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The integration of short rotation coppice in Belgian agricultural landscapes

Guidelines and strategies for managing short rotation coppice cultures

Jomme Desair, Louise Vercruysse, Amaury Sonneville, Julie Callebaut, Francis Turkelboom, Marijke Steenackers

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Reading Guide

This report builds on the report “Short Rotation Coppice in Belgium: Review on Opportunities, Barriers and Effects” (Desair et al., 2022) and provides a complementary view on the potential of short rotation coppice to the report “Spatial trade-off analysis of short rotation coppice in Belgium: Effects on ecosystem services and biodiversity” (Callebaut *et al.,* 2024). These three studies were conducted as part of the AD-LIBIO-project *“ADvanced Liquid BIOfuels for advanced engine concepts enabled by advanced wood breeding and catalysis”*. This research and development project focuses on wood from short rotation coppice (SRC) as a feedstock for biofuel production. Besides investigating novel engineering methodologies for optimal biofuel production, the potential of short-rotation coppice in Belgium is evaluated.

The first report by (Desair *et al.*, 2022) sketches the policy relevance of SRC as well as the current legislation. It gives an idea of the current area of SRC in Belgium, including changes over time, and the availability of land for potential expansion of SRC. It explores the potential delivery of different ecosystem services, the potential for biodiversity and the effect on landscapes and its inhabitants. The second report of Callebaut et al. (2024) dives deeper into the spatial opportunities and barriers for short rotation coppice. It is a technical report, discussing different expansion scenarios for SRC and their respective effects on the delivery of ecosystem services and their potential to support biodiversity. This third AD-LIBIO report takes a complementary approach in that it deepens our understanding of the current use of SRC in Belgium and assesses the local impact of planting SRC. Based on this we provide guidelines and strategies on how SRC could be integrated in different farm types and agricultural landscapes.

Everyone who is interested in planting or promoting SRC in Belgium is invited to read this report to broaden their understanding of the concept, understand the different motivations for uptake and the different potential synergies and trade-offs of integrating SRC on farm management.

Abstract in English

Short rotation coppice (SRC) is an agricultural practice involving the periodic harvesting of the above-ground biomass of fast-growing tree species, such as poplar or willow, every two to eight years. This practice offers a promising system for woody biomass production, without increasing pressure on forests and fitting well into farm management. Building on prior studies, this report delves into local motivations for SRC cultivation, diverse management practices, and the effects on farms and broader landscapes in Belgium. Fieldwork in the form of interviews and site visits with SRC owners in Flanders, revealed various types of SRC, differentiated by their management intensity and scale.

Our study identified five primary types of SRC based on the interviews: coppice woodland with short rotations, small-scale extensive short-rotation coppice, short rotation coppice as a compromise between nature and production, intensive short rotation coppice with long rotations, and intensive short rotation coppice with short rotations. We also included pollard trees and hedgerows as special forms of SRC based on literature. The motivations for planting SRC varied between types. Each type had different benefits and trade-offs that the owners reported. We relied on the IPBES framework of intrinsic, instrumental, and relational values, to categorise these benefits and trade-offs. The instrumental values, particularly energy independence, was the predominant motivator among respondents. However, relational and intrinsic values, typically non-use values, were also significant, especially in less intensive SRC practices.

The integration of SRC on farms depends on the different values SRC can provide but also on the land, labour, capital, and knowledge present on the farm. The study assessed the feasibility and benefits of different SRC types for four exemplary farm types in Flanders, identifying that linear and extensive SRC types often offer the most benefits with the least trade-offs. These types enhance ecological resilience on the farm and landscape level, and provide private benefits such as habitat for pollinators, erosion control, and reduced agricultural input costs. Intensive SRC practices are feasible for farms with high heat demands and stable resources. However, the trade-off with food production is high which can have detrimental social, economic and ecological effects on a larger scale. There is no one-size-fits-all approach to integrating SRC sustainably on a farm. The choice if and which type of SRC to plant should start from the specific needs and possibilities of the farm and farmer, as well as its surrounding landscape.

In conclusion, SRC holds significant potential to enhance the multifunctionality of agricultural landscapes in Belgium, balancing woody biomass production with ecological and agricultural resilience. This potential is maximised when the relational and intrinsic values of nature are considered alongside instrumental values, fostering choices that benefit both nature and agriculture.

Samenvatting in het Nederlands

Korte-omloophout (KOH) is een landbouwpraktijk waarbij de bovengrondse biomassa van snelgroeiende boomsoorten, zoals populier of wilg, om de twee tot acht jaar wordt geoogst. Deze praktijk biedt een veelbelovend systeem voor de productie van houtachtige biomassa, zonder de druk op bossen te verhogen. Ze is daarnaast ook goed in te passen in de landbouw bedrijfsvoering. Voortbouwend op eerdere studies onderzoekt dit rapport de lokale motivaties voor de teelt van KOH, de verschillende beheerspraktijken en de effecten op bedrijfsvoering en landbouwlandschappen in België. Via veldwerk in de vorm van interviews en veldbezoeken met eigenaars in Vlaanderen identificeren we verschillende types KOH, gedifferentieerd door hun beheersintensiteit en schaal.

Onze studie identificeerde vijf typen KOH: hakhoutbos met korte omlooptijd, kleinschalig extensief korte-omloophout, korte-omloophout als compromis tussen natuur en productie, intensief korte-omloophout met lange omlooptijd, en intensief korte-omloophout. Op basis van literatuur namen we ook knotbomen en hagen mee als speciale vormen van KOH. De motivaties voor het planten van SRC verschillen per type. Elk type heeft verschillende voor- en nadelen. We baseerden ons op het IPBES raamwerk van intrinsieke, instrumentele en relationele waarden om deze voordelen en afwegingen te categoriseren. De instrumentele waarden, met name energieonafhankelijkheid, waren de belangrijkste motivator onder de respondenten. Relationele en intrinsieke waarden, typisch niet-gebruikswaarden, waren echter ook significant, vooral bij minder intensieve SRC praktijken.

Of het interessant is om KOH te integreren in een landbouwbedrijf, hangt af van de verschillende waarden die SRC kan bieden, maar ook van de beschikbare oppervlakte, de arbeid die beschikbaar is en het kapitaal en de kennis die aanwezig zijn op de boerderij. Deze studie beoordeelde de haalbaarheid en voordelen van verschillende KOH types voor vier voorbeeld boerderijen in Vlaanderen, en concludeerde dat lineaire en extensieve KOH types vaak de meeste voordelen bieden met de minste compromissen. Deze types verbeteren de ecologische veerkracht op bedrijfs- en landschapsniveau, en bieden voordelen op bedrijfsniveau zoals habitat voor bestuivers, erosiebestrijding en lagere kosten voor bepaalde noden zoals energie, bemesting en voeder. Intensieve KOH is enkel haalbaar voor boerderijen met een hoge warmtebehoefte en stabiele inkomsten. De competitie met voedselproductie is echter groot, wat op grotere schaal nadelige sociale, economische en ecologische gevolgen kan hebben. Er is geen algemeen recept om KOH duurzaam te integreren op een boerderij. De keuze of en welk type KOH te planten moet uitgaan van de specifieke behoeften en mogelijkheden van het bedrijf en de boer, evenals het omringende landschap.

We concluderen dat KOH een aanzienlijk potentieel heeft om de multifunctionaliteit van agrarische landschappen in België te verbeteren, door de productie van houtachtige biomassa te combineren met ecologische en agrarische veerkracht. Dit potentieel wordt gemaximaliseerd wanneer de relationele en intrinsieke waarden van de natuur naast de instrumentele waarden worden beschouwd, gezien keuzes stimuleert die zowel de natuur als de landbouw ten goede komen.

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1. INTRODUCTION

Short rotation coppice (SRC) is an agricultural crop of which the entire above-ground biomass of fast-growing tree species such as poplar or willow is harvested every two to eight years. SRC is a promising woody biomass production system as it limits the pressure on forests and can fit into farm management (Desair et al., 2022). In the previous report of Desair *et al*. (2022) we investigated the role SRC could play in the unrolling bioeconomy in Belgium. Building on that report, we have furthered the study in two directions. In the accompanying report of Callebaut *et al.* (2024), we model the impact of different expansion scenarios of SRC in Belgium on ecosystems and biodiversity. These high-level models provide us with necessary insights on potential effects and trade-offs but are not able to account for local diversity of circumstances, preferences for the landscape and the effects on a smaller scale. They are also not made to capture the myriad of ways that SRC is planted and the reasons for doing so. In this report we will therefore take a complementary approach and start from the drivers and the needs of the land users that cultivate SRC. We will focus on the local motivations for cultivating SRC, the SRC management approaches and on its effects on the direct environment, e.g. the farm, and the broader landscape. SRC is an agricultural cultivation and the study of Callebaut et al. (2024) pointed out that the largest current land use that has the potential for expanding SRC, is agricultural land. Therefore this report will mainly look into the use of SRC in an agricultural context.

Our fieldwork shows that SRC comes in many different shapes and sizes. The legal definition "Cultivation of fast-growing woody plants where the above-ground biomass is harvested periodically up to 8 years after planting or after the previous harvest"[1] leaves ample space for different management practices to reflect the local needs. To structure this information in an accessible way, we have identified seven types of SRC.

The motivations of land users to plant SRC depend on a variety of reasons and values that are regarded as important. In this report we build on the specific 'values of nature typology' as used by IPBES (Pascual et al., 2023), namely instrumental value, relational value and intrinsic value. The choices that are made for planting, managing and harvesting the coppice have consequences on the different values that an SRC provides for the owner, but also on the social and ecological environment. Apart from the expected benefits from planting SRC, the way this SRC will affect farm management is an important barrier or reason for adopting SRC. There is no one-size fits all measure to successfully integrating SRC in the business model of a farm. No farm is alike and therefore not all farms would benefit from this integration. Rather, a case by case approach is needed. Therefore, we look into the factors that determine the feasibility of integrating SRC in the existing business model of different farm types and identify the best synergies of SRC types for these farms.

This report seeks to delineate the different types of SRC in Belgium, thereby highlighting their respective benefits and trade-offs as reported by producers. Furthermore, by building on previous studies about the implementation of green-blue measures on farms, synergies can be identified between these specific types of SRC and different farm types. This is a first step to develop locally-adapted pathways to integrate the cultivation of SRC further in different Belgian agricultural landscapes.

[1] Bosdecreet article 4 provision 14 bis 1

2. METHODOLOGY

To address the research aims stated above, it was necessary to define and list the types of SRC being cultivated in Belgium and to gain an understanding of the motivations and experiences of those cultivating it. To collect this information, interviews in combination with field visits were conducted with the owners of SRC cultures in Flanders. Interviews were considered the best method to assess the actual occurrence of different types of SRC, as there is little literature on examples in Flanders. Furthermore, the data from the interviews served as the basis for the qualitative analysis of the experiences and motivations of the SRC cultivators, which is essential to have a realistic view on the possibilities of SRC in the future. The data was compared and expanded with relevant literature on woody biomass in Belgium.

For the interviews all former and current owners of SRC on agricultural parcels in Flanders were contacted by letter to ask for their interest in participating in this study. The addresses were provided by the Department of Agriculture and Fishery of Flanders who queried their database for farmers who had declared the use of SRC as a main crop between the years 2008 and 2022. This yielded 108 different owners in Flanders of which 38 were still active in 2022. Eight owners - all still active in 2022 - were willing to be interviewed. This response rate is arguably low. Nonetheless, having interviewed eight out of 38 current owners of SRC, we sampled 20% of the owners in Flanders. Three of the interviewees were primarily farmers, two were former farmers. Three other interviewees were working in sectors related to agriculture, namely as researcher in agriculture and horticulture and as arborist. One respondent was a land surveyor. Half of the interviews were conducted with male respondents, two with a female respondent and two with a male and female respondent. The acreage of the SRC plantation varied between 0,05 hectares and 6 hectares, half of the cases being less than one hectare. As illustrated in figure 2.1, most of the interviews were conducted in the sand-loam region, three were conducted further north, in the Flemish sand region, and one interview took place in the Kempen.

The interviews were conducted on site, in a semi-structured format. Each interview lasted more or less an hour and was followed by a visit to the field to see the SRC, where the conversation continued in an informal manner. The questions covered topics related to the type of SRC (scale, location, tree species, use), the management (rotation length, use of fertilisers and pesticides, harvesting methods), the motivation to start with short-rotation coppice, the experienced benefits and disadvantages (personal, relational, ecological) and the difficulties that the user has encountered along the way. At the end of each interview, the interviewee was asked to give additional recommendations for policy and for other farmers who might be interested in cultivating SRC. The interview guidelines can be found in Annex 1 (in Dutch).

The interviews were recorded and transcribed. For the analysis, the data was divided into the aforementioned categories (type of SRC, management, motivations, benefits, disadvantages, difficulties). To clearly illustrate the array of possibilities for producing and managing SRC and the impact of these choices, we divided the examples of SRC into several types. Based on the data from the interviews, five types of SRC were distinguished:

- Coppice Woodland with short rotations
- Small-scale extensive short-rotation coppice
- Short rotation coppice as compromise between nature and production
- Intensive short rotation coppice with long rotations - Italian system

- Intensive short rotation coppice with short rotations

The description of these five types is uniquely based on the data from the interviews, as there are little studies on the reality of SRC in Belgium specifically. The differentiation of the types of SRC and their order reflects a combination of their position on a scale from extensive to intensive and from small-scale to large-scale.

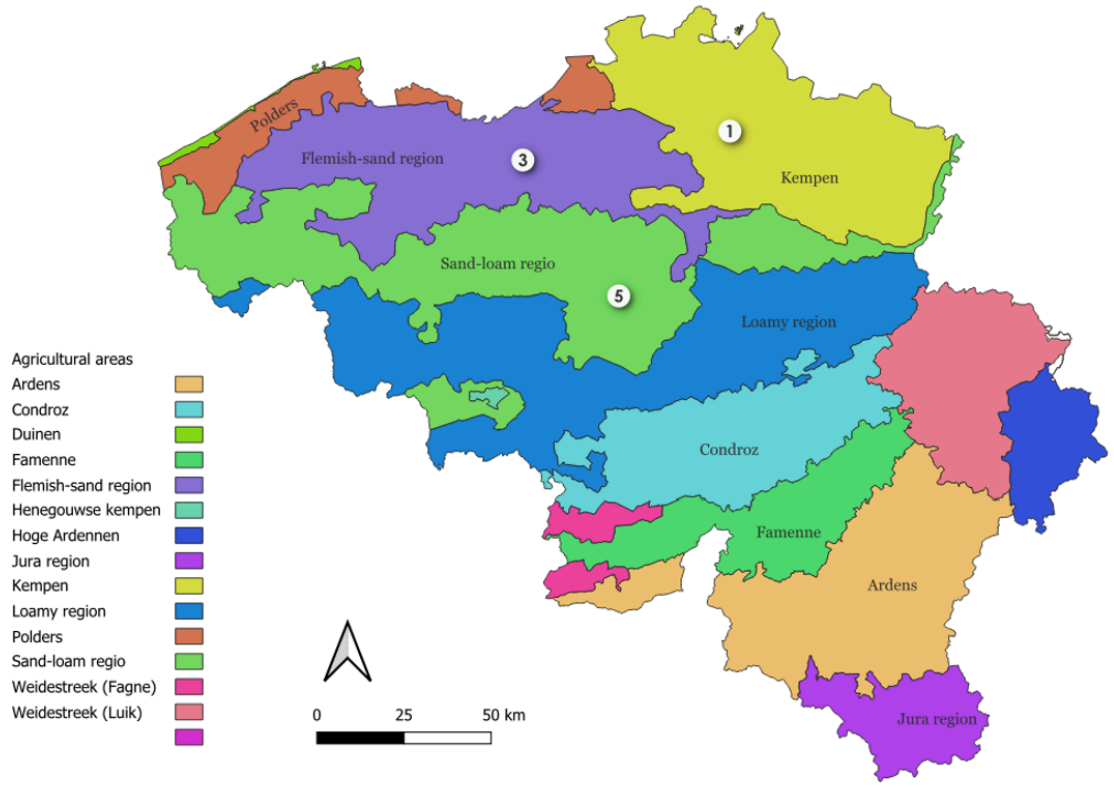

Figure 2.1: Distribution of interview respondents according to agricultural areas.

