level. This idea was also explained by Lemaire et al. (2014) where they underline the fact that the integration of livestock-crop systems at a regional level could be a solution towards a sustainable transition which take into consideration the needs of some territories to keep specialised farms systems in place (Lemaire et al., 2014). A good example of this kind of integration is the cover crop grazing by sheep, which is a practice expanding in Wallonia alongside the sheep sector. The sheep farmer bring their sheep to eat the cover crop or the rapeseed regrowth after the harvest, this help the specialized crop farmers to destroy their cover crop which they would to do it mechanically, the sheep will give "free manure", and in exchange, the sheep farmer has a new rich fodder source for his sheep. Another positive aspect for the specialised crop farmer is that the cover crop grazing can reduce the cost of the cover

thanks to the graze lease contract(McKenzie et al., 2017). However, the legislation does not suit this kind of system and needs to evolve.

#### **4.3.4 Update the cover crop/catch crop plantation rules**

Concerning the production diversity at the plot level, we recommend updating the rules concerning the proportion of legumes in the mixes is based on the legumes weight but the problem is that the legumes' seeds usually weight more than other seed's crop in the mix. Moreover, the seeds costs for the plantation of cover crops is an important expense for farmers. However, the farmers are not allowed to reuse their seeds without paying royalties, we propose that the royalties rules should not be applied if the farmer wants to use the seeds for cover crop purposes.

#### **4.3.5 Creation of pasture contract for grazed cover crops**

The sheep sector is developing consistently in Wallonia, and there is an emergence of a new practice, cover crops grazing. The concept consists of grazing the cover crops and catch crops by sheep to help their destruction. Favouring this practice could help develop diversification of productions at a regional level with livestock farmers bringing animals into specialised crop farmers. The problem is that this practice is not included in the livestock units (LSU) calculation when the nitrogen pressure is calculated on the farm to meet the sustainable nitrogen management plan. We recommend the creation of cover crop grazing contract for that problem, which could be considered in the nitrogen pressure calculations. S

#### **4.3.6 Support the community creation around agroforestry market**

This is a regional level we believe that they should be supports for the community creation around agroforestry. The nature of this should be human to organise the market creation for agroforestry products by farmers communities. The supports should be also financial for example if a groupement of farmers decides to invest in common on some machinery, they would have financial support. This could help to overcome the maintenance barriers explained by farmers, if they have support to buy machinery to maintain the hedgerows they maybe would be more keen on planting more of it and incentive other farmers to set up agroforestry on their farm by allowing them to be part of this community.

#### **4.3.7 At the CAP level, the creation of an AEM specific to agroforestry.**

Studies have shown that agroforestry has positive impacts on biodiversity(Torralba et al., 2016, Jose et al., 2004). We believe that the creation of a specific AEM for agroforestry could be a good solution to support farmers. This recommendation could help to lift the barrier of farmers worries about the loss of profitability and the maintenance costs. Moreover, we found in the literature that at the CAP level other recommendations were provided to help the agroforestry development at European level in the AGFORWARD project(Mosquera-Losada et al., 2017).

### **4.3.8 Stimulate the development of short term profitable agroforestry systems**

This recommendation would concern the development of short term profitable agroforestry systems. Often the profitability barrier came up, and the fact that agroforestry would take productive lands and lower the farmer profitability. One of the solutions would be to stimulate agroforestry systems which in short period of time (from five years) would bring an income or compensate the potential profitability loss. One solution would be to support the short rotation coppice plantation through a pull market approach from the public sector. The short rotation coppice (SRC) could be harvested after already after three-four years (Bullard et al., 2002), the harvested wood chips could be used to produce heat to, for example, heat public buildings (schools, swimming pools, offices, ...).

### **4.3.9 Legislate the farmer's advisory context**

We believe that there is a need to legislate at the Walloon level a law that would ban, the companies which sell the seeds, feed, chemicals and fertiliser to advise farmers on how they should run their farm. We had examples of farmers who told us that some of the companies they used to buy all their chemicals, fertilisers, seeds and feed hindered them from going organic and trying to reach the proteic and fodder autonomy on their farm throughout the implementation of new crop varieties.

### **4.3.10 Creation of a land distribution organisation**

The land pressure and access in Wallonia rely on the fact that farmers who have an important financial pressure cannot buy lands anymore because of the land price soaring; only the biggest farms can give an important price for land thanks to their economic power.