After identifying these 5 types of SRC derived from the interviews, we concluded that more historic and cultural forms of land uses such as pollard trees, hedgerows and hedgerow systems, can also be a regular source of woody biomass and reasons for planting or not planting these can be similar to the above mentioned. Moreover, the definition of SRC in both Flanders and Wallonia only requires regular harvests but does not specify the height of the stump or the shape of the plantation. Therefore these could be considered as a special form of SRC as well. Although legally not recognized as SRC, we decided to open up the SRC-category and included the following two categories to our typologie:

- Row of pollard trees
- Hedgerows

Although these types of SRC were also present on some of the farms visited, they were not regarded during data collection. Therefore, information on these biomass production methods were derived from literature as indicated in the respective sections.

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We analysed the motivations for each of the SRC types by identifying the created values and trade-offs, both for the land users themselves and for the public. Furthermore, we identified the impact of each type of SRC on the farm management, by elaborating on the necessary input of land, labour, capital and knowledge. After elaborating all the SRC types, we discuss the policy recommendations as brought forward by the respondents.

In the second half of the report, we look into how different types of SRC can be integrated into different farm types. For this we build on the study of Sannen *et al.* (2024), which examines business models for green-blue measures on four exemplary farm types in Flanders which together cover about 70% of the agricultural land use in Flanders. The four farm types are:

- Arable farm on loamy plateau
- Livestock and arable farm in polders
- Dairy farm in the sand region
- Dairy farm in hilly landscape

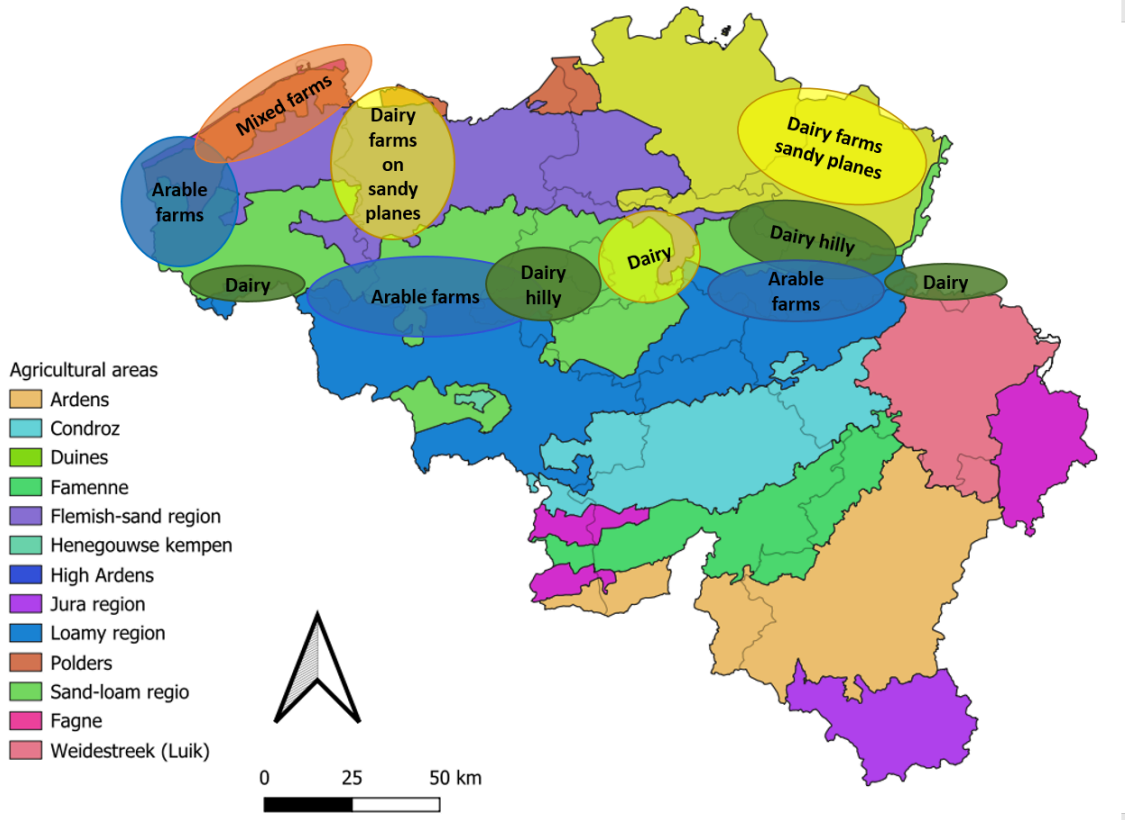

Figure 2.2: Occurrence of farm types in the different agricultural zones in Belgium, based on (Sannen et al., 2024).

These four farm types cover the main areas which in Callebaut et al. (2024) are defined as suitable areas for SRC, as can be appreciated in figures 2.2 and 2.3. Two of these farm types (dairy farm in hilly landscape and Arable farm on loamy plateau) can also be considered as exemplary for the regions where SRC could primarily be implemented in Wallonia, as indicated by the areas highlighted in the search zones for SRC in the report of Callebaut et al. (2024), which are mainly located in the loamy regions in Wallonia.

For each of these four farm types, the characterising factors are described and linked to the benefits or trade-offs that the implementation of SRC could have on the farm. Drawing on the different values and impacts on farm management we highlight the different benefits and trade-offs of the 7 types of SRC from the first section of the report.

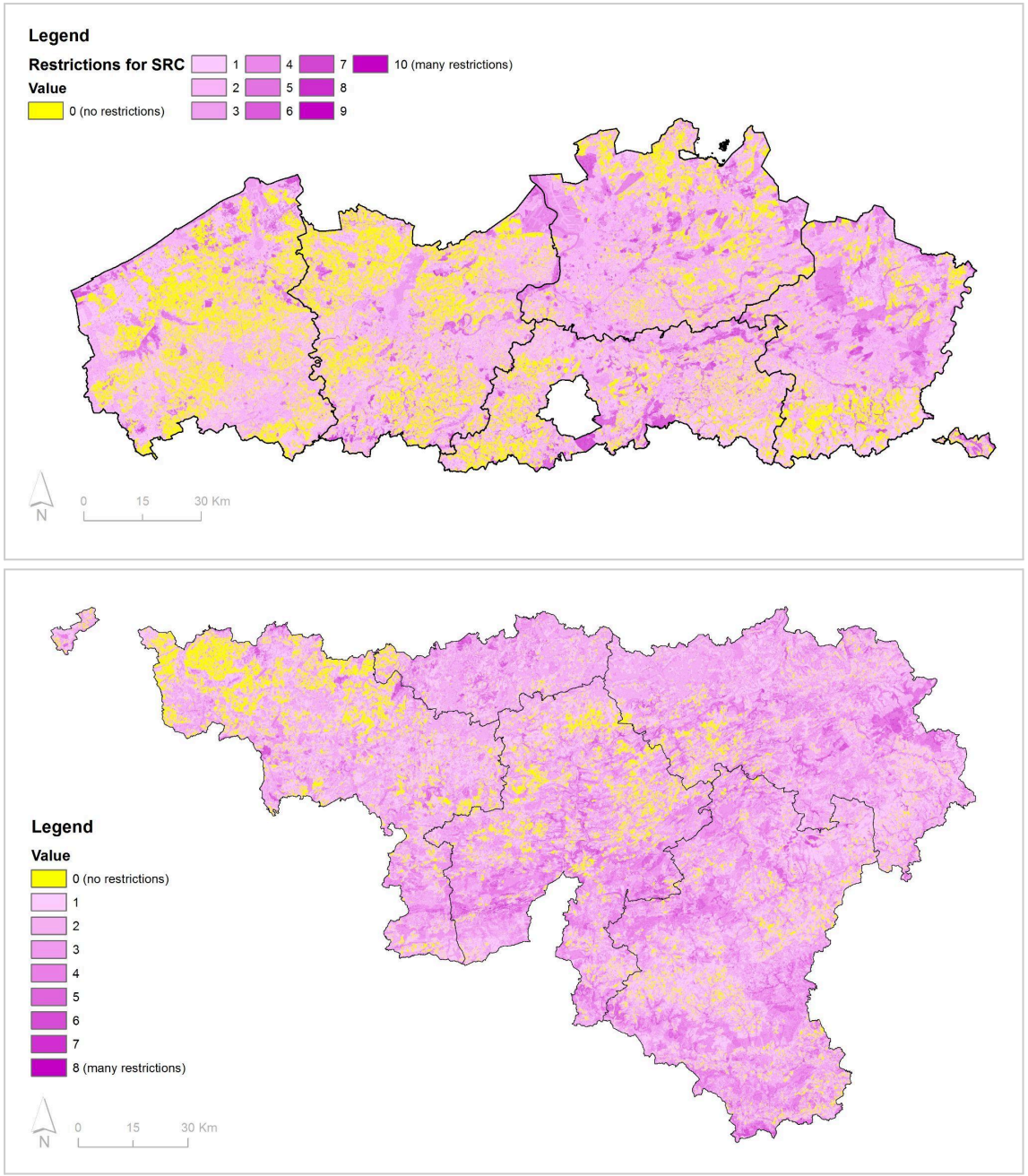

Figure 2.3: Restrictions (pink) and search areas (yellow) for SRC in Flanders (upper) and Wallonia (lower), from Callebaut et al. (2024).

To broaden the analysis and connect to the insights from Callebaut et al. (2024), we also did this exercise for agroforestry systems. Callebaut and colleagues hypothesise that SRC as linear elements and integrated into farms through agroforestry would provide most of the benefits and least of the

trade-offs of SRC with food production. This was however impossible to model and is therefore further qualified in this report. For this we build on the existing literature (e.g. (Stadig *et al.*, 2020) on SRC as a part of agroforestry in Belgium.

FRAMEWORKS USED

Plural valuation

To cluster the benefits and trade-offs of each type, we draw on the diverse values of nature framework as delineated by IPBES (Pascual *et al.*, 2023). They identify three broad value categories for nature: intrinsic values, instrumental values and relational values. For our analysis we coded responses in the interview as intrinsic **[N]** when the respondents refer to the value of nature (supported by SRC) in itself, regardless of human judgement. Instrumental values **[I]** were coded as such when the owners refer to the benefits derived from the SRC, which often comes back to material or economic advantages. We identified relational values **[R]** as the values that relate to cultural or traditional practices related to SRC, and/or the values that relate SRC to the broader community, for instance the affective opinions of neighbours and visitors. Combinations of the two are also possible, in which case they are separated by a backslash, e.g. **[N/R]**.

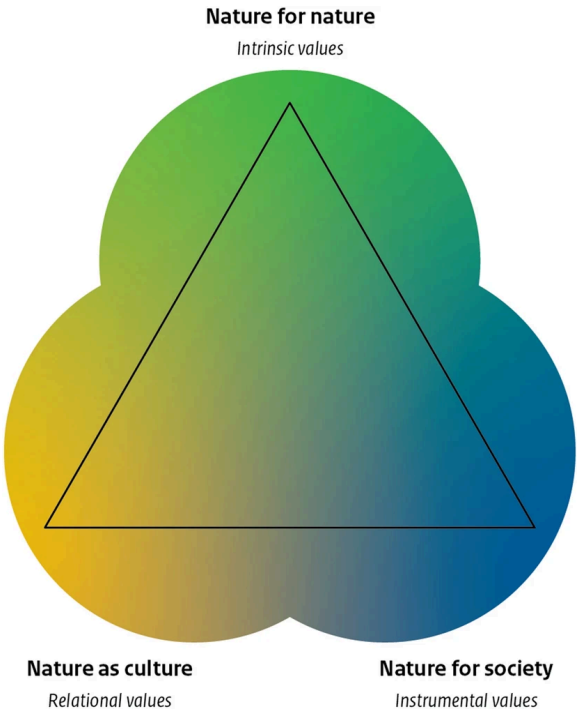

Figure 2.4: Intrinsic, Instrumental and Relational values to valuation approaches (Durán et al., 2023).

Factors of production

To assess the impact of the different types of SRC on the farm management, we concentrated on four factors of production (in a similar fashion to Winkler *et al.*, 2020):

- **land** needed for planting the SRC
- farm- and external **labour** needed to plant, maintain and harvest the SRC

- **capital** needed to plant, maintain and harvest the SRC, and
- expert **knowledge** needed.

The first three categories are the production factors often used in classical economics (Ricardo, 1817). Innovation is often seen as a fourth factor of production. In the context of this research, knowledge was however deemed more apt. Some types of SRC can be regarded as heritage while others can be regarded as novel or innovative crops. However, what separates them is the knowledge that the farmer (still) has to manage them or the need for external expertise when this knowledge is not present (anymore). Together, these four factors determine to what extent there is room (spatial, financial, physical and mental) on a farm to integrate SRC. Together with the values of SRC, the trade-off can be made either in favour or against planting SRC.

3. Seven types of short rotation coppice

This section describes the 7 types of SRC. There are multiple ways in which they could be sorted, we ordered them through a combination of scale and intensity of the management. For the five types of SRC, derived from the interviews, only information from the interviews was used while for the other two types, pollard trees and hedgerows, literature served as the only source of information. For each type of SRC a small description of the practice is given, followed by the values and trade-offs for private and public actors based on intrinsic, instrumental en relational values and finally the impact of the type of SRC on management is described. These are summarised and compared in section 3.2 and 3.3 respectively.

3.1 Descriptions of the seven types of SRC

1. Row of pollard trees

Figure 3.1: Picture of pollard trees. Credits: INBO.

What is it?

Pollard trees are a typical feature of the agricultural landscape in Belgium. While not falling under the intended definition of SRC, pollard trees could be seen as a linear SRC plantation of which the stool is the tree trunk, elevated above the mowing field. Although pollard trees were present at least on two

of the farms that were visited, they were not the focus of the interview and therefore all information in this section is based on the practical guide to pollard trees of Regionale Landschappen[2] and of the Public Services of Wallonia, department of nature and forests[3].

Pollard trees are often planted from cuttings of more than 2,5 metres. The distance between trees can vary depending on the aims and management. Pollard trees need to be pruned with fairly short rotations in order to prevent them from ripping apart under the weight of the branches and to enable the wound of the pruning to heal. Rotations can go from yearly up to 12 years. Phased harvesting, where some trees are pruned and others not, is also not uncommon. Harvesting from pollard trees is often done with a chainsaw or by hand. It requires specialised material and know-how, especially for larger trees or trees for which the pruning is overdue.

Pollard trees have historically been planted for a large number of reasons. They provide a wide range of different types of wood, from twigs to fuelwood and wood for tools. Apart from that they can be used to demarcate properties, as part of a fence or next to waterways and ditches for their draining function. In Wallonia they are less present and were historically mainly planted in the Hainaut region but can be sporadically found elsewhere too. More information and technical guidelines can be found in Dutch[4] and French[5].

Values created by this type of SRC

Private

- **[I]** In contrast to the more traditional coppice forests or SRC plantations, this linear and elevated way of producing wood requires little land, leaving room for agriculture (own deduction).
- **[I]** The young twigs can be used as a mineral source in fodder for cattle (RLRL, 2021).
- **[I]** Currently most wood is however used for energy in domestic heating installations (RLRL, 2021).
- **[I/R]** The wood from pollard trees knows many uses. It was used in Belgium for making clogs, wickerwork for baskets, closures and walls, and wooden tools. Some of these uses remain.

Public

- **[I/R]** The wood from pollard trees has many historic and culturally important uses. From wickering to clogs.
- **[N]** Pollard trees maintain a considerable amount of associated biodiversity (RLRL, 2021). Species like the small owl (*Athene noctua*) and bats can find both food and housing in old pollard trees.
- **[R]** They form a part of a recognizable agricultural landscape in Europe. Many pollard trees are even protected as heritage, the term “knotboom”, dutch for a pollarded tree yields 915 protected landscape elements in the inventory of heritage objects[6].

[2] https://www.rlml.be/assets/afbeeldingen/rl-meetjesland/Algemeen/Knotbomenbrochure.pdf
[3] http://environnement.wallonie.be/publi/dnf/vergers.pdf
[4] https://www.ecopedia.be/landschapsbeheer/knotbomen
[5] http://environnement.wallonie.be/publi/dnf/vergers.pdf
[6] https://inventaris.onroerenderfgoed.be/erfgoedobjecten?status=-90&tekst=knotboom

Potential trade-offs

Private

- **[I]** Management of pollard trees requires skilled labour and is a big time investment. Conventional farmers often lack the time and skills to do this.
- **[I]** Unlike a forest or the most extensive forms of SRC like coppice forests, pollard trees need to be maintained regularly to avoid the trees being ripped apart by the weight of the branches.

Public

- **[I]** Pollard trees which are not maintained regularly form a danger for the people managing it and for possible bypassers.

How does this type of SRC impact management?

Land

Land needed for planting pollard trees is minimal, especially on pasture land where the shadows of the trees don't pose a problem but are rather a benefit during hot summers. This type of SRC therefore competes only minimally with other agricultural land uses.