We propose that creating an organization that could distribute the land, such as the SAFER in France, would be a good solution to that problem.

## **5 Conclusion**

This study aimed to understand how policies influence the development of diversification of production and agroforestry in Wallonia. To achieve that, we first tried to understand the main reasons and barriers towards adopting production diversification and agroforestry adoption in Wallonia. We conclude that agroforestry in Wallonia is at its beginning and still has an important journey in front; the cognitive lock-in mainly influences the slow adoption process it's under and the lack of a specific legal framework. The financial pressure and lack of quick financial return also seemed like one of the main barriers. Regarding the diversification of productions in Wallonia, we understood that there is an important difference in the numbers of productions in the function of the farming systems, with specialized crop farmers and mixed livestock-crop farmers having in

average a high number of production compared to the specialized livestock. The main drivers for the adoption of diversification of productions were the diversification of incomes, the good pedoclimatic conditions, and market opportunities. In the same way, the main barriers towards diversification of productions at a farm level in Wallonia were the poor soil conditions of some regions, the strict hygienic rule for small on-farm transformation units and the lack of knowledge.

After understanding the main reasons and barriers for the diversification of productions and agroforestry adoption were, we tried to understand the policies that influence their development in Wallonia. We understood that the regional laws and policies mainly influenced agroforestry. We found that the diversification of productions is affected European and Belgian policies regarding the authorized seeds and pesticides allowed on the Walloon territory, limiting the options for setting up intercropping practices and the cropping of some crops (such as legumes). The associations' support by European and regional funding also positively impact the diversification of productions. Those associations (LAGs, pilot centres) advise farmers and can help them set diverse productions on their farms with honest advice. The only CAP related policies which positively impact the diversification of productions were related to the second pillar of the CAP.

Finally, we proposed recommendations to support the development of the diversification of productions and agroforestry in Wallonia. Those recommendations were mostly related to adapt the legal framework for agroforestry in Wallonia for the agroforestry topic. Regarding the diversification of productions, we suggested maintaining the actual supports and adapting the policies favouring the integrated livestock-crop systems at the Walloon level and intercropping practices.

If agroforestry development needed time and only some specific legal adjustments, diversification of productions would need to be studied more in Wallonia. Especially regarding the adoption of legumes as well as the development of integrated crop-livestock systems.

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## Appendices

### I. The Wallon agronomic regions

#### The Limoneuse region

The first larger agricultural region in Wallonia is the *Limoneuse region*, it represents a surface of 3941 km<sup>2</sup>(SPW Environnement, 2018); the region is characterized by its good fertility(SPW Environnement, 2018), allowing cropping some industrial crops such as potatoes or sugar beet. Its good soil fertility comes mainly from the silty character(Quériat et al., 2021). The main crops covering this region are winter wheat (16,2%), potatoes (11,6), sugar beet (10,4%), forage corn (7,8%) and barley (4,2%)(Statbel, 2019). The Permanent grasslands represent around 16,2% of the total agricultural area(SPW Environnement, 2020). Flat low lands and uplands characterize this agricultural region with deep silty soil(Feltz et al., 2021, Quériat et al., 2021). However, this land is not uniformly flat; there is a presence of hills and valleys which often let appear some streams(Feltz et al., 2021, Quériat et al., 2021). The rich silty soils are occupied mainly by crops, whereas the bottom wet valleys and rocky or sandy soils are let often for pasture. In the same way, not the whole region is covered in deep silty soils; some areas have less of it and even let appear some rock spots (Feltz et al., 2021, Quériat et al., 2021). Even though this region is known in Belgium for its cropping aspect, cattle livestock systems are also present on nearly half of the farms in this region(44%), and permanent pasture is present on 79% of the farms(Statbel, 2019).

The origin of those silty soils comes from the last glaciation period; the silt settled thanks to wind deposits (loess) brought by strong north-east winds(Feltz et al., 2021, Koster, 2005).

## The Condroz region

The Condroz region, with a surface of 2370km<sup>2</sup>, is the third-largest region in Wallonia, representing around 15% of the total Wallonia surface(Godart et al., 2021b) and about 17.50% of the Walloon agricultural area(SPW Environnement, 2020). This region is characterized by the succession of lines of hills and valleys oriented west-east with an altitude increasing from north (around 200m above the sea level) to south (more than 300m above the sea level)(Godart et al., 2021b). The land occupation of this region depends highly on the bedrock, which has influenced the soil nature present in the area(Godart et al., 2021b). The soil types in this region are very heterogeneous, there is a presence of soils coming from the degradation of limestone and sandstone bedrocks, but there is also the presence of silty soils which origin is the same as the soils present in the Limoneuse region(Godart et al., 2021b). This heterogeneity in the soil types and their quality allows the Condroz region to have an important part of its area cropped (around 66%); permanent pastures cover the other majority of the agricultural land with about 31% of the total agricultural surface(SPW Environnement, 2020). The three most important crops in Condroz are; winter wheat(30,7%), forage corn (8,0%), winter barley (8,0%)(SPW Environnement, 2020). The silty soils also allow growing potatoes and sugar beet in this region. The cattle livestock systems are present in 54% of the farms in this region.

## The Famenne region

The Famenne region represents a total area of 1708km<sup>2</sup>(SPW Environnement, 2018), the agricultural area represents 36,9% of the whole Famenne surface(SPW Environnement, 2020). This region is characterized by a depression in altitude between the Condroz region in the north and the Ardenne region in the south(Ministère de la région wallone, 1997). The soil quality is various throughout the region(SPW, 2007); the permanent pastures cover most of the agricultural surface(61,7%)(SPW Environnement, 2020) and are present on 95% of the farms(Statbel, 2019). The winter barley and the forage corn are the major crops grown in this region, respectively 7 and 8% of Famenne's agricultural surface(SPW Environnement, 2020). Moreover, in 2007, the whole Famenne region was under the status of the less favoured area(SPW, 2007), some municipalities were removed from this status within the Famenne region with subsequent CAP reforms. Concerning the livestock systems, the predominant species is the cow for beef and milk production(SPW, 2007). They are present on 73% of the farms in this region(Statbel, 2019).

## The Hergère region

The Herbage region, directly translated *the Herbageous region*, is located in the northern eastern part of Belgium. This region is mainly composed of pasture permanent pastures, representing more than 80% of the agricultural surface of this region (SPW Environnement, 2018, SPW Environnement, 2020, SPW, 2007). It is present on 93% of the farms (Statbel, 2019). The steep valleys and hills added to the low soil depth make this region unsuitable for ploughing and cropping (SPW, 2007). Where cropping is possible, the most frequent is corn (SPW, 2007); 31% of the farmers can grow it (Statbel, 2019). The grass and corn produced in this region are mainly used to feed milking cows (SPW, 2007); 73% of the farmers raise cows in this region, 54% raise milking cows (Statbel, 2019), which represent 2/3 of the farms having cows in this region. An important part of this region is also under the less favoured area status (SPW, 2007). The low allocation of this land could underline the difficulty for cultivating the land in this region to agriculture. Out of the 1867km<sup>2</sup> of the region only 541km<sup>2</sup> are dedicated to agriculture which represents around 29% (SPW Environnement, 2020).

This region is also known in Belgium for its presence of hedgerows and old high stem orchards. However, the fruit production in this region comes primarily from low stem orchards (SPW, 2007).

## The Ardenne region

The Ardenne region is the highest in terms of altitude in Belgium (Godart et al., 2021a). After the slow depression in the Famenne region, the altitude starts increasing again from below 300 meters above sea level to more than 550 meters above sea level (Godart et al., 2021a). However, this region is uneven in altitude, ranging from 250 meters in the west up to 550 meters in the northeast (Godart et al., 2021a). This region represents 3479km<sup>2</sup>, which over 50% of it covered by forests (SPW Environnement, 2018). The permanent pastures are present on 97% of the farms in this region (Statbel, 2019), cover 69,8% of its agricultural area. If we add the temporal pastures, the percentage of the farming reaches 83,4% (SPW Environnement, 2020). The principal crop grown in this region is the forage corn (SPW Environnement, 2020). The low depth, acidity and lack of permeability of the soils in the Ardenne make this region unsuitable for cropping (Godart et al., 2021a); this is why an essential proportion of grasslands characterizes this region, making the grazed livestock system the dominant agricultural system on the area (Godart et al., 2021a) which is found on 80% of the farms from this region (Statbel, 2019).