Labour

Labour needs are high during the pruning season once every couple of years. Mostly trees are pruned manually with a chainsaw. There are however also possibilities to do this mechanised, drastically increasing the harvest speed (Poncin, personal communication). Harvesting is in winter and thus competes minimally with work on the land. When pruning a large number of trees in a short amount of time, there can be a need for external labour to assist. There is a smaller one-time labour need for planting the trees.

Capital

Financial capital needs are rather low. Planting costs and maintenance are minimal. The largest need for capital is the investment in the equipment for pruning, though many ways already exist (for example the initiative Goed Geknot[7] in Flanders) to contract volunteers or companies to prune the trees, in the case of Goed Geknot they prune the trees in exchange for the wood.

Knowledge

Knowledge on pollard trees is important for the most beneficial planting, use and maintenance of the trees. While this was part of cultural knowledge, much of this is potentially lost in conventional farms. To counter this, there are a number of trainings for maintenance of pollard trees, in Flanders organised by for example the Regionale Landschappen or Inverde[8].

[7] https://www.goedgeknot.be/
[8] https://www.inverde.be/opleidingen/bomen-knotten-basisopleiding

2. Hedgerows

Left: Figure 3.2: Picture of hedgerows. Credits: Desair, Jomme.

Right: Figure 3.3: Picture of landscape with hedgerows. Credits: INBO

What is it?

Hedgerows can be defined as a dense woody vegetation that is wider than a treerow, often managed as coppice and possibly combined with a few tall trees (Ecopedia, n.d.). The density of hedgerow systems in the province of Antwerp in recent years was around 24m/ha (Van Den Berge *et al.*, 2014, 2022). This is rather low compared with traditional still existing bocage installed in southern England and northern France where densities vary between 100 - 300m/ha, pointing to the historic loss in Flanders (Van Den Berge *et al.*, 2022). In the spatial analysis by De Vroey *et al.* (2024) they modelled the decline of hedgerows and tree rows based on an AI inventory of old maps such as the Ferraris (1775) and topomaps of 1873 and 1996. Over the years the amount hedgerows declined from 113.103 km to 27.969 km. The intensification of the agricultural landscape is the main reason for the disappearance of hedgerows (Deckers *et al.*, 2005). Although hedgerows were present on at least three of the farms that were visited, they were not the focus of the interview and therefore all information in this section comes from literature.

Hedgerows are characterised by a heterogeneous species composition with tall tree species in the tree layer, such as pedunculate oak (*Quercus robur),* silver birch (*Betula pendula),* common hornbeam (*Carpinulus betulus,...)* and typical shrub species in the shrub layer (species like *Prunus sp., Sorbus sp.)*. Hedgerows form linear, heterogeneous and uneven-aged ecosystems but in reality come in many forms. A practical guide to hedgerows set up for the province of Antwerp recommends systematic thinning with rotations from 4 to 8 years, depending on the tree species. If coppice management is installed, aftercare such as protection against game or livestock, is needed to assure continuous growth the following years (Van Den Berge *et al.*, 2022).

Throughout history hedgerow systems served several purposes such as demarcating parcels, containing livestock, protecting against wind and erosion and providing wood (Montgomery *et al.*,

2020). Because of their historic character they are now often regarded as cultural heritage (Van Driessche, 2019).

Values created by this type of SRC

Private

- **[I]** It provides woody biomass without confiscating much of the land area.
- **[I]** Hedgerows can improve agricultural production through shelter for animals, wind breaking, erosion control and by providing a habitat for pollinator species and pest management species

Public

- **[I]** Other than SRC on a specific plot, hedgerows are spread over the landscape and offer many services such as erosion control, microclimate, water regulation, carbon sequestration…
- **[N]** More than other SRC systems, hedgerows have a heterogeneous species composition and offer a range of habitats for insects, birds and mammals.
- **[N]** Hedgerow systems can provide good corridors for a number of species which increases the connectivity of natural habitats.
- **[R]** In Flanders and Wallonia hedgerows and hedgerow systems hold a cultural and historical significance. It creates a heterogeneous landscape and offers recreational opportunities.

Potential trade-offs

Private

- **[I]** Depending on the area and type of hedgerow specialised harvesting tools are needed.
- **[I]** Through phased harvesting the ecological value can be assured but this results in low biomass cost efficiency. Phased harvesting makes the wood lots uninteresting to sell and hiring the harvesting machines is not profitable.

Public

- **[N]** Hedgerows can disrupt the habitat of meadow birds who depend on open landscapes (Besnard & Secondi, 2014).
- **[R]** If planted in an open landscape, hedgerows can impact long distance views.

How does this type of SRC impact management?

Land

Hedgerows only confiscate a small percentage of the arable land. The majority of farmers do not see hedgerows as a barrier to food production or production potential (CPRE, 2022). Still the location determines whether hedgerows have a negative impact. For example hedgerows being present on the headlands can decrease manoeuvrability of machines.

Labour

Depending on the rotations and the system installed in the region, farmers need to harvest once every couple of years. Nonetheless, regular maintenance such as filling gaps in hedges and skillful pruning for stool regeneration may be necessary between harvesting rotations. Harvesting, planting and maintenance are labour intensive and time consuming and often farmers prefer to outsource this type of work.

Capital

The cost of planting, establishing and managing hedgerow systems can form a barrier for farmers. Prices for hedgerows vary from 0.8 euro/m to 6 euro/m (ILVO, n.b.). If protection is installed around the hedgerows such as barbed wire, prices can go up to 18 euro/m. However, subsidies and financial schemes (see section 7) can reduce the capital cost for installing hedgerow systems. In Flanders this is most notably the Hedgerow plan ("Houtkantenplan")[9] while in Wallonia this is the Yes We Plant action[10].

Knowledge

Hedgerows can be applied in very different ways using different species composition, practices and rotations. Knowledge is needed concerning the management of these species. Historically knowledge was orally transferred. Less interest in hedgerows might result in less transfer and even knowledge loss (Van Den Berge *et al.*, 2022).

[9] https://publicaties.vlaanderen.be/view-file/52236
[10] https://yesweplant.wallonie.be/home.html

3. Coppice woodland with short rotations

Left: Figure 3.4: Picture of willow trees in coppice woodland. Credits: Vercruysse, Louise.
Right: Figure 3.5: Picture of coppice woodland. Credits: Desair, Jomme.

Figure 3.6: Picture of mixed coppice woodland. Credits: Desair, Jomme.

What is it?

Coppice woodlands have historically been an important source of wood in Belgium, providing different types of wood at a faster pace than regular forests and in a larger volume than pollard trees. As long as the harvest is within 8 years, this is legally seen as a SRC. Three interviews were conducted on SRC that fits this description and provided all the information included here.

The coppice woodland can either be planted or naturally advanced, or a combination of both. All of the occurring tree species should fall under the selection of varieties considered SRC in Flanders e.g.

elms, willows and poplars, oaks and ratchet poplars and even some fruit-holding trees[11]. Several respondents showed a preference for indigenous species.
These types of woodland are often manually managed and no fertilisers nor pest management measures are generally used. In the planting phase, mowing may be carried out to reduce competition. The rotation length is rather long but to adhere to the legal definition of SRC should be at most 8 years. Harvesting is often done phased and often irregularly owing to the extensive nature and the use of the wood.

The wood is often used for heating. The longer rotations make for thicker stems which can readily be used in a stove. The wood can also be chipped and either spread on the field to enrich the soil or used for heating as well.

Values created by this type of SRC

Private

- **[I]** A small-scale SRC mixed woodland provides economic benefits, as the wood is usually used for domestic heating. By doing this, the user is independent from the energy market, which is seen as valuable, especially in times of volatile energy prices.
- **[I]** The management costs are limited. There is no need for large equipment. In the example cases, the management was done by the owner, without relying on external salary workers.
- **[I]** The trees can be a productive element in the agricultural landscape on soils that are more prone to waterlogging and inapt for conventional farming, for example through compaction.
- **[I]** The soil fertility improves, especially when the harvest residues are left.
- **[N/I]** The diversity of tree species limits the risk of plagues.
- **[N/R]** In some cases, the desire for more trees or to restore a traditional landscape, is the main motivation of the farmer to plant a coppice woodland.

Public

- **[I]** Planting a coppice grove can reduce erosion.
- **[I]** The trees can help to break the wind.
- **[N]** The ecological values of the plot are high, due to the diversity of species used and the non-invasive management. The coppice forest was stated to be a refuge for deer, rabbits and pheasants.

Trade-offs

Private

- **[I]** In wet areas, it is difficult to use machinery. The manual work, on the other hand, requires some manpower, especially when large amounts need to be harvested.
- **[I]** The shadow produced by the trees can cause loss of production. This was reported to be a 30% loss in the first 10m adjacent to the grove for potatoes, cauliflower and parsnip.
- **[I]** The leaves that fall into the crops can cause loss of value of the crop, this was especially reported to be the case for leeks.
- **[I]** Wild animals like wood pigeons that find a suitable habitat in the grove can cause damage to the crops, this was especially reported for cauliflower.
- **[I]** The land cannot be used for any other non-agricultural purposes that could be desired by the owner, like water reservoirs in one of the cases visited.

[11] https://lv.vlaanderen.be/steun/perceelsgebonden-steun/perceelsgebonden-ecoregelingen-en-agromilieuklimaatmaatregelen-9

- **[I]** The value of the land on which the trees are standing reduces significantly, this was reported to be a reduction from ten euros per square metre to two euros.
- **[R]** Not all owners find trees a pleasant or beautiful element in the landscape and would rather see an agricultural field with a nice crop.
- **[R]** Overhanging branches and the wild appearance of the grove can lead to disagreements between the owner and local residents or neighbours.

Public:

- **[I]** Trees planted on agricultural parcels were reported to lead to an increase in price for the remaining agricultural land. This posed a problem in the long term for the farmers who are in competition with the agency for nature and forest for acquiring new land, with the budgets of the agency, estimated by the farmer to be higher and thus unfair competition.
- **[R]** There can be a lack of respect for the grove by visitors and local residents, and there is a risk of fly-tipping.

How does this type of SRC impact management?

Land

This type of coppice forest is often planted on land that is unsuitable for agriculture due to being waterlogged or unproductive. This limits the competition of land with agricultural production. However, the land use competes with other non-agricultural purposes like a water reservoir, which was reported to be the preferred alternative for the coppice forest in one of the farms visited. Protection of the coppice forest from being cut therefore stood in the way of the owner to do as they pleased with this land.

Labour

Labour requirements for this type of SRC are low and seasonal. Wood can be harvested at a slow pace, constantly throughout the years, in phased harvesting or all at once, with the latter two requiring a higher peak in labour. Depending on the choice, there will be a need for external labour. In the case of one of the farms visited, the harvesting was done manually by one person. As harvesting is mostly done in winter the competition of labour needed for the harvest, competes minimally with working on the land.

Capital

The capital needed for a coppice forest is low. Harvest costs are high, depending on the need for external labour and for equipment. When only cleaved and dried for heating purposes like in one of the farms visited, the harvest costs are very low. If the wood needs to be chipped, like in one of the cases visited, costs increase due to the rent or purchasing of the chipper. Capital costs also come in the form of lost yield, as reported in one of the cases to be 10% for the adjacent parcel and opportunity cost for other uses, in this case being a water reservoir.

Knowledge

There is a specific knowledge needed on how to maintain the health of the coppice forest and the know-how to harvest it in a way that does not damage the stools. This skill set would be most closely linked to foresters although in none of the cases the farmers lacked these skills.

4. Small-scale extensive short rotation coppice

Figure 3.7 and 3.8: Pictures of small-scale extensive coppice. Credits: Vercruysse, Louise.

What is it?

The extensive short rotation coppice is a rather small area where wood is grown for personal use. One interview was conducted at a SRC that fits this description and all information included comes from this interview.

In contrast to the previous type, this woodland has less variation in the types of trees. The planting is deliberate and done for the purpose of producing SRC. The spacing of the trees is relatively wide and natural propagation or thinning can occur. The rotation length is shorter than the coppice forest though still rather long, between five and seven years. No fertiliser or pesticides are used. However, an overgrowth of shrubbery might be cut.

The wood mainly serves for heating purposes though composting and mulching could also be possible. In the case of the farm visited, the owner splits and dries the wood himself and uses it for his heat supply.

Values created by this type of SRC

Private

- **[I]** Planting SRC can be a way to extract value from a parcel of inferior agricultural quality, for instance a parcel that is prone to flooding.
- **[I]** The labour investment is relatively low. Depending on the size of the parcel, the work of harvesting, cleaving and drying is limited to a couple of days a year, with few people.
- **[I]** In the case of willow trees, there are few pests and the system can easily stay in place for multiple generations.
- **[N/R]** The SRC woodland is a refuge for deer, tits and turtle doves. These species are seen as positive by the farmer.

Public:

- **[N/R]** The SRC woodland is a refuge for deer, tits and turtle doves. These species are seen as positive by the farmer or owner as well as by the broader society.

Trade-offs

Private

- **[I]** There is a loss of land value, due to the tree roots that will remain. It is not recommended to plant this type of SRC on valuable farm land.
- **[I]** It is important not to wait too long to harvest the trees, as the labour can become too heavy. If the SRC is planted on a wet parcel, it can only be managed manually, as tractors can't access the land.

Public:

For this type of SRC no public trade-off was reported by the owner. Though the reference to valuable farm land being used could be interpreted as a public trade-off.

How does this type of SRC impact management?

Land

This type of coppice forest is often planted on land that is unsuitable for agriculture due to being waterlogged or unproductive. This limits the competition of land with agricultural production.

Labour

Labour requirements for this type of SRC are low and seasonal. Wood can be harvested at a slow pace, constantly throughout the years, in phased harvesting or all at once. In the farm visited, every year one day worth of work was needed, half a day for harvesting and half a day for cleaving the wood. The parcel measured 0,1 ha. Due to the aim of domestic heating, harvest is done quite small-scale and therefore not necessarily requiring external labour. In the case of the farms visited, the family helped out in exchange for a share of the wood. As harvesting is mostly done in winter, the competition of labour needed for the harvest, competes minimally with working on the land.

Capital

The capital needed for a small-scale extensive SRC plantation is low. Planting and maintenance of equipment are probably the highest capital costs due to labour mostly being farm labour, without the need for external help. Neither of these were mentioned in the farm visited as being a significant cost as the trees were propagated manually. The capital gained from this type of SRC comes from the saved costs of buying wood or other fuels for heating.

Knowledge

Knowledge needed for this type of SRC is similar to a coppice forest with knowledge needed on how to properly coppice the trees. In the farm visited, this clearly was still present for the farmer, who reported to do the maintenance of many woody landscape elements in the area.

5. Short rotation coppice as compromise between nature and production

Left: Figure 3.9: Picture of young short rotation coppice woodland with Canadian poplar trees. Credits: Vercruysse, Louise.
Right: Figure 3.10: Picture of short rotation coppice of 3 years. Credits: Desair, Jomme.

What is it?

With this type of SRC, the manager aims to find a good balance between efficient production and increasing ecological values. This type of SRC was encountered in two interviews, which provided all the information included below.

The tree variety is chosen because of its yield, and planted close together to ensure that the trees grow tall rather than wide to make them easier to manage mechanically. After planting, green manure can be applied. The harvest is done in phases, and the rotation length can vary between 3 (case of figure 3.10) to about 7 years (figure 3.9, recently planted). Harvesting can still be done manually but larger parcels can be harvested with dedicated machines as well. As with the previous examples, there is no use of artificial fertilisers or pesticides.

The wood mainly serves for heating purposes though composting and mulching could also be possible. In both interviews the wood was chipped and burned with the aim to increase their energy independence.

Values created by this type of SRC

Private

- **[I]** As with the previous examples, this way of producing SRC can be done as a side activity which doesn't have to be related to the main profession.
- **[I]** The production of SRC answers a desire to be energy self-sufficient.
- **[I]** It is one of the only ways to extract value from a wet parcel as farming on these parcels compacts the soil too much.
- **[N]** There is an increased biodiversity as compared to conventional farming.
-

Public:

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- **[I]** There is an increased interest for local wood to use for domestic heating, as energy bills become more expensive.
- **[R]** The public appreciates having more trees in the landscape.

Trade-offs

Private

- **[I]** The tree density of this type of short rotation is higher than in the previous examples. This makes the manual management more laboursome.
- **[I]** Harvesting with machines introduces a dependency on external labourers with the proper equipment which also increases the cost.

Public:

- **[I/N]** Using wood as the main domestic source of heating has some drawbacks, for instance the emission of possibly harmful pollutants. However, the respondent that made this observation is aiming to produce his own wood pellets, which burn more cleanly.