## **II. The interviewed associations**

AWAF

This is the association for agroforestry in Wallonia and Brussels; its role is to vulgarise, communicate and defend agroforestry in Wallonia. The association also tries to stimulate the agroforestry expansion in Wallonia and Brussels by helping farmers to develop projects on their farms, the association is also active at a regional level throughout the different project, which aims to create a regional market chain for agroforestry products.

## CDAF

Centre de développement agroforestier de Chimay (Chimay's agroforestry development centre). Is an association with a similar role as AWAF. However, this association is more oriented towards research and fieldwork with farmers.

## NFT

It is a syndicate that represents the right of the landowner. This association was interviewed especially for the lease law problem concerning the agroforestry development in Wallonia.

## Valbiom

ValBiom is an association that stimulates and facilitates the realization of sustainable initiatives integrating biomass production and its transformation into energy and materials. It focuses on different topics around the biomass such as the education of the public to a biobased economy or facilitates the exchanges between various stakeholders around biomass projects.,...

## Natagriwal

Natagriwal is an association which primary mission is to inform, advise and help farmer, forester and public/private owners in their implantation of agro-environmental measure and the European ecological Natura 2000 network. They are also the associations responsible for the AEM's in Wallonia( advise, controls, communication, ...)

## The syndicates

The FWA(“**F**édération **W**allone de l’**A**griculture” which means the wallonian agriculture federation”) and the FUGEA( “**F**édération **U**nie de **G**roupements d’**É**leveurs et d’**A**griculteurs” which means the United Federation of farmer’s and breeders groupements), who are the two

most important syndicates in Wallonia were interviewed the FWA being the most important one in Wallonia. Those syndicates are fighting for the farmer's rights across Wallonia; they are the farmers' spokespeople. Often composed of farmers, the syndicates' committees are the primary interface between the farmers and the policymakers when designing new policies applying to agriculture.

## Biowallonie

This is the leading association in Wallonia for advising farmers in their conversion to organic agriculture. They are developing new market channels for organic product and helps farmers to develop short market channels. They are often in contact with farmers and other stakeholders of the Walloon agriculture.

## Fourrage Mieux

Fourrage Mieux is one of the eleven pilot centres working on the vegetal sector. Fourrage Mieux domain is the forage productions (mainly grass and other forages except for silage corn production, which has a specific association dedicated to that topic), its missions' are the development of field trials about the different forage species and varieties that could be cultivated in Wallonia and vulgarize the results to advise farmers in their seeding choices and also the different seeds' sellers in Wallonia.

## Greenotec

This association promotes, study and vulgarize the new cropping techniques. They are very active in no-till farming; they are the reference associations for that topic in Wallonia. They also advise farmers when needed. The association also receives funds from the Walloon region.

## Walagri

It is a company active in the agriculture business; they are part of the Arvesta group. They sell seeds, chemicals, fertilizer; they also buy the farmers productions. They've collaborated with researchers from the Walloon agronomic research centre on the peas-wheat association to produce high-quality food peas and wheat. They are the only company in Wallonia offering the opportunity for farmers to sell and deliver the peas-wheat mix.

## Agroecology expert

An agroecology expert in Belgium, which is a pioneer in developing agroecology in Belgium, was also interviewed. His expertise in working with farmers on developing farms within an agroecological approach was valuable for this study. As production diversity is one of the leverage often used to build up a resilient farm within the agroecological approach, this agroecology expert has been in contact with all the political and sociological issues regarding the development of diverse production systems in Belgium. The Walloon region subsidizes this association.

### III. The interview guides

#### Agroforestry

#### Farmers practising agroforestry

##### **Farmer's and Farm's information**

1. What is the farm history?
2. Could you explain your farming system(numbers of crops grown, animals)?
3. What are the policies supporting your farming system?

##### **Farmer's opinion**

4. Why did you implement agroforestry on your farm? What is the aim of your agroforestry system?
5. Where did you get your knowledge from?
6. Could you tell me more about the long term plans for your plantation?
7. Do you have an expert in forestry/agroforestry that you are consulting for your project? Why?
8. Did you encounter any barriers(social, economic, environmental, knowledgeable) during the implementation of your agroforestry system?
9. How did you overcome those barriers?
10. How do you think policies could have lifted those barriers?
11. Is there any policy or subsidy programmes supporting the implementation of agroforestry on your farm?