How does this type of SRC impact management?

Land

This type of SRC can still be planted on marginal lands but the increased focus on the production element also translates in the occupation of soils that could otherwise be used for food production. Therefore there can be a competition with other agricultural production for land.

Labour

As intensity increases, the labour need increases as well. This type of SRC is on the verge of still being manageable in an extensive way through harvesting with a chainsaw. However, it can also already be harvested with dedicated SRC machinery. This introduces a dependency on external labourers if the equipment is not owned by the farmer, which is rarely the case. This dependency can pose a risk as not many people own this type of machinery in Belgium and when there is only a short period of time with frost, all the parcels need to be harvested at the same time. On the other hand, if not enough parcels are available for harvest, the owner of the equipment can also decide not to harvest that year, leaving the SRC owners without new biomass.

Capital

With intensity also capital costs increase. Planting, weeding, fertilising and harvesting can all be done with dedicated machines, increasing either the investment cost or the cost of hiring external labour with the necessary machinery to do this.

Knowledge

As a part of the production process can be outsourced, there is potentially less need for specific knowledge. However, the ability to assess when the parcel is ready for harvest remains. Moreover, with increasing intensity there comes an increasing risk of pests and diseases because of decreased genetic diversity in the plantation. This increases the knowledge needed to recognize pests and diseases and act accordingly.

6. Intensive short rotation coppice with long rotations - Italian system

Figure 3.11: Picture of intensive short rotation coppice with long rotations 6 years into its second rotation. Credits: Desair, Jomme.

What is it?

Intensive SRC with long cycles is not practised much in Belgium. It is distinct from coppice woods in its homogeneity, larger scale and the aim for maximising the biomass yield rather than creating a multifunctional forest. This type of SRC was encountered in one interview which provided all the information included below.

Planting this type of SRC requires extensive planning due to its size and profit-maximising aims. This includes soil preparation, potentially fertilising, hiring a specialised planter and a number of labourers. Mostly the same species are used throughout the plantation, ideally in a mix of different varieties to increase the resilience of the plantation against diseases. The planting distance is larger, up to 2 metres, to accommodate for the longer cycles. In the first year, it can be necessary to replant a number of trees due to fall-out or damage from wild animals such as deer and rabbits. Harrowing to limit competition can also be recommended. In the provided example, the choice was made by the owners to prune the trees to concentrate the growing power in the two or three largest shoots. This significantly increases the amount of labour needed. Harvesting needs to be done with a forestry harvester due to the thickness of the stems. After a couple of cycles (two or three) the yield will drop and the choice can be made to leave the plantation to grow into a forest or to return to an agricultural use. For the latter the extensive root systems should be removed which is potentially a high cost and is a very invasive measure.

The wood that can be harvested from these types of SRC are of higher quality than all other systems described in this report. This is due to their homogeneity and the thickness of the stems, making the first two metres suitable for material such as poles and the paper industry for example. Nonetheless the owners reported to merely break-even financially due to high planting and harvesting costs. This calculation also did not take into account the own labour costs of the pruning. They did not sell to the paper industry because this would leave them with the rest of the trees that would still need to be processed into chips and sold. They chose to chip everything to have higher quality chips.

Values created by this type of SRC

Private

- **[I]** This form of SRC yields the most high-value biomass.
- **[I]** The long cycles decrease the maintenance costs (except for the pruning).
- **[I]** The large scale of this operation means that a large energy requirement of the owner could be met.
- **[I]** The parcels provide a quiet place to work manually during the prunings, this increases mental and physical well-being.
- **[R]** The SRC becomes a forest which houses a number of wild species which the owners cherish.

Public

- **[I]** The SRC resembles a (very structured) forest that is used for recreation.
- **[N]** The long cycles make it a fairly undisturbed young forest with a potential to house a number of species.

Potential trade-offs

Private

- **[I]** Even this intensive production method is not economically viable as an investment, making it an unattractive land use unless the alternatives like using or leasing it for agricultural purposes are not feasible.
- **[I]** This type of SRC is harder to retransform into agricultural parcels due to the extensive root systems and large trunks that will have developed over time.
- **[I]** The intensive nature of the plantation makes it more prone to damage from diseases and animals.
- **[I]** The aim of being a productive investment means that there is less flexibility in the management and every choice needs to be evaluated against its possible impact on the return on investment.
- **[I]** The older trees can spread both through suckers (plants that sprout from the roots) or seedlings. This can hinder the harvest and takes up energy from the tree that does not go to growth.

Public

- **[I]** The large scale of this form of SRC puts pressure on the available land for other purposes. The land could have been used for a more biodiverse forest or for the production of food, or both in the form of agroforestry. This means that telecoupling effects could take place. Farmers might also oppose the use of agricultural land for the production of woody biomass.
- **[N]** The impact of harvesting a large plantation of SRC with long cycles on the ecosystem is high. While this ecosystem will restore, the same species that populated the 8-year old SRC

are not necessarily able to repopulate the resprouting SRC for the first couple of years. This would be mitigated by phased harvesting but this is unfeasible in economic terms

- **[R]** The impact of harvesting a large plantation of SRC with long cycles on the landscape is big. This can be perceived as deforestation and provoke negative reactions from passers-by or residents in the neighbourhood.

How does this type of SRC impact management?

Land

As this type of SRC is focused predominantly on production, it is planted on moderate to good agricultural land and therefore stands in direct competition with other agricultural uses. It requires significant areas of land to achieve economies of scale for planting and harvesting which will increase its economic viability but inevitably also its competition with other land uses. In the case of the respondent, the SRC replaced maize cultures. The choice was made to plant SRC because the owners of the plot were not farmers and leasing their agricultural land to farmers was not profitable and cumbersome.

Labour

Labour requirements for this intensive type of SRC come in large peaks. Planting and harvesting are the main peaks while theoretically in between there is little work, therefore competing only to a very limited degree with labour on the farm or elsewhere. Experience from the case visited has shown however that much labour is required to have a well-maintained plantation. This includes replacing the trees that died in the initial year, which can be significant during an especially dry year or if, like in the case visited, many were damaged by rabbits or other animals. Another labour cost is keeping the plantation clean, meaning harrowing the first year and potentially managing plants like brambles throughout the whole cycle as this can go into competition with the trees before their crowns close or during spring and they can obstruct the plantation, making it impossible to go in and inspect for diseases or to harvest. In the case visited they also pruned the trees to focus the growth in three stems, which is not necessary but improves the quality of the chips. This is a large labour cost. Almost all activities require external labourers. Especially if the owner has no equipment.

Capital

The plantation requires a large investment. Planting is a large cost as are the investments in material for maintenance, unless done by external labourers which in turn would then be a cost. Harvesting needs to be done by professional foresters with forestry harvesters. In the case visited, the company that harvested the wood also bought it. This meant that the harvesting cost was deducted from the income of the woodchips. While the income of the woodchips covered the expenses of the planting, the maintenance (which was mostly unpaid own labour) and the harvest, the owners doubted that the second cycle would yield as much wood as the first and therefore if in the end the whole investment would be positive.

Knowledge

The knowledge needed for this type of SRC can be rather limited as there are companies that can assist from start to end, including the selection of the best yielding varieties, the checks for different types of damages and how to mitigate them to the maintenance and the harvesting. In the case visited, the information on the exploitation and which clones to use was provided by the company that planted the SRC and the company that provided the planting material. They also visited info events organised by Inagro. Apart from this the owners had experience in forestry and were

therefore able to supervise and perform many of the actions themselves. Knowledge on these types of SRC would not typically be within the expertise of conventional farmers.

7. Intensive short rotation coppice with short rotations - Swedish system

Figure 3.12: Picture of recently harvested short rotation coppice. Credits: Desair, Jomme.

What is it?

Large scale SRC with short rotations is the textbook example that is most often referred to and which is used for the intensive expansion scenario in the report of Callebaut et al. (2024). It is also the most intensive form of SRC that is found in Belgium. Like its counterpart with longer cycles, it is not much prevalent in Belgium.

Intensively managed SRC requires soil preparation, fertilisation, and harrowing. The choice can be made to apply herbicide before planting and after the first harvest to reduce competition. Insecticides can also be used in case of plagues such as Wilgen Haantje (*Chrysomela vigintipunctata*) which is common in Belgium. Planting is done mechanically with an adapted leek planter for example. The cuttings are planted close to each other in rows, to facilitate harvesting. Due to the size, mechanical harvesting is necessary. Due to the short rotations of one to three years, this can be done with an adapted maize harvester. Fertiliser can be applied after each harvest to maximise the yield.

Wood from this kind of SRC is used mostly for energy production. The wood can also be chipped and used for other purposes such as composting or as a cover in horticulture or gardens, but the price is often too low to have a financial profit.

Values created by this type of SRC

Private

- **[I]** This type of SRC often has the highest biomass yields
- **[I]** When multiple hectares are planted, it can provide biomass (bi)yearly and make the owners independent for their heat demand
- **[I]** The plantation can be reconverted into an agricultural parcel by removing or ploughing in the root systems. This is easier than in other forms of SRC due to the thinner trunks.
- **[N/R]** Emitting less greenhouse gases is good for the image of a nature-based entreprise.
- **[R]** The plantations can be experienced as a nice element in the landscape, housing birds and other wild animals

Public

- **[I]** The local supply of biomass for energy or other purposes makes the local market more independent and reduces emissions from transport.
- **[I/R]** The economically sustainable use of SRC shows that integrating a nature-based solution for heat requirements can be showcased as an inspiring example.
- **[N]** An intensive SRC still has a certain ecological value through creating stepping stones for different animals.
- **[R]** The plantation can be experienced as a nice element in the landscape.

Potential trade-offs

Private

- **[I]** The financial gain from this type of SRC is still low and uncertain as long as the prices of woodchips or fuel are low.
- **[I]** The intensive nature of the plantation makes it vulnerable to shocks and unforeseen circumstances such as plagues that affect the growth rate and mild winters that impede harvesting. Those can have a large impact on the financial gains.
- **[I]** The machinery for planting and harvesting are not readily available and the owners are therefore dependent on those few persons that do have these machines for their services.
- **[I]** The plantation creates shadow for the neighbouring parcels which can therefore have a reduction in yields.
- **[I]** The plantation provides a habitat for animals such as deer which can damage neighbouring crops.
- **[I]** Infestations of the genetically less diverse plantation can take on large proportions. In the case visited an infestation of leaf beetles proved to be a real nuisance for adjacent houses which were covered with the bugs.

Public

- **[I]** The plantation of large areas of SRC is in direct competition with other agricultural purposes, potentially having tele-coupling and spill-over effects.
- **[N]** The harvesting of this intensive type of SRC means that a large habitat is lost which takes at least a year to re-establish. If there is no phased harvesting, this affects wildlife and of course less mobile fauna and flora.
- **[R]** The harvesting of this intensive type of SRC means a drastic change in the landscape

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How does this type of SRC impact management?

Land

As this type of SRC is focused predominantly on production it is planted on moderate to good agricultural land and therefore stands in direct competition with other agricultural uses. It requires significant areas of land to achieve scale benefits for planting and harvesting which will increase its economic viability but inevitably also its competition with other land uses. In the example visited the land was taken out of seasonal lease to farmers to plant SRC.

Labour

The labour requirements for this type of SRC come in peaks of high requirements for planting and harvesting but are limited in between rotations where the plantation is only harrowed and fertilised the first year after establishment and after each harvest. All interventions are done mechanically and often by hired labour. In the case visited the owners put in very little of their own labour. The consequence is however that they depend on this hired labour and since this type of SRC is not abundant in Belgium, there are only a few companies that do the exploitation. If these companies were to stop, they would run into problems operating the plantation. In the case visited they reported that this is a plausible scenario as the number of plantations the harvester could visit was dropping dramatically.

Capital

The limited own labour that needs to be invested into this type of SRC is compensated by a higher capital need as all external labour needs to be paid. If the harvest is sold, the investment costs are limited to the plantation itself as there is little need to buy the machinery which are owned by the hired labour. If the chips are used on site there is of course the need to invest in infrastructure such as a covered space for drying the chips and the heating installation which uses the chips. Both are substantial investments.

Knowledge

The knowledge needed for this type of SRC can be rather limited as there are companies that can assist from start to end, including the selection of the best yielding varieties, the checks for different types of damages and how to mitigate them to the maintenance and the harvesting. In the case visited the owners were assisted by Inagro to set up the exploitation plan and to oversee the plantation. The knowledge on how to manage this kind of SRC would not typically be within the expertise of conventional farmers.

3.2 Synthesis and comparison of the values of SRC

From the data we distinguished seven types of SRC. As expected, many of the benefits and disadvantages are found in multiple types. In a similar measure, for most types, all three value types could be identified. In the next section, we will compare the predominant values and their distribution.

However, it is worth repeating that the difference in values brought forward in the types of SRC are sourced from different data sources. The data of SRC types 1 (Pollard trees) and type 2 (Hedgerows) were from literature and therefore analysed mostly by researchers, while the other types were identified by means of interviews with practitioners.

Instrumental values

The instrumental values that were mentioned by the interviewees or identified in the literature, can be roughly subdivided into two categories. The majority of the arguments mentioned can be considered economic in nature. By economic, we mean benefits and trade-offs that relate to inputs such as land, labour and time, and material outputs, such as biomass, energy and of course financial profits. The second category relates to instrumental reasoning in terms of regulating ecosystem benefits, which includes erosion control, soil fertility, an increase or decrease of pests and interaction between the SRC and other crops, for example shade and damage to crops by increased presence of wildlife.

The data of the more extensive types of SRC shows that the input costs are minimal since, in the cases of extensive SRC we identified, a limited amount of land is needed, and the management can be done manually, usually without hiring extra labour force. Moreover, SRC is a good option to extract some economic value from land with an inferior agronomic quality (see “management” section). In the more intensive SRC types, the investments are larger and the lack of sufficient revenue to make it a viable economic activity, is more frequently mentioned as a trade-off.

Five of the eight respondents mentioned that energy independence is an important motivator to grow SRC. The biomass was mainly used to provide heat for domestic use, e.g. for heating the home or office. Type 6, Intensive SRC with long rotations was the only type where the owners did not use the wood themselves but grew it for commercial purposes. In the examples of intensive SRC types we have seen, the land input for this type is large and the management requirements strict, but the financial gain is limited.

Among the public instrumental values, energy independence of the region and local energy production are mentioned as important factors, both in the extensive and the more intensive SRC cultivation types.

The category of regulating benefits of SRC includes some specific private trade-offs and public benefits. One positive regulating benefit that was brought forward by the interviewees is that SRC helps to protect against erosion, which can be an important motivator in erosion-prone areas. Soil fertility through the application of the chips on the field or because the soil on which the SRC is planted recuperates, is another frequently mentioned benefit. It is important to note that much of the gained soil fertility of the soil under the SRC will be lost again when the SRC is removed and the root system uprooted or ploughed in.

Some trade-offs relate to the interaction between the SRC and adjoining agricultural crops, such as a strong decrease of growth of arable crops due to the shade shed by the SRC. The occurrence of pests within the SRC itself is another trade-off, but, as mentioned above, this depends on the type of SRC. Extensive types, especially those with a certain variety of tree species, are well-protected against pests, while the intensive cultivation presents a greater risk of pests. It is important to note that these pests are SRC-specific (Wilgenhaantje and rusts) and therefore pose no threats to nearby agricultural crops.

Intrinsic values

Intrinsic values are those that refer to the existence of SRC as being valuable as such, as an end in itself rather than, or next to being a means to other ends which are explained above. In this category

it was difficult to distinguish between public and private values, as, in this study, we identified descriptions of the connection between the individual and nature while also surpassing the private as intrinsic values. Therefore, we coded most of them as public values, except when the respondent explicitly referred to him or herself as explicitly having this value, as opposed to the rest of society (for instance in an expression similar to “I find more trees in the landscape important - as opposed to my neighbours”).

The intrinsic value of SRC as a refuge for a number of animals is mentioned in relation to almost all types of SRC. Deer and birds such as pheasants, tits and pigeons are often identified and appreciated by the land users.

The more intensive the SRC cultivation is, the less ecological value can be expected. The impact of harvesting in Type 6 -Intensive SRC with long rotations (Italian System), for example, has a particularly high ecological impact, since the long rotation allows for the ecosystem to develop well, and the harvesting is done mechanically with a clearcut system. In all systems, the habitat takes at least a year to re-establish after a large-scale mechanical harvest.

Relational values

The category of relational values are values “grounded in specific relations between humans and natural objects (or between humans but mediated by those objects)” (Chan, Gould and Pascual, 2018). In this category, we included all statements made in relation to culture, tradition, landscape and aesthetics.

The wildlife mentioned above is cherished by the land user, increasing the pleasure and happiness derived from the landscape. Not only the land user but also the wider public shares this appreciation of having more trees in the landscape, and in some cases the SRC can provide recreation. Some specific tree uses, for instance pollard trees, are seen as an important cultural heritage, and linked to traditional uses of local wood. The relational value of a traditional landscape with more woody elements is an important motivator for the land user to plan SRC. However, other land users might find an open, agricultural landscape aesthetically preferable.

The aesthetics of the woodland was more specifically mentioned in one case (type 3 “Coppice Woodland with Short Rotations”), where the interviewee addressed the “wild” look of the woodland as a public disadvantage. While a wild look might be easily related to the extensive management, the aesthetics of SRC is also dependent on the diversity of tree species used.

Interlinkages of values

In all of the SRC types, both those based on literature and those based on interviews, the instrumental values are mentioned far more frequently than the intrinsic or relational ones. For the interviews, this can be explained by the fact that several of the questions were specifically asking about the experience of the land users of instrumental benefits or trade-offs. Furthermore, intrinsic values are more personal in nature, and are less likely to arise in literature based on experiments that did not seek to identify these specific value types related to SRC.

In two interviews, related to the more extensive SRC type 3 (coppice woodland with short rotations) and type 4 (small-scale extensive SRC), the respondents expressed that their primary motivation for cultivating SRC were intrinsic and relational values: they found it a beautiful use for a plot of land

that was inferior as farmland. All other respondents identified instrumental values as the primary motivator, and within this category, energy independence the most recurring one. The type of SRC that is cultivated is therefore partially dependent on the values of the land users. For some, the choice is made by a desire to have more trees in the landscape, which leads to a choice for more extensive types. Since most respondents referred to energy independence, this needs to be taken into account when developing policies that promote SRC.

The most prominent trade-off of values exists between the economic instrumental values and the intrinsic values of biodiversity. In the more intensive SRC types, more biomass is produced, but the ecological benefits are lower than in the extensive SRC types. This has mostly to do with the type of management. Manual planting and harvesting is less intrusive to the established ecosystem than mechanical management. Furthermore, the type of SRC can also have an impact on the regulating benefits. More diverse woodlands can cause a higher increase in soil fertility, increasing the water storage capability and helping water purification. They also create a better habitat species contributing to natural pest control.

As the instrumental and specifically the economic arguments are often identified as important, in what follows, we will take a closer look at the impact and opportunities of integrating different types of SRC on farm management, from an economic perspective.

3.3 Synthesis and comparison of the Impact of SRC on farm management

Each type of SRC has a different impact on farm management. In this section we discuss this impact on the main determinants already discussed: land, labour, capital and external expertise needed. To be able to compare the different types we also discuss these impacts in relation to the amount of biomass yielded. While the information included is based on the interviews, we contrast them with literature where appropriate to cope with the limited amount of interviews. The impacts are summarised in table 3.1. It should be noted of course that the actual impacts will depend much on the specific context and that a large number of other factors can influence the final outcome. The table should therefore more be seen as a conservative estimate, based on the experiences that were captured in this study.

Table 3.1: Impact of the different types of SRC on farm management.

	Pollard trees	**Hedgerow**	**Coppice forest**	**Extensive SRC**	**Nature-production SRC**	**Italian SRC**	**Swedish SRC**
Biomass yield	Low	Low	Medium	Medium	High	Very high	Very high
Type of agricultural land required	Strip of low to high quality	Strip of low to high quality	Parcel of low quality	Parcel of low quality	Parcel of low to high quality	Large plot of medium to high quality	Large plot of medium to high quality
Amount of land needed per unit of biomass	High	High	Medium	Medium	Low	Very Low	Very Low
Own labour needed	High once	Low each	Low each	Medium each	High to low	Low to	Low

	every 5-8 years	winter or high every 8 - 10 years	winter or high every 8 years	winter		medium	
External labour needed	Low	Low	Low	Very low	Low to high	High	High
Amount of labour needed per unit of biomass	High	High	High	High	Medium	Low	Low
Reliance on external expertise	Medium	Low	Low	Low	Medium to high	High	High
Investment cost	Low	Low	Low	Low	Medium to high	High	High
Maintenance cost	Very low	Very low	Low	Low	Medium	Medium	High
Financial revenue	Negative to low	Negative to low	Negative to low	Negative to low	Negative to low	Negative to low	Negative to low

Biomass is one of the most frequently mentioned reasons for planting SRC. Each type of SRC has a different type and amount of biomass yielded. Longer rotations will lead to better quality wood and higher periodic yields while the shorter rotations will provide a more constant yield of wood chips with a high bark to wood ratio, which is often regarded as of lesser quality for heating and material applications, but is better as a food source for animals. The total biomass yielded increases when going from left to right in the table. The linear elements are regarded to provide less biomass as there are simply less trees present on a parcel in comparison to types of SRC that cover the whole parcel. It is however important to note that the individual coppice tree can provide more biomass than individual trees in the other systems as there is less competition. Coppice forests and extensive SRC can be regarded as having a medium yield, resembling the yields from young forests that are thinned. The more intensive types of SRC have a high to very high yield, on average higher than deciduous or coniferous forests, with the side note that the type of biomass is of course very different and assuming that the forest would not be harvested in its totality. A comparative study of Inagro (Verdonckt, 2010) measured the yields of coppice trees, coppice forest, hedgerows and SRC in a case study (table 3.2). It is of course important to note that depending on the species, management and soil, large differences can occur.

Type of SRC	Yields in cubic metres of dry wood chips[12]	Approximate comparable yields
Willow pollard tree (Type 1 - harvested each 7 years)	4,8 m^3 chips/10 trees	~ 68 m^3/ha*year If we assume that 1 tree is about 100m^2
Mixed coppice forest (Type 3 - harvested every 10 years)	170-500 m^3 chips/ha	~ 17-50 m^3/ha*year

[12] This equals about 0,2-0,3 tons, depending on the species and type of wood

Hedgerow with full-grown trees left uncut [13] (Type 2 - harvested every 15 years)	10-30 m^3 chips/100m	~ 15-50 m^3/ha*year If we assume the hedgerow is about 20m wide
SRC (type 5, harvested every 3 years)	165,50 m^3 chips/ha	~ 55 m^3/ha*year

Table 3.2: comparison of yields for Types 1,2,3 and 5, based on Verdonckt (2010)

For the type of agricultural land needed we can distinguish between the linear elements of pollard trees and hedgerows, which take up little space and can therefore be planted on productive agricultural soils without much opportunity costs for agricultural production. Of course they can also be planted on less productive soils. The coppice forests and extensive forms of SRC are often planted on agriculturally less favourable soils in smaller patches. This is because they form an extra source of wood but do not require high yields as long as they can provide enough for domestic heating, which for an average household would be about 3-4 cubic metres per year (Brouns, 2013; Verdonckt, 2010). The more intensive forms, which are required to have a high yield to justify the investment, demand more productive soils. Therefore only the last types are really in strong competition with food production. However, when regarding the amount of biomass that each SRC type yields per unit of land, the more extensive forms require much more land than the intensive forms. The final choice of course depends on the local (nature, landscape and economic) conditions and needs (nature, landscape and economic).

The own and external labour that is needed to plant, maintain and harvest the different forms of SRC depends on the rotations and the amount of wood that is harvested each time. Longer rotations imply that there is more biomass to be harvested and larger areas imply a higher dependency on external labour to cope with these peaks. Pollard trees, hedgerows and coppice forests require much labour once every harvest cycle or a bit every year, spreading out the labour requirement but decreasing the efficiency of the labour invested. As these are only planted on a small scale, it often suffices to work with their own farm labour, in some cases supplemented with family or volunteers. The more intensive forms require less own labour as these are managed in a mechanised way, therefore relying much on external labour for planting, managing and harvesting. This is closely linked to the need for external expertise which also increases with more intensive and mechanised forms. When looking at the amount of labour needed per unit of biomass the picture changes drastically. The most intensive forms become the most efficient through mechanisation and high yields. The flipside of mechanisation is of course the substitution of manual labour with energy and capital. The energy use per unit of biomass harvested increases with every extra step that is done in the production cycle (Sperandio *et al.*, 2021)

The external knowledge needs are, as previously mentioned, related to the intensity of the SRC. The more intensive forms are oriented towards high productivity and therefore require the best performing propagating material and a strictly managed production cycle. These are rarely within the realm of expertise of farmers and therefore require dedicated companies or research facilities to assist. While this expertise was partly to be found in Inagro and University of Antwerp, there seems to be currently a gap of knowledge production and dissemination, mainly thus affecting the intensive forms of SRC.

[13] “Haag met overstaanders” or “haag met doorgroeiende bomen”

Looking at the costs of planting, maintaining and harvesting SRC, the investment costs for the extensive forms are rather low while those for intensive forms are high. The former only need a chainsaw and a small space to dry the wood and in some cases a woodchipper. For pollard trees, investment costs can be higher because of dedicated material needed to work safely on a height. The more intensive forms require investment of space to dry the chips if they are used on site and machinery to maintain the SRC, such as to harrow. Harvesting machines in Belgium are generally not owned by farmers with SRC but by a few private companies and persons who rent their services to the owners of SRC. This, of course, decreases the investment cost but increases the harvest cost. The financial revenue for all systems is zero to low or even sometimes negative. While this might be a deterrent for many people to consider these biomass production systems, it is important to note that the financial value is only one value that is considered by the owners. The direct use of the biomass is a primary reason for planting SRC. Indirect uses and other values like the intrinsic and relational are also deemed worth planting SRC for. The financial revenue would increase when the demand for woody biomass increases or when the prices of the products it can substitute (like fossil fuels for example) increase. In Verdonckt (2010) three case studies are highlighted of farmers that use different types of SRC for heating purposes in a financially beneficial way. The financial benefit came from avoided fossil fuel costs and state support for heating installations. The last point brings us to another way to increase the revenue of SRC, which is to subsidise more (see also the section in this report on the different subsidising schemes already available) or when payments for the public values SRC provides are remunerated.

4. Discussion on the main benefits and trade-offs of SRC on farms

Our research shows that SRC comes in many shapes and sizes and that motivations for planting it are manyfold and variable. This means that there is no one-size-fits-all strategy that policy can implement to incentivize farmers to adopt SRC. In this section we will discuss the main benefits and trade-offs that emerged from the interviews and put them into perspective with literature where possible.

4.1 The benefits of SRC on farms

The benefits of SRC on farms centre around the values delivered by SRC and the efficient allocation of the available factors of production of land, labour, capital and knowledge. The main stated benefits were the heat demand, the use of chips to increase the soil carbon content, and the species that are associated with the SRC. From previous research we can also add the prevention of soil erosion, the prevention of nutrient leaching and the use as feed.

Covering heat demand

Heat demand is often present at farms. This can be in the form of domestic heating or heating of parts of the agricultural infrastructure of the farm such as barns or greenhouses as was the case for a number of the cases visited for this research. However, also other heat demands could exist that did not come up in the field visits such as for drying hay or for heating water or dairy products (Shine *et al.*, 2020), or even the drying of the woodchips themselves.

For generating 1.000kWh, about 1 cubic metre of dry chips (moisture content less than 30%) or 0,2-0,3 tons are necessary (Verdonckt, 2010). For an average household about 35.000 kWh are needed yearly, amounting to about 8,75 tons. Practical examples of farms (Verdonckt, 2010) but also municipalities[14] with varied heat supply needs, show the economic viability of this system. An assessment of the specific energy and therefore biomass need, is of course needed for each case and therefore hard to generalise. It is possible to state, however, that linear and extensive types of SRC are generally sufficient for domestic heating (Chambers *et al.*, 2010). Larger energy requirements are easier to meet with large scale SRC as the linear forms will increase the logistical costs. To put this into perspective, one of the respondents had a large greenhouse that was warmed with woodchips from 4 ha of SRC. In the study of Verdonckt (2010), the same order of magnitude was reported for another farmer with a heated greenhouse.

Increasing soil health

Soil organic carbon is imperative for a healthy soil. It holds the soil together, ensuring a good soil structure. This soil structure increases the soil permeability for water, water retention capacity, soil fertility and the soil health in general[15]. Soil organic carbon content is known to decrease in both

[14] Projects include: “Kempens energiehout”, “Loket onderhoud buitengebied”, “HOUT=GOUD”, “Limburgs groen voor een groene economie”, “Trees from Traffic”, “Houtige Biomassa” and “Stère” (Desair et al., 2022)
[15] https://ilvo.vlaanderen.be/nl/dossiers/bodem-koolstofopslag

Flanders and Wallonia (Gentile *et al.*, 2009). Maintaining and increasing soil organic carbon content was even identified as the main soil challenge for Flanders for the coming decades (Ruysschaert *et al.*, 2021).

The wood harvested from SRC can be used to improve the soil organic carbon content, as was already practised by some of the interviewees. Improving soil organic carbon contents on the field can be done with SRC in two ways. The first is through direct spreading and ploughing in of the woodchips on the field. The woodchips can be superficially ploughed into the soil in autumn. They decompose slowly over the next few years, immobilising nitrogen in the process, which prevents its leaching out. However, care should be taken to not plough in the chips too deep as the effect of the nitrogen immobilisation could lead to nitrogen hunger in the crop (Vervoort et al., 2020). This can be avoided through using fresh chips, combining it with a green fraction or to work in the chips in the autumn right before sowing in a green catch crop (Willekens, 2022). The soil services of Belgium did a field test and modelled the soil carbon content for applying a one-time dose of 150 m³ of fresh chips/ha, which would be about 75 m³ of dry chips. This would equal about 0,3 ha of intensive SRC (type 7) or 110 pollard trees according to the calculations of Verdonckt (2010). The tests showed that it would be beneficial to afterwards apply 40 tons/ha every 5 years, which is about 10 tons and would come from about 335m of hedgerows (Vervoort *et al.*, 2022). Taking a square field of 1 ha, this would mean it is almost entirely surrounded by hedgerows or three of the four sides with SRC of 10m width.

The second option is to compost the chips together with a green fraction like manure or grass. This is of course especially interesting for farms which already produce their own manure or have large green fractions. The mixture should be about 60% volume of brown (woody) material and 40% green material (Willekens, 2022). After composting, it can be applied in doses of about 10 to 15 tons per hectare each year. This means that at least 6 tons of chips are needed per hectare per year. 15 pollard trees would give this amount of chips every 7 years according to Verdonckt (2020), meaning that you would need about 105 trees which would cover about a hectare. An intensive SRC could, according to the same study, deliver this with 0,4 hectares in phased harvesting.

Apart from the application of wood, the extensive root system and the leaves also increase the soil organic carbon content of the soil underneath the SRC and just adjacent to it (Chiartas *et al.*, 2022).

Preventing soil erosion

Soil erosion is a widespread problem in Belgium with 19% of the soils in Wallonia and 14% in Flanders being under risk of erosion (Gentile *et al.*, 2009). Due to the extensive root system, absence of soil tillage, constant soil cover and high interception rate, there is less erosion under SRC (De Somviele *et al.*, 2009). The main factor influencing the erosion mitigation potential of the different types of SRC is their ground cover. This means that any type of SRC has the potential to mitigate erosion as long as there is a cover crop included. This is however easier with linear elements and more extensive types of SRC as there will be more light reaching the ground than in intensively managed SRC types.

It is important to note that the intensive types of SRC are often planned to be removed or replanted every 20 to 30 years (Desair et al., 2022). This includes removing the root systems which will greatly increase erosion at that point in time.

Preventing nutrient leaching

The water quality in most of Belgium is below the targets of the Water Framework Directive (VLM, 2023). Agriculture is a large contributor to the pollution, especially concerning nutrients. SRC can reduce leaching of both nitrogen and phosphorus (Livingstone *et al.*, 2021). This application is mostly done with linear forms of SRC (Johnston & Sherry, 2023), but larger areas are of course also possible.

Supplementing feed demand

Even though this was not mentioned in the field visits, SRC can also provide a source for feed. Industrialised farming practices have standardised feed and increased the amount of time cattle spends in a barn rather than grazing on a field (Legrand *et al.*, 2009). This has resulted in a lack of micronutrients for cattle (Spears, 2000). Trees have historically been a food source for animals and can still provide this service, mitigating the nutrient deficiencies and saving the farmer on expensive supplements (Kunkle *et al.*, 2000). A comprehensive guide on how to include fodder-trees on a farm has recently been published for Flanders (Van Colen *et al.*, 2022) and a dutch website[16] provides an overview of the micronutrient delivered by each tree.