12. In Flanders, 80% of the plantation costs are covered by the rural development program, and 200€/ha are given if the farmer carried the work himself. What do you think about that policy? If this policy would have been implemented in Wallonia when planning your project, how would it have changed your plans?
13. Are there any policies that are deterring you from being able to work as you wish?
14. What sort of policies would you like to see in the future?
15. What are the barriers against the development of agroforestry in Wallonia.
16. How old are you?
17. What is your academic background?

## Farmers not practising agroforestry

### **Farmers' and Farm's information**

1. What is the farm history?
2. Could you explain your farming system (numbers of crops grown, animals)?
3. What are the policies supporting your farming system?

### **Farmer's opinions**

4. What do you know about agroforestry?
5. Do you have any trees, hedgerows on your farm? What is their history?
6. Do you get any subsidies for those elements?
7. I will show you some example of agroforestry. What do you think about it?
8. What will be the most important incentives for setting up an agroforestry project on your farm?
9. What will be the barriers to the implementation of agroforestry on your farm?
10. Do you know that agroforestry could be used in the CAP declaration as EFA?
11. Do you know any policies favourable to trees plantation on farms?
12. Did you remove any trees/ hedgerows on your farms? And why?
13. Here is a list of the subsidies given for the tree plantation in Wallonia. What do you think about it?
14. Do you think we are enough informed about agroforestry in Wallonia?

## Diversification of productions

### **Farmer' and Farmer's information**

1. What is the farm history?
2. Could you explain your farming system(numbers of crops grown, animals)?
3. Are there any policies and subsidy programmes supporting your farming system?
4. Do you consider your farm as diversified, and why?

### **Farmer's opinions**

5. **If 6 YES** → What were/are the main barriers to implementing production diversification on your farm?
6. **If 6 NO** → Have you considered diversifying more your productions? What are the main reasons stopping you from diversifying more your productions?
7. Why did you or not choose to diversify your farming system?
8. How do you think those barriers could be lifted(incentives)?
9. What do you think are the ways to diversify farm production?
10. If farming system specialised in either crops or livestock → Have you ever considered to work with a crop/livestock farmer and integrate each other production into each other systems?
11. Have you tried in the past to diversify your systems with non-conventional crops such as hemp, camelina, lentils, old cereal varieties, miscanthus or animals introduction? How did it worked? What were the reasons of its success/failure? How could policies have helped?
12. (For conventional farmers only) How does the crop diversification rule is influencing you in your choices regarding to crop diversification?
13. What is your opinion about the CAP policies in general?
14. Do you think there are enough EU/regional policies favourable towards the implementation of production diversification?
15. Are they any policies that are deterring you from being able to work as you wish?

16. What sort of policies would you like to see in the future?

17. How old are you?

#### IV. Table representing the elements allowed to be considered as an ecological focus area in Wallonia

Elements	Particularity	Description		Ecological focus area
Surface (ha,acre)	Parcel	Fallow	per 1 m <sup>2</sup>	1 m <sup>2</sup>
		Meliferous fallow	per 1 m <sup>2</sup>	1,5 m <sup>2</sup>
		Short rotation coppice	per 1 m <sup>2</sup>	0,5 m <sup>2</sup>
		Miscanthus	per 1 m <sup>2</sup>	0,7 m <sup>2</sup>
		Nitrogen-fixing crops	per 1 m <sup>2</sup>	1 m <sup>2</sup>
		Buffer strips	per 1 m <sup>2</sup>	1,5 m <sup>2</sup>
	Intercropping Parcel	Cover crops	per 1 m <sup>2</sup>	0,3 m <sup>2</sup>
Linear (m)	Topography	Ponds	per 1 m <sup>2</sup>	1,5 m <sup>2</sup>
		Trees group	per 1 m <sup>2</sup>	1,5 m <sup>2</sup>
		Ditch	per 1 m	6 m <sup>2</sup>
Ponctual (trees numbers)		Hedgerow, afforested strip or trees alignment	per 1 m	10 m <sup>2</sup>
		Isolated tree	per tree	30 m <sup>2</sup>

#### V. Table representing the subsidies given by the Walloon region for trees and hedgerows plantations.

Plantation	Subsidy amounts
Trees' alignments	6€ per tree bought in nursery
	2€ per willow's cutting
Orchards	25€ per tree from a recognized variety or certified
Hedgerows	5€ per meter in the case of a single row plantation
	7€ per meter in the case of a twin-row plantation
	9€ per meter in the case of a triple row plantation
Linear coppice	1,50€ per meter in the case of a single row plantation
	3€ per meter in the case of a twin-row plantation
	4€ per meter in the case of a triple row plantation and more with a maximum width of 10 meters
Pollard treed maintenance	20€ per tree maintained in a pollarded style
The amounts mentioned in this table are multiplied by 1,5 when the plantation is done by a company specialised in this type of work. However, the subsidy amount can not exceed 80% of the total bill for the plantation.	