The specific need for each farm needs to be assessed and matched with the species used in the SRC. The types of SRC that would be feasible as a feedstock are the ones that include young twigs that are the easiest to digest and most nutritious. Therefore only the coppice forest and the intensive SRC with long rotations are not feasible. As to our knowledge, there are multiple practical cases being rolled out in Belgium (e.g. Regionaal landschap Noord-Hageland, CTA Strée) but no scientific literature has been published on the subject in our regions.

Financial benefits

As expressed by the respondents, SRC is not a financial investment with a good interest rate. A financial analysis of an SRC plantation for a farm in Belgium concluded that the investment would be profitable after 21 years, meaning 7 rotations of 3 years (El Kasmioui & Ceulemans, 2013). The profit was nonetheless rather limited with only 16,3 € ha^{-1} $year^{-1}$. The same authors stated that SRC in Europe is not financially viable, unless a number of additional conditions are fulfilled, such as high biomass prices, high yields and government support (El Kasmioui & Ceulemans, 2012).

However, it was clear that most respondents did not see the SRC as an investment, the financial benefit can be achieved through substituting other costs like heat demand, but also compost or feed. Multiple studies have demonstrated the potential for SRC to be an economically feasible alternative for fossil fuels, though with a high investment cost for the heating installation. The multiple factors that influence the profitability for a farmer and a private investor are detailed in Desair et al. (2022).

However, different subsidies and income support schemes are available for the seven types of SRC. In Flanders subsidies can be obtained for pollard trees (1), hedgerows (2), coppice woodland with SRC (3), small scale extensive SRC (4), SRC as compromise between nature and production (5), the Italian (6) and Swedish (7) systems and agroforestry. In policy documents no distinction is made for types (3-7) and they are categorised as one.

Currently agriculture in Europe is steered by the Common Agricultural Policy (CAP), initially installed in 1962, now active under the 'CAP 2023-2027'. The newly approved Strategic Plans are designed to

[16] https://www.voederbomen.nl/voederwaarden/

make a significant contribution to the ambitions of the European Green Deal, Farm to Fork Strategy and Biodiversity Strategy. Each Member State proposed their incorporation of CAP in their legislation. Therefore Belgium, consisting of two regions, Flanders and Wallonia, is the only country with two separate CAP Strategic Plans. In Flanders, subsidies for the seven SRC types can be obtained as VLIF-non-productive-elements, agri-environmental schemes or management agreements. VLIF is financial support for sustainable investments on farms that contribute to improving biodiversity, improving soil quality, improving water quality, habitat protection, erosion control,…[17] In the following section, possible subsidies are listed for each of the seven types of SRC.

- **Pollard trees (1) and hedgerows (2)** on farmland can be installed using VLIF subsidies as non-productive elements on the farm. Farmers can get up to 100% financial support for planting if the prescribed conditions are respected[18]. Under the CAP's second pillar as well, the farmer can engage in **management agreements**[19] (beheerovereenkomsten) with the Flemish Land Agency (Vlaamse Landmaatschappij, VLM). These agreements, installed to improve overall biodiversity, last for 5 years, where you receive a yearly payout. For **pollard trees (1) and hedgerows (2)** a farmer can receive support for yearly pruning (1.92euro/m), coppicing (25%: 1827euro/ha/year or 0.84 euro/m - 75%: 2882euro/ha or 1.33 euro/m) and pollarding (8.51euro/tree).
- Subsidies for **SRC types (3), (4), (5), (6), (7),** which can be approached as the more intensive types of SRC, are integrated under agri-environmental schemes. On the website of the Agency for Agriculture and Marine Fisheries these measurements are found under 'area-based' support: perennial cultivation with positive impact on environment, climate and/or biodiversity. Support up to 600 euro/ha can be received under the condition that the plot has a minimum of 0.3ha, the density is more than 1000 trees/ha and that the cultivation is harvested within a maximum of 8 years. To receive the total amount, a yearly application needs to be submitted. No subsidy is available solely for the installation of these types of SRC.
- For the installation or management of **agroforestry** subsidies exist, both under the agri-environmental schemes. But VLIF support also offers financial support for the installation of agroforestry on the farm as non-productive elements. The agri-environmental scheme for the installation offers support with up to 75% of the costs being repaid[20]. For maintenance a farmer can receive up to 270 euro/ha for the agroforestry system[21].

[17] https://lv.vlaanderen.be/subsidies/vlif-steun/niet-productieve-investeringssteun

[18] https://lv.vlaanderen.be/sites/lv/files/2024-01/Fiche%20NPI%20-%20kleine%20landschapselementen%20%28KLE%29.pdf

[19] https://lv.vlaanderen.be/subsidies/perceelsgebonden/vlm-beheerovereenkomsten-de-verzamelaanvraag

[20] https://lv.vlaanderen.be/media/8514/download?attachment

[21] https://lv.vlaanderen.be/media/8874/download

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Table 4.1: Financial support for installation and maintenance of categories of SRC.

	Installation	support	Maintenance	support
Pollard trees (1) **Hedgerows (2)**	VLIF for non productive elements	100%	"beheerovereenkomsten"	Pruning Coppicing pollarding
SRC-types (3) (4) (5) (6) (7)	"Agromilieu Klimaatmaatregelen"		"Agromilieu Klimaatmaatregelen"	€600/ha
Agroforestry	1) "Aanplant boslandbouwsysteem" 2) VLIF	75%	"Onderhoud boslandbouwsysteem"	€270/ha

Efficient allocation of land, labour, capital or knowledge

From the analysis of the factors of production it became clear that there is a trade-off between the four factors when regarding different types of SRC. On farms where there is sufficient land and capital, intensive forms of SRC can provide an interesting diversification both financially and ecologically. A study in Bavaria, Germany, investigated the difference between farmers that did own SRC and those that did not (Hauk *et al.*, 2014). They concluded in the same fashion that the owners of SRC on average had larger farms and leased a smaller proportion of the land that they cultivated. This gave these farmers more independence and room to experiment with different crops. We did not see this same trend in our research though the same principles would probably apply if SRC were to become more mainstream. The respondents of our study demonstrated that small-scale SRC can be interesting on those lands that are not productive (anymore). It was only when heat demand was large that this was not considered a viable option.

Should farms have labour to spare, the more extensive or linear forms of SRC provide an opportunity. These often require manual labour in the winter. Pollard trees can take up to one day to harvest four trees, while in the same time 2 hectares of the intensive SRC with rotations of less than 4 years can be harvested with appropriate machines. New mechanical harvesting technologies are nonetheless also emerging for the more extensive types. A small dedicated machine can drastically increase the harvesting rate of pollard trees to up to 40 per day while also increasing the safety for the harvester (Personal communication, O. Poncin, 29/05/2024). The more intensive forms of SRC also require less manual labour and can be almost fully outsourced from planting to harvesting. The basic machinery needed are often already present on the farm and the dedicated machines are brought by the externally hired professionals. This also makes for an efficient machine-sharing economy.

Increasing (functional) biodiversity

Agriculture is dependent on a number of ecological processes which in their turn depend on biodiversity (Van Gossum et al., 2014). SRC can increase biodiversity (Vanbeveren & Ceulemans, 2019), especially in agricultural landscapes where little natural elements are left. Introducing SRC in landscapes where there are between 2% and 20% semi-natural habitats has the greatest added value for biodiversity (Verheyen *et al.*, 2014). Unfortunately, in some agricultural landscapes the biodiversity value is already so low that it cannot be resolved using SRC (Pedroli *et al.*, 2013). This

means that SRC cannot be seen as a unique measure that will solve the biodiversity decline in Belgium but one that can play a part in a broader strategy.

More directly affecting the farm, SRC can offer a habitat for natural enemies of pests that can affect agriculture (Verheyen *et al.*, 2014). This means that in the longer term and when part of integrated pest management, SRC could increase the productivity of adjacent crops or at least lower the costs of pesticides. This was however not reported by any of the owners of SRC and likely therefore requires a better strategy and monitoring.

Biodiversity is mainly higher in extensive, small-scale and heterogeneous SRC plantations that are cleverly built into an agricultural landscape to connect the fragmented nature. Likewise, the integrated pest management with SRC is mostly with the more extensive and linear types of SRC (Garratt *et al.*, 2017).

Attracting fauna and flora

SRC can host a number of species which were reported by owners to be of (relational) value. Research in Western Flanders found that mainly common birds could be found in SRC (Dochy, 2011). The species that were mentioned by the owners can also be regarded as quite common species, confirming this finding. While the owners interviewed enjoyed these species for their presence, SRC also offers a potential habitat for game (Cornelis, 2015). This was reported for Wallonia to be a common reason to plant SRC (Desair et al., 2022).

4.2. The trade-offs of SRC on farms

There are also a number of trade-offs from planting SRC on a farm. These were mainly reported to be the opportunity cost and interference with agricultural production, the impact on the landscape of the rotations and the changed factors of production. From previous research we can also add the potential negative impact on biodiversity.

Loss of agricultural production

The loss of agricultural production is in the first place in the form of land that is occupied by SRC. The report of Callebaut et al. (2024) clearly showed this trade-off for large-scale implementation of intensive SRC.

In the second place, the loss can come from competition between the crop and the SRC for water, nutrients and light (Mantino *et al.*, 2023; Swieter *et al.*, 2022). This competition occurs mainly at the borders between the two crops and therefore are mostly relevant for linear types of SRC or in agroforestry. Yield losses in alley cropping systems can be very significant in the first metres next to the tree borders, going even up to 97% lower at a 1m distance from the SRC (Swieter *et al.*, 2022). Significant yield losses in the first 10 metres were reported by one of our respondents. The average long-term yield of arable crops are however not necessarily affected as also positive effects from nutrient cycling, water redistribution, protection from wind and reduced evaporation can occur and counter the yield loss (Swieter *et al.*, 2022).

Landscape impact of SRC

SRC can be regarded as an interesting or beautiful element in the landscape. However, not all people enjoy that view and in some places SRC can be very disruptive for the landscape or obstruct viewpoints (Bell & McIntosh, 2001). Moreover, the cycles mean that there can be abrupt changes in the landscape when harvested. This was also reported by some respondents to attract negative attention as a harvest of larger areas of SRC can be experienced as a clearcut for bypassers, which is often negatively perceived (Bliss, 2000; Konczal *et al.*, 2023). More extensive types of SRC will probably be less susceptible to these negative connotations.

Increased pressure on land, labour, capital and mind-space

Intensive types of SRC are a novel crop and including any type of SRC would be a new element on the farm which needs to be managed. It is important to note that farmers in Belgium often do not have much time, land or financial resources to spare, leading to high stress levels and low mental wellbeing (Messely *et al.*, 2020).

The increased pressure on land, in the form of opportunity cost for doing other things, was reported during multiple field visits. The pressure on agricultural land is a recurring issue in the densely populated area of Belgium and was subject of much media debate in the spring of 2024[22]. The fact that SRC would take up valuable agricultural land is clearly contentious. This was felt by the owners of SRC themselves but also by neighbouring farmers as illustrated by an interviewee that felt incomprehension by neighbouring farmers on the choice to plant SRC on former maize parcels. The efficient allocation of land can therefore not be seen as an individual choice but rather a societal responsibility. Not only financial or individual gains should be considered, but also wider interests such as sustainable food production and the restoration of biodiversity in the degraded environment.

A new element on the farm also means that labour needs to be diverted to it. While most labour is in winter, farmers are not simply doing nothing in winter and a relative drop in workload in the winter can still sometimes not compensate for the much longer than average workweek for farmers (Dankaert & Lenders, 2024).

SRC requires a financial investment, especially the intensive types. However, 1 in 7 farmers in Flanders is not able to pay themselves an income because their farm is unprofitable, and 1 out of 4 farmers in Flanders lives beneath the poverty line (De Keyzer, 2023), this investment is clearly not for all. Many farmers depend to a large degree on subsidies (Statistiek Vlaanderen, 2024) as will be outlined per farm type in the next chapter as well. Most types of SRC are also eligible for subsidies as was already discussed in the section above. However, this lack of financial solvency is a clear hindrance for any type of SRC, but especially the more intensive types. Other economic models for agriculture could alleviate this pressure (Verwimp, 2023) and give farmers more financial space to experiment with and adopt different types of SRC.

22 https://www.demorgen.be/nieuws/drijft-natuur-de-boeren-van-hun-grond-de-olifant-in-de-kamer-is-het-paard~bfdc3d30/ & https://www.tijd.be/politiek-economie/belgie/vlaanderen/gepoker-over-landbouwgrond-dreigt-nergens-heen-te-leiden/10526547.html

Negative biodiversity impact

The overall effect of planting SRC can also have a negative effect on biodiversity. This is in the first place on a local scale, due to lost habitats for species that used the previous land use. When SRC replaces agricultural production, this is mostly irrelevant (Vanbeveren & Ceulemans, 2019). This does pose a problem however for open landscape farmland birds, the grey harrier and meadow birds. The structure, height and possible operations of all forms of SRC are unfavourable for these bird species (Besnard & Secondi, 2014). Farmland birds avoid structures and elements higher than around 2 metres, tolerating only a few small solitary or linear woody plants in their habitat (personal communication J. Jansen, INBO). This means that only to a very small extent type 1 and 2 would be possible in the zones set aside for these birds.

SRC would also be detrimental for biodiversity if it were to replace any biodiverse vegetation like historic permanent grassland or forests. This is however not permitted by law in Flanders and therefore irrelevant (Desair et al., 2022). In Wallonia the historic permanent grasslands are not as well protected and therefore this does pose a risk there.

Secondly, the negative impact can come from indirect land use change effects (Njakou Djomo *et al.*, 2015; Whitaker *et al.*, 2018). When SRC takes the place of agricultural land without there being a reduction or shift in consumption that requires less food to be produced, there is a clear risk that another parcel of land will be converted into agricultural land. As this is not that easy in Belgium due to high pressure on land and strict spatial planning, this is often done in other countries with less stringent or enforced environmental rules. This could lead to biodiversity loss in that country. The impact of Flemish consumption on biodiversity abroad is already significant. 99% of the negative biodiversity impact due to land and natural resources used by our Flemish economy, is located outside of Flanders, including for example a yearly loss of 26.000 ha of (sub)tropical forest (Alaerts et al., 2023).

5. Integrating SRC on different farm types in Belgium

In the next section we demonstrate how the different benefits and trade-offs of SRC could be taken into consideration when choosing if and which type of SRC to plant to best match the needs and constraints of a farm. For this, we use the four different exemplary farm types identified in the study of Sannen et al. (2024). For each type we summarise the description in the respective sections and assess which elements (bold printed) fit with the incorporation of SRC on the farm, and which elements impede it. Subsequently we also consider the integration of SRC as part of agroforestry as a promising synergy between woody biomass production and food production which was highlighted to be the main trade-off by Callebaut et al. (2024).

Based on this analysis we can distinguish which SRC types are potential fits for the different farm types and which ones are less feasible. It is nonetheless important to note that in reality each farm is different and has different motives to plant SRC. The effects and management of SRC will be different for every farm. The following analysis should therefore be interpreted as a demonstration of the trade-offs a farmer could make for planting SRC. We do not pretend to demonstrate a one-size-fits-all way of implementing SRC on all the different farms that could be considered as part of these categories.

In this exercise we do not take into account legal obstacles to planting and managing SRC. For these we refer to our previous report of Desair et al. (2022), which includes a detailed description of the different policies affecting SRC and a flowchart describing all the potential legal restrictions on SRC.

By combining the insights from this exercise with the synergies and trade-offs of the previous chapter, we will draw some general strategies that farmers could use for integrating SRC on their farm and measures they could take to minimise potential trade-offs.

Description of arable farm on loam plateaus

Figure 5.1: Picture of Arable farming landscape on the loam plateau. Credits: Vildaphoto

The first type of farm is the arable farm, specifically those on loam plateaus. Loamy soils are among the best for arable farming in Flanders. The landscape in which the farm is located can be called an '**open field landscape**', characterised by expansive views, **few prominent landscape elements** such as hedges, hedgerows, or rows of trees, and occasionally a solitary tree. Specialised arable farms in Flanders, where arable farming is the main activity, have an average 53 hectares. Intensive cultivation with heavy machinery results in **soil degradation and little carbon in the soil**.

The farms are **highly mechanised**, meaning advanced and heavy machinery is used for soil preparation, planting, harvesting and other tasks. **Good agricultural land** is very important to achieve high productivity and to be profitable. The average workforce of 1.3 employees per farm, including 1.2 family workers, indicates that family members play a significant role in the farm's operations but that through mechanisation little external workforces are required. Due to the volatile market and the consequent pressure to produce a significant amount of biomass, every piece of land is intensively utilised. The **workload decreases in the winter**. The financial costs of the farm encompass various aspects, including investments in mechanisation, purchase of crop protection products and other inputs, and depreciation. The farm yearly income ranges between 29,800 and 72,400 euros, of which 19,000 euros from agricultural subsidies, Arable farming has a **less favourable profitability**. On average up to 50% of their income is derived from subsidies. To survive, significant investments need to be made in machinery and storage capacity, constituting 20% of total costs. **Crop protection products** are a variable cost, comprising approximately 12% of the total costs of the average arable farm. This reflects the necessity to control pests, diseases, and weeds to maximise crop yields. Furthermore they supply a global volatile market, having little control of their profitability.

Arable farms pay major attention to crop rotation. They are the first to experience the negative consequences on yields when this is not applied thoughtfully.

Integrating SRC on arable farms on the loam plateau

The loam regions provide for an excellent soil for SRC. The report of Callebaut et al. (2024) demonstrates that about 27.000 hectares within the loam region in Flanders would be suitable for SRC. A part of the area identified suitable for SRC in Wallonia can also be regarded as part of this agricultural landscape. The productivity on these soils would be the highest achievable for SRC, especially if the soil is moderately wet, with yields up to 30 m³/ha per year (Callebaut et al., 2024).[23]

The open-field landscape of these arable farms poses a limitation to the type of SRC that can be implemented without changing the character of the landscape, mainly excluding any planting close to roads or viewpoints (Desair *et al.*, 2022). The open landscape has the capacity to absorb extensive areas of SRC as long as they are in the middle or background view (Bell & McIntosh, 2001). Linking to existing small landscape elements and reducing the scale of harvest on the edges can even increase the visual interest of the landscape, though this will decrease the financial feasibility and increase the amount of labour needed.

The biodiversity in the agricultural landscape would probably increase when integrating SRC. Though, with few natural remnants left, this gain might be only minor if not accompanied with other measures that increase the space and decrease the pressures for nature. This landscape can also be the habitat for farmland birds so care should be taken to respect these set aside areas.

The soils with decreased soil carbon content could significantly benefit from SRC. The farmers can either directly work in the chips on the field or, if they have any green fractions at hand, make compost.

The large agricultural fleet on these farm types can be used to manage the more intensive types of SRC. A maize harvester can be adapted for harvesting SRC up to an age of three maximum four years (Desair et al., 2022), though this is also a risk and an investment that is not necessary as long as there is the possibility to hire people who have this already at hand. The ploughing, harrowing and fertilising machinery are often also already present. Arable farms also could have space on their farms to store the woodchips to dry. This is however mainly necessary if they are used for energy production or for selling.

The highly productive soils make the trade-off between woody biomass production and agricultural production economically and socially less acceptable. While SRC would also have high yields, the foregone profits from arable farming and the possible telecoupling effects are considerable. Moreover, the less favourable profitability of arable farming means there often is little room to integrate any type of SRC that takes up a large amount of their land. Additionally, any extra investments could potentially pose a high risk for these farmers.

The decrease in workload in winter for arable farms makes them suitable for integrating woody elements that are best harvested or pruned in winter. This is true for all types of SRC.

Arable farms often rely on pesticides. SRC can provide a good habitat for natural pest management species. This could both reduce their costs and contribute to the goal of the EU Biodiversity strategy

[23] This is expressed in volume of wood, not in volume of woodchips.

to reduce the use and toxicity of pesticides (Hermoso *et al.*, 2022). This service is however best provided by linear elements with a high diversity of tree species. Large areas of monoculture SRC are less capable of providing this benefit.

To conclude, arable farms can make use of SRC for increasing the soil fertility, protecting land against erosion and for natural pest management. The drop in workload on the farm in winter is a good match for the increase in workload for SRC. The investments that are needed for intensive types of SRC are minor as most machinery is already present. The biodiversity would increase with the integration of SRC and the landscape character would not be disrupted when SRC is implemented strategically, even at a large scale. However, due the little financial room, and if only used to increase soil fertility, the exemplary arable farm could probably benefit most from the linear and more extensive types of SRC. These can be installed on corners of the land that are difficult to cultivate such as wet spots or lost corners, although this is likely to be a minimal amount of land on the prototypical loam plateaus. This way the trade-offs are minimised with their agricultural production and the benefits for nature and their farm are maximised. Should a specific arable farmer however have a large heat requirement and/or land that is not needed to be profitable, the trade-off could be tipped in favour of the more intensive and large-scale types of SRC with the most obvious choice being the Swedish system which aligns most with agricultural production techniques.

Description of mixed beef-arable farm in the polders

Figure 5.2: Picture of the Polders farming landscape. Credits: Vildaphoto

The second farm type is a mixed farm where cattle farming and arable farming are carried out complementarily on the **clay soils** in the polders. Clay soils are fertile and contain a **high amount of organic matter**. On the other hand, a **high water level** impedes easy cultivation. The polder landscape is an **open agricultural landscape** associated with ditches and dikes, alongside **linear small**

landscape elements, rows of poplar trees, and hedges. Fertile and easy workable land is used for crops while the cheaper and wetter grassland is used for livestock.

The combination of livestock and arable crops creates a farm type with a **high workload** and a **high skill demand**. During the growing season in summer, intensive focus is placed on arable farming, while **in winter, attention shifts to the livestock**, which needs to be housed and cared for in the stables. The average workforce on a mixed farm is 1.8. This farming approach shares many challenges with arable farming, including **soil degradation**, **high costs of pesticides and animal feed**, **low carbon content in the soil**. The dual investment in time and money in both livestock and arable farming poses an **additional vulnerability**.

An average mixed farm utilises 64 hectares and has an income of 40,000 euros, subsidies worth 25,000 euros, 11% of the total income, and energy costs around 6,000 euros. **Manure** is supplied by the livestock, and if problems arise on the market for arable products, this can be neutralised by the livestock farming. Due to this synergy, it is **more profitable than a specialised arable farm**. The trade-off between allocating land to arable farming rather than livestock grazing depends on the price of feed that needs to be bought when there is less grazing area and the potential revenue from taking the land under arable farming. Mostly, the productive lands are therefore allocated to crops while the less productive lands are reserved for grazing. The **import of animal feed, needed to compensate for the deficit, is expensive**.

Although the polders have very fertile soil, **working it with heavy machinery is not straightforward**. Combining two farming types requires good management. The farmer must be **familiar with various areas of expertise** and **invest** in mechanisation and infrastructure for both arable farming and cattle rearing. Provided that the farmer has a well-thought-out crop plan and rotation including protein crops, the cost of concentrate feed can be minimised.

Integrating SRC on mixed beef-arable farms in the Polders

The polders is also a suitable region for SRC. The study of Callebaut et al. (2024) shows that about 22.000 hectares would be suitable for SRC production in the Polders region. While productivity on heavy and wet clay soils is not as high as on its loamy counterparts, yields can still be as high as 26 m^3/ha per year on moderately wet soils (Callebaut et al., 2024).

The high water levels on arable land have historically been treated with small landscape elements (Mennen *et al.*, 2013). Therefore SRC types such as pollard trees, hedgerows or even the more intensive types with poplar or willow can be implemented on less workable lands. While the trees can cope with the wetter soils, high productivity will not be achieved on very wet soils (Callebaut et al., 2024). Moreover, more intensive forms of SRC would need to be harvested when the soils are frozen to avoid compaction. This is occurring less frequently due to climate change, and is reported to be a risk in the interviews.

The open agricultural landscape could once again integrate both large and small-scale SRC as long as they are not located next to roads or in viewpoints. The linear and extensive forms are however most culturally appropriate in the Polders as they form part of the heritage (Ameeuw *et al.*, 2008). The nature value could also increase when placed around remnant forests or next to streams, to form a buffer against any possible pesticide or fertiliser from agricultural land (Longley *et al.*, 1997; Oshunsanya *et al.*, 2019). Similar to the arable farm on loam plateaus, in this open landscape, it is not desirable to plant in the habitats reserved for farmland birds. Moreover, grasslands generally also

have a high soil organic carbon content and switching these to SRC might involve a net loss of this carbon stock (Blair, 2021; Don *et al.*, 2012).

As opposed to pure arable farming, there is no drop in workload in winter and a higher pressure on labour throughout the year in general. This leaves little (mental) space for farmers to include any additional elements on their farm.

The need for soil carbon was a possible synergy with SRC discussed under the arable farm that also applies for this farm type. Additionally, the manure of the cattle can be used in combination with the wood to produce high value compost.

At mixed farms there is the possible application of SRC as feed for the cattle. Apart from feed, also the shade and shelter provided by the trees can be beneficial for cattle (Whistance, 2018). ILVO demonstrated the potential of linear woody elements as shelter for animals thoroughly (Bracke *et al.*, 2021).

Another possible use for the wood of SRC could be for heating. This could be to dry the hay from their own fields to convert to high quality feed. This does require of course an investment in this infrastructure. Alternatively, domestic heat demand could also be covered by wood from SRC.

As with arable farming, some investments for the more intensive types of SRC may not be needed anymore as the machinery is already present on the farm.

To conclude, SRC can be used for a variety of reasons: increasing or reinstating landscape diversity, increasing soil fertility, as feed or shelter for the cattle or as a heat source. The landscape and soil favour more extensive forms of SRC that require less heavy machinery and are potentially less conflicting with the open landscape for nature and as cultural heritage. Should the heat demand however be high and if the own farm labour cannot be spared in winters for harvesting, it can nonetheless be a sensible choice to install more intensive forms of SRC, with care for specific habitat conservation, landscape quality and conserving soil quality.

Description of dairy farm in sandy regions

Figure 5.3: Picture of farming landscape in the sandy region. Credits: Vildaphoto

On the sandy regions in Flanders the typical dairy farms can be found. This region historically was a **bocage landscape with species rich meadows and small landscape elements** such as hedgerows, ponds, solitary trees,... Through intensification the poor sandy soil was enriched making it now one of the **most desirable and most expensive soils in Flanders** for agriculture. On average the farms cover 56 ha. Over 50% of the farms exist of grassland (in rotations) followed by maize which are perfect for sandy soils. On the other hand the sandy soils are prone to **leaching of nutrients and drying out**. Common practices such as fertilising with manure and artificial fertilisers cause a **low C/N-ratio unfavourable for mitigating nitrate leaching**. Due to the limited relief in these areas, erosion is not as prevalent a concern on such farms.

For the dairy cows, often Holstein-Friesian breeds, the farm needs to supply **roughage and concentrated feed**. Cultivation of those requires specific machinery. The larger farms are often automated, using milking robots, automatic feeding systems and manure scrapers, which can lead to more efficient work and **less manual labour**. On the other hand, managing a large herd requires precise observation, care, and attention to the health and well-being of the animals, which can lead to a constant intensive workload.

On average, these farms have an income of 71.000 euros, and receive 20.000 euros in subsidies (28%). The **biggest expense (28%) is animal feed**, most of it being roughage. The prices of dairy products are influenced by the world economy. Prices of dairy and roughage in combination with thoughtful investments and expertise of the owner determine the profitability of dairy farms. In general dairy farms in Flanders have **difficulties being profitable**.

Integrating SRC on dairy farms in sandy and sandy loam regions

The sandy and sandy loam region of Flanders has suitable soils for SRC but with yields varying between 8 m^3/ha per year on dry sandy soils and 30 m^3/ha per year on moderately wet sandy loam (Callebaut *et al.*, 2024). About 170.000 hectares are found to be suitable for SRC in these regions in the study of Callebaut et al. (2024).

The landscape with historical small landscape elements can be regarded as an enclosed landscape, alternating with an undulating landscape. This means that there are options at the field level to plant larger areas of SRC but there are also opportunities for extending existing linear elements.

The species rich meadows should be preserved as their conversion to SRC would mean a loss in biodiversity and probably as well in soil organic carbon.

The high soil prices make the more intensive forms of SRC economically less feasible, although the high possible yields could be attractive when heat demand of the farm is high.

The run-off of nutrients and pesticides from agricultural soils can be best mitigated through linear forms of SRC which can protect streams and nature reserves. The correct use of woodchips, with their nitrate-fixating properties could also be beneficial to mitigate both the leaching of nutrients and to cope with the decrease in soil organic carbon in intensive agriculture. The brown fraction of the woodchips also provides an opportunity to transform the manure into compost.

As with the mixed farm, more extensive forms of SRC can be used as fodder trees, as can the intensive forms with very short rotations. The latter are especially interesting for the more intensive farms where the animals are most of the time in the barn. The young SRC can be harvested, shredded and mixed with the hay to feed the cattle. For the extensive forms and if the animals graze on the field, the trees can provide shelter.

The constant workload of the farmer throughout the year can pose a problem for the more extensive and linear forms of SRC. The more intensive forms on the other hand could be a better match if the labour is outsourced.

The low profitability of dairy farms, combined with the probably high investment costs make the more intensive forms of SRC less interesting for this type of farms. They mostly do not have the machinery to maintain and harvest the intensive plantations themselves, therefore incurring a high investment cost or external labour cost. On the other hand, should the cost for supplements be higher than the plantation and investment cost for strips of more intensively managed SRC that can be harvested regularly as feed, this can be still worthwhile.

To conclude, dairy farms could use the nutrients and shelter provided by SRC for their cattle or the woodchips for maintaining soil health. Linear and extensive forms of SRC with shorter rotations are capable of providing these services without while limiting the risk of decreasing biodiversity and soil organic carbon through substituting valuable grasslands. Strips of more intensive SRC could also be interesting, should the investment cost and benefit be smaller than the cost of nutrient supplements and feed. It is however questionable if these most expensive lands would be even considered to be planted with SRC due to economic and social pressure. The constant labour on the farm makes it difficult to integrate any type of SRC.

Description of dairy farm in hilly landscape

Figure 5.4: Picture of farming landscape in the hilly landscape. Credits: Vildaphoto

On the hilly parts of the sandy and loamy areas of Flanders similar dairy farms can be found. (Pajotteland, West-Vlaamse heuvels, Haspengouw and the Voerstreek, Vlaamse Ardennen). Dairy farms in hilly areas face obstacles in their efforts to expand and specialise, unlike those situated on sandy soils. The rugged terrain is a primary factor contributing to this situation. Often hilltops are unsuitable for farming and instead often serve as habitats for **valuable forests** while expansive moist valleys restrict land use to **wet grassland**. Across the area often **smaller nature reserves are spread**, applying restrictions on neighbouring agricultural land. Small landscape elements are still present in these areas. The land use proportion, grassland and maize, is similar to that of farms on sandy soil. **Erosion poses a major challenge** and the protected areas need to be **buffered against pesticide and fertiliser run-off**.

Characteristics of the traditional farm can still be perceived on farms in the hilly regions. Often, although converted to specialised dairy farms, they still manage a small part of land for arable farming, resulting in a **higher workload**. Nonetheless the labour intensity is quite similar with dairy farms on the sandy plateaus.

For financial cost and economical challenges we refer to dairy farms on sandy soils.

Integrating SRC on dairy farms in hilly landscapes

The hilly parts of the sandy and loamy areas of Flanders can also be suitable for SRC with yields between 8 m³/ha per year on dry sandy soils and 30 m³/ha per year on moderately wet sandy loam (Callebaut et al., 2024). The hilly landscape is only a part of the loam and sandy loam area and

therefore the suitable area for SRC will be lower than the abovementioned 170.000 hectares. A part of the for Wallonia suitable areas for SRC can also be regarded as within this agricultural landscape.

The hilly landscape provides opportunities for extensive and intensive SRC on a larger scale as this does not have a large visual impact. Towards the top, larger areas could be integrated into the landscape while in the lower lying areas the scale of harvesting should be smaller (Bell & McIntosh, 2001).

The forests, natural areas and wet grasslands present should be safeguarded from any conversion into SRC as this would mean a loss in biodiversity and soil organic carbon.

The erosion risk means that any type of SRC should maintain a permanent ground cover. This excludes any large scale SRC that would be replaced after a number of rotations if that would mean that the stumps are removed. Linear but also broader belts of extensive to intensive SRC could be planted to manage the erosion risk, to protect the natural areas from nutrients and pesticides and to protect the streams. Moreover, they can provide stepping stones for a number of species when going from one natural area or forested hilltop to another (Davies & Pullin, 2007).

The different uses for SRC are similar to the dairy farms on the sandy areas. Feed and shelter would probably be in most cases the most interesting application as soil organic carbon content is not as much a problem (Burel, 1996). This can be achieved through belts of intensive SRC or linear types of SRC with shorter rotations.

In terms of labour and capital investment, none of the types of SRC will be suitable for over-burdened farmers with little financial buffer. More extensive forms as fodder trees could possibly be the most cost-effective application while large investments would probably be required for the intensive forms.