#### VI. Table related to agroforestry farmers information

Farmers ID	Rodger's curve category	Agroforestry system	Number of ha
NA1	Laggards	No Agroforestry	320
NA2	Laggards	No agroforestry	300
NA3	Laggards	No Agroforestry	220
NA4	Laggards	No Agroforestry	175
SB1	Early adopter	Sylvoarable	250
SB2	Early adopter	Sylvoarable	274
SB3	Early adopter	Sylvoarable	200
SP1	Early adopter	Sylvopastorable	100
SP2	Early adopter	Sylvopastorable	300
SP3	Early adopter	Sylvopastorable	50
SP4	Early adopter	Sylvopastorable	63
SP5	Early adopter	Sylvopastorable	70
SB4	Innovator	Sylvoarable	130
SB5	Innovator	Sylvoarable	150
SPB1	Innovator	Sylvopastorable/Sylvoarable	90
SPB2	Innovator	Sylvopastorable/Sylvoarable	210
SPB3	Innovator	Sylvopastorable/Sylvoarable	12

## VII. Table related to diversification of productions farmers' information

Farmer's ID	Region	System	Number of ha	Number of crops	Numbers of animal productions
M1	Famenne	Organic	50	3	3
M11	Famenne	Conventiona	320	9	2
M12	Condroz	Organic	115	8	1
M2	Limoneuse	Conventiona	95	5	3
M3	Herbagère	Organic	100	9	1
M4	Herbagère	Conventiona	108	4	1
M5	Condroz	Conventiona	110	5	1
M6	Condroz	Conventiona	120	6	1
M7	Famenne	Conventiona	130	10	3
M8	Limoneuse	Conventiona	150	6	1
M9	Condroz	Conventiona	200	10	3
SA1	Ardenne	Conventiona	108	2	1
SA2	Ardenne	Organic	100	1	2
SA3	Herbagère	Conventiona	112	2	1
SA4	Ardenne	Conventiona	63	3	2
SA5	Ardenne	Organic	60	3	1
SC1	Limoneuse	Conventiona	167	9 N/A	
SC2	Limoneuse	Conventiona	175	9 N/A	
SC3	Limoneuse	Conventiona	200	7 N/A	

## VIII. Past measures influencing agroforestry in Europe

### Regulations 2078/92 and 2080/92

Even though the CAP seemed to have negative impacts on the development of agroforestry and production diversity on farms (Peyraud et al., 2014, Santiago-Freijanes et al., 2018), throughout its evolution, the CAP has started to incorporate various measures favourable to farms diversification (Barnes et al., 2015) and agroforestry (Santiago-Freijanes et al., 2018). The firsts

measures, which, to some extent, were favourable to agroforestry, appeared in 1975 when the European Commission set up payment for “Less-favoured areas” and then in 1988 with the set-aside measure creation as part of the regulation 1272/88. The set-aside scheme was based on the principle of leaving a proportion of their land uncultivated or set aside. Under this set-aside scheme, some measures related to agroforestry were introduced, such as preserving old trees, tree rows and hedgerows. One of the aims of that measure was preserving biodiversity (Santiago-Freijanes et al., 2018). The set aside scheme evolved during the CAP history and was abolished in 2008 (European Commission, 2008). After regulation 1272/88 introduced the set-aside scheme, the regulations 2078/1992 and 2080/92 were created in 1992 (Lawson et al., 2002). These regulations had been widely used (regulation 2078/92 was present on around 20% of European farmland (Lawson et al., 2002)). The interpretation of those regulations was up to each government or region of the member's states, which resulted in an important variety of measures (Lawson et al., 2002). Depending of the country or region, measures were created to afforest agricultural land and or to maintain the woody elements already present on agrarian lands (such as isolated trees or hedgerows) (Picard et al., 2001), which to some extent could be linked to agroforestry depending on the tree density and systems implemented (hedgerows, grazed orchards,...) (Picard et al., 2001). One of the issues regarding the measures adopted from the regulation 2080/92 and its “*Community aid scheme for forestry in agriculture*” is that no supervision of the plantation was planned after the programs' 5-7 years duration. Lawson et al. state that even though some measures related to agroforestry were introduced, regulation 2080/92 did not directly support any agroforestry schemes (Lawson et al., 2002). However, Santiago et al. claim that theoretically, the 2078/92 and 2080/92 regulations positively affected the development of agroforestry in Europe (Santiago-Freijanes et al., 2018).

## Regulation 1297/99 and the rural development programs

In 1999, regulation 1297/99 was established to have one legal tool to support rural development in Europe (Lawson et al., 2002). This regulation, also called the “rural development regulation” (Lawson et al., 2002), brought to the establishment of rural development programs in 2000 (Santiago-Freijanes et al., 2018), which contained measures to afforest agricultural lands and to preserve the actual woodlands, as well as the maintenance of fire breaks (Santiago-Freijanes et al., 2018). The first period of the rural development program started in 2001 and ended in 2006, then the second period of the rural period was set up from 2007 to 2013. The afforestation was still included within this period. It was represented by measure 221 (first afforestation of agricultural land), measure 223 (first afforestation of non-agricultural land). For the first time in CAP history, a measure was created to support agroforestry directly, measure 222 (first establishing agroforestry systems on agricultural lands) (Santiago-Freijanes et al., 2018).

However, amongst the measures present in the 2007-2013 rural development program, several other measures were linked indirectly to agroforestry as the measure 214 (Agri-environment payments)(Mosquera-Losada et al., 2016, Santiago-Freijanes et al., 2018) which some countries/regions to promote the environmental benefits of silvopastoralism by the preservation of isolated trees in meadows and the implementation of grazed orchards(Santiago-Freijanes et al., 2018). Several countries used the 221, 222 and 223 measures within their rural development programs(Mosquera-Losada et al., 2016). Belgium has two various regional rural programs, one for Wallonia and another one for Flanders. In Wallonia, measure 222 was not adopted, whereas it was adopted in Flanders. However, this does not mean that Wallonia did not implement agroforestry systems during the 2007-2013 period. The promotion for implantation of meadows orchards was subsidized throughout measure 214 in Wallonia(Mosquera-Losada et al., 2016). In the 2014-2020 rural development program, measure 222 was replaced by the sub-measure 8.2 (support for establishment and maintenance of agroforestry systems), which main change was the payment of subsidies for the maintenance of agroforestry over a period of five years(Santiago-Freijanes et al., 2018) this measure wasn't still applied in Wallonia. In contrast, the sub-measure 10.1( payments for agri-environment-commitments ), a new version of the measure 214 in the rural development program, was used in Wallonia(Mosquera-Losada et al., 2016). Within this sub-measure, Wallonia's rural development program promoted the implementation of grazes orchards, trees rows, hedgerows and the conservation of isolated trees(Service public de Wallonie, 2017). As Santiago et al. (2018) explained in their paper, the sub-measure 10.1 and measure 214 promote the ecological services of practices such as silvopastoralism more than the agroforestry itself(Santiago-Freijanes et al., 2018). It is also essential to add that the CAP pillar I policies hinder agroforestry development(Lawson et al., 2016). The Delegated Regulation 640/2014 (Article 9.3) indicates that any parcels with a higher tree density than 100trees/ha won't be eligible for direct payments from Pillar I(Lawson et al., 2016). This is a critical hindering force towards the establishment of more developed agroforestry systems because the agroforestry plantations, as they are done now in silvoarable and silvopastoral systems, use around 400 seedling trees/ha(Lawson et al., 2016) from which trees will be removed every year to select the best individuals(Lawson et al., 2016). The EURAF association suggests that the tree density limit should be specified as trees with a crown diameter larger than 4m(Lawson et al., 2016). Moreover, it is suggested in the literature that when agroforestry plantations are set up on farms, a management plan should be created with the farmer to assure a good development of the plantation and show that the limit 100trees/ha of mature trees will not be exceeded(Lawson et al., 2016, Santiago-Freijanes et al., 2018).



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