To conclude, the landscape allows for larger areas of SRC to be planted without compromising the view and with possible benefits in terms of nature connectedness. However, the soil type with its erosion proneness makes this choice unfeasible if the plantation would at any point be removed again. SRC as a source feed and for shelter is probably the most relevant application and when investments cannot be made without substantial risk, linear types of SRC can be a good compromise.

Integrating SRC as part of agroforestry

Figure 5.6: Experimental site of short rotation willow trees and free range chickens. Source: Bracke et al., 2020.

Agroforestry as a farm type is not discussed in Sannen et al. (2024), but the practice of combining trees with other agricultural production is of course at the core of this report and many of the abovementioned integrations of SRC on a farm can be regarded as agroforestry.

Agroforestry is defined as "all forms of association of trees and crops (silvo-arable systems) and/or animals (silvopastoral systems), on a parcel of agricultural land, whether in the interior of the parcel or on its edges (hedges)" (EURAF, 2020). Agroforestry can be applied in almost all types of landscapes in one form or another. In Belgium, it is a relatively new concept, but EURAF estimates some 650 hectares of land have been planted with new agroforestry systems in the past 8 years, most of them with alley-cropping systems. In Flanders, the cultivation of fruit and nut trees in agroforestry systems has become more common, while Wallonia has seen an increase of mixed hedgerows[24]. The main organisations disseminating and researching agroforestry are Agroforestry Vlaanderen[25] and AWAF (Association pour la promotion de l'agroforesterie en Wallonie et à Bruxelles)[26].

In agroforestry systems, the cultivation of woody crops can be used to produce food, as in the case of nut and fruit trees, or to produce feed or biomass, which can be the reason for integrating SRC as a part of agroforestry. Apart from these use values, the trees can also have an important number of

[24] Belgium | EURAF (europeanagroforestry.eu)
[25] https://www.agroforestryvlaanderen.be/en/
[26] https://awafinfo.wixsite.com/awaf

other (supporting) roles in the production, many of which are already mentioned in the chapter on the benefits and trade-offs of SRC on farms.

Various agroforestry models exist, each potentially accommodating different forms of SRC integration. Notably, literature highlights successful instances of SRC within alley-cropping agroforestry systems and as hedgerows on dairy farms.

In **alley-cropping systems**, crops are planted between widely-spaced rows of trees, which can be trees used for short-rotation coppice. Typically, initial management involves intensive practices, gradually transitioning to more extensive approaches as the system matures. In an alley-cropping system, SRC serves as an initial phase, allowing subsequent transition to a longer-term agroforestry system with slower-growing trees. In drier areas, SRC protects the adjoining plants against evaporation, but this is also true if other trees would be used. However, the advantage of SRC over for instance noble trees, is that it can provide an income after only a few years, while the rest of the agroforestry system might take longer to develop. Furthermore, as the trees are cut down regularly, SRC casts less shade over the adjoining crops than noble trees do.

Another important benefit is that SRC has a positive effect on the soil quality and can therefore positively influence the growth of the adjoining crops. One study even found that conversion of a SRC to arable cropping decreased soil quality, which includes soil organic matter, microbial biomass and activity in upper topsoils, within a year (Lamerre *et al.*, 2015). However, in an alley-cropping, choosing to produce SRC directly limits the space that can be used for producing food and, additionally, the economic lifetime of SRC may be limited compared to the cultivation of fruit-producing noble trees. Therefore when SRC coppice is produced in an alley-cropping system, it is often seen as a temporary system preceding the planting of fruit-bearing noble trees in its place. This could also be found in the literature.

Hedgerows on dairy farms, if managed as such, can be seen as a traditional SRC system. Recent studies (eg. Stadig *et al.*, 2019) have also found that short-rotation coppice on **chicken farms** has a positive effect on the chickens, who seem to appreciate the cool shade and protection the trees provide. The wood production is not affected by the presence of the chickens, while nut producing trees, such as hazels, have a lesser fruit production when cultivated in such a setting (Bracke *et al.*, 2020). As in other farm types, including SRC in these farming systems, increases soil quality and fertility, but in addition to this benefit, there are more specific synergies found in the combination of SRC and chicken or livestock production. The hedgerows, for example, can be used as fodder trees for livestock (Hermansen *et al.*, 2018). By choosing the right tree species, such as willows, the health of the animals can be improved with a variety of minerals provided by the trees. Furthermore, the hedgerows provide shade for livestock and/or for chickens. And, contrary to the previous examples, SRC cultivation on livestock or chicken farms does not directly occupy space which could be used for food production.

Strategies and measures for integrating SRC on a farm

This exercise of identifying the synergies and trade-offs that occur in exemplary farms, confirms the fact that there is no one-size-fits-all strategy to integrating SRC on a farm. We see that even in these abstractions of farm types, there are always elements that favour and elements that impede the same types of SRC. Each farmer, thinking of incorporating SRC should therefore start from their own needs and capacities, as well as the possibilities in the socio-ecological landscape. Nonetheless we outline some general strategies for farms to incorporate specific types of SRC and measures to limit

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the trade-offs, based on the experiences of the interviewed owners outlined in chapter 3, the specific synergies and trade-offs emerging from these experiences put into context in chapter 4 and the exercise of integrating SRC on different farms in this chapter.

If SRC is considered as a strategy to cover a small demand for biomass, either for domestic heating or for providing woodchips to increase the soil quality, farmers should consider planting linear or extensive forms of SRC as these will fulfil the demand without increasing much of the pressure on land, without large investments needed and because these fit easily into all landscapes. There should however be enough labour capacity in the farm.

Measures that could be taken to limit the trade-offs of these types of SRC are:

- The areas used for SRC should preferably be those less fit for other agricultural purposes such as wet parcels or difficult to use corners.
- To cover a lack of labour on the farm, the farmer can consider connecting to other farmers with small landscape elements or groups such as the Regionale Landschappen Natuurpunt, ValBiom etc. that could assist with the harvest or with connecting to other people/companies with the right expertise and material.
- If the farm is located in an area reserved for farmland birds, SRC is only possible in very small patches and with very short rotations, in agreement with the authorities.

Farms that consider integrating SRC as a strategy to cover a large biomass demand, which in most cases will be for heating, can consider planting large scale and intensive SRC. A cost-benefit analysis should be done on a case-by-case basis to see if the opportunity cost of taking the land out of agricultural production is covered by the decreased cost of purchasing fossil fuels. This will be mainly applicable to farms with a large acreage in their own possession. Most of the labour would need to be outsourced to companies that have the right machinery and expertise.

Measures that could be taken to limit the trade-offs of these types of SRC are:

- The farmer should preferentially use those parcels that are less suitable for arable crops for human consumption. Policymakers should tackle the risk of indirect land use through aligning with the Farm to Fork strategy and the protein-shift to make sure any loss of agricultural land here does not lead to high biodiversity value land somewhere else.
- Shorter rotations can facilitate the harvest also when frost is occurring less, as the smaller branches of younger SRC can be harvested with lighter machines, decreasing the (fuel) cost and the risk of soil compaction.
- Longer rotations and phased harvesting can improve the nature value of the parcels and attract more wildlife.
- Larger areas of SRC should be avoided for ecological and landscape quality reasons.
- It could be advisable to inform neighbours and potentially even passers-by about the aim of the production to limit negative reactions about the land use or the periodic harvesting.
- Multiple patches with a variety of species and genotypes will increase the nature value, visual attractiveness and robustness of the plantation.
- These types cannot be planted in zones for the protection of farmland birds or in erosion-prone areas if they are going to be uprooted at any time of their lifespan.

Farms that have specific needs of significant amounts of young twigs, for example for feed, in combination with poultry or that want a productive buffer for waterways and nature reserves, can use strips of intensive SRC. These should be well tailored to the specific nutrient needs if used for

feed, and the placing should be well-thought for the use as a buffer. The intensive nature potentially requires outsourcing of the management.

Measures that could be taken to limit the trade-offs of these types of SRC are:

- Buffers work best when they go beyond the farm boundaries and are a shared endeavour of all farmers nearby the stream or nature reserve. This can be achieved through cooperation between farmers, potentially facilitated by a third actor such as a company or civil society actor that does the maintenance of the strips.
- When used as feed, the farmer can consider using the SRC as fodder trees, taking advantage of the other benefits of SRC such as the shade and breaking the wind.

Farms that want to integrate SRC for their nature value (either intrinsic or relational) should consider using extensive and linear types of SRC, with a large variety of species and with phased harvesting. This will make them good stepping stones for species, especially when designed to connect different natural elements in the landscape. If they include species with berries, this can provide a good food source for birds and a nice element for the owners. The biomass yield of these types will probably be low but could still be sufficient to cover a low domestic heat demand or the improvement of a small number of parcels through direct application of woodchips or compost.

Measures that could be taken to decrease the trade-offs of these types of SRC are:

- While the owners of these types of SRC might not bother with potential negative impacts such as yield loss close to the SRC or loss of quality of the vegetables due to leaves falling in or damage due to wildlife, the neighbouring farmers might not be as forgiving. Owners of this type of SRC should therefore communicate with adjacent farmers to mitigate any potential negative effects and avoid conflict.
- Also these more extensive types of SRC should preferentially be planted on less productive soils to prevent unwanted indirect land use changes and to mitigate any potential conflict on the use of productive agricultural land and linked increases in farmland prices.

Farms that want to include SRC as a part of their agroforestry system should choose the linear types of SRC. Depending on their use, this can be either extensively or intensively managed. The SRC can provide shelter and food for animals and recycle nutrients, break the wind and protect against evaporation for crops in alley cropping systems. The SRC will also have numerous other indirect benefits for agricultural production through increasing the functional biodiversity on the farm. There will be a high need for expertise and labour in these types of SRC and the financial costs of these systems might therefore be higher.

Measures that could taken to decrease the trade-offs of these types of SRC are:

- Good training or room to experiment with the right species mixtures, planting distances and harvest cycles to avoid too much yield loss. These are potentially provided by agricultural research centres such as ILVO or AWAF.
- Different business models that favour high-quality local and agro-ecological produce.

6. Limitations and further considerations

Short rotation coppice in its strict definition, is a relatively unknown concept. We contacted all land users that indicated their land to be “short rotation coppice” in the “verzamelaanvraag” in Flanders. This limits our data collection in three ways.

First, it reduces the focus to only agricultural parcels. In the study of Callebaut et al. (2024), agricultural land was the main land use that would be eligible for SRC, especially in Wallonia. However, this does not mean that private land owners that are not regarded as farmers or public land owners such as municipalities, would not be interested or able to plant SRC. While our discussions focus on farmers, these private and public actors can still be inspired by the different types of SRC highlighted in this report and the trade-offs and synergies discussed to decide on the best fit for their own purposes. Though arguably, more research is still needed on the cultivation of SRC on non-agricultural land.

Second, this limits our data collection to those people that actually register their parcel and do this under the category of SRC rather than afforested agricultural land for example. This introduces a bias towards mostly people that indeed recognize their practices as SRC and see the benefits of registering it, be it for the subsidies or for their contribution to their ecological areas.

Last, from this group we were able to conduct eight interviews. Even though this is a fifth of all official SRC cultivators, this dataset is too small to gather any conclusive arguments on the benefits and trade-offs of SRC or to make any quantitative analysis. We merely managed to identify some general perceptions which we then selectively compared to literature.

Building on this selective research we investigated the possibility of the integration of SRC on different farm types. However, it is worth repeating that three out of eight respondents were not farmers as a main profession. Because of the low number of respondents and the fact that not all of them are professional farmers, the circumstances of our respondents do not match all the different farm types of Sannen et al. (2024). While the approach of taking these exemplary farms mitigates the effect of very specific circumstances found on a certain farm, they can not be generalised and are partly reliant on deductive reasoning rather than data.

A last limitation in our study consists of the focus on Flanders for data collection. While throughout the project some visits to SRC in Wallonia took place, we exclusively interviewed Flemish farmers and only validated our final report with one expert in Wallonia. Therefore our typology is maybe more fit for categorising Flemish SRC than Walloon SRC. Moreover, as values are place-bound, some of the reasons for planting or not planting SRC might be different in Wallonia than in Flanders. This bias continues in our farm typologies with two of the farm types being predominantly Flemish. The other two can be regarded as shared between Wallonia and Flanders, but their descriptions are based on the Flemish case. Agroforestry is of course applicable in the two regions. This regional bias mainly has an effect on the profitability indicators for the farms which can be drastically different in Flanders and Wallonia due to the variability of the landscape and the differences in policy. That being said, when looking at the study of Callebaut et al. (2024), most of the areas that are suitable for SRC in Wallonia do fall under the categories of agricultural landscape discussed here, and Wallonia has in general less area suitable for SRC than Flanders.

In this report we aimed to illustrate the different types of SRC that we found in Belgium, explore the values and trade-offs related to these types and their fit into the agricultural landscape. Most of this data is based on interviews with producers of SRC. However, since we didn't interview anyone who chose not to cultivate SRC, we can't say to what extent the values of SRC and the possibilities offered by the relevant policy context are enough to incentivize more land users to produce SRC. Previous research showed in fact that non-financial factors related to identity, lifestyle, farming culture and the perceived priority of food production are more important in the negative attitude of farmers regarding SRC (Warren *et al.*, 2016). Also previous research on the motivations of farmers to plant SRC highlighted these social barriers (De Somviele *et al.*, 2009). That being said, even though all our respondents were sceptical about the potential financial revenue and would therefore not recommend it to any other farmer, they still did plant SRC and most were not planning on stopping. From our discussion on the values brought forward by the respondents, it became clear that intrinsic values such as an increase of biodiversity, are important factors and potential leverage points to motivate land users to cultivate SRC. This might also be the key to overcoming the social barriers. Therefore, more research should be conducted on how to connect farmers again with the intrinsic and relational values of multiple types of nature, not only the crops that they already grow today.

7. Conclusion

In this study we searched for the different ways in which people benefit from SRC and the trade-offs that they face. We identified different management types of SRC that influence the intrinsic, instrumental and relational values of SRC. The choice on which type of SRC to implement depends on the farm type and the values that are sought after.

The respondents in our study mostly identified instrumental values as the primary motivator, and within this category, (personal) energy independence the most recurring one. However, intrinsic and relational values of nature were also often deemed of importance. With increasing intensity of management, the focus on instrumental values increases and the relational and intrinsic values become secondary. Where SRC is done in linear or extensive ways, relational and intrinsic values are often a significant part of the motivation to plant SRC.

When integrating SRC on a farm, multiple aspects should be taken into account. In our study we focused on four exemplary farm types for which the values and trade-offs as well as the impact of integrating SRC was assessed, supplemented with an analysis of SRC as a part of agroforestry.

In general, SRC as linear elements provide the most benefits and the least trade-offs. They can be either managed intensively when there are clear use values such as for heating or feed, or extensively when non-use values such as nature value or attracting wildlife take precedence. These linear forms are more easy to fit into the landscape and can provide important stepping stones for nature while minimising the potential indirect negative effects on biodiversity. They can be managed by the farmers themselves or outsourced when knowledge or labour are not present but capital is. They provide a number of other benefits for agriculture such as habitat for pollinators and pest management species and supporting higher biodiversity in general which sustains agricultural production in the long run. They form buffers against erosion, nutrient leaching and pesticide drift. The use of SRC can decrease the costs for feed, pesticides, compost and heating, making it financially feasible where these demands are sufficiently high.

Intensive and large-scale SRC are mostly interesting for farms with very large heat demand and material (financial and land) stability. They can be financially feasible through their substitution of costs for fossil fuels and through that same substitution be a good farm-level contribution to mitigating climate change. Their nature value is larger than intensive agricultural production but still rather limited. To avoid that these types of SRC have negative effects through indirect land use change, their wide introduction into the Belgian agricultural landscapes can only be sustainable when accompanied by a regional, national, european and potentially even international strategy to decrease the area used for agricultural production. These are already in place in Europe through the Green Deal which include the Biodiversity Strategy and the Farm to Fork Strategy but are not yet sufficiently reflected in the Common Agricultural Policy and regional food and agricultural production strategies.

Though the focus on the instrumental values can inform a clear cost-benefit analysis of the use of different types of SRC, this report has shown that the relational and intrinsic values that owners of SRC assign to it, are clear leverage points. SRC can therefore be used as a way to increase the multifunctionality of our agricultural landscape, combining the production of woody biomass production with increased resilience of our agricultural system and ecological network. But this will

best be achieved when there is an increased attention for the relational and intrinsic values of nature, which will lead to more ecologically grounded choices that bring the most benefits to both nature and agriculture.

8. Policy recommendations

Policy recommendations from the owners of SRC

Only three out of the eight respondents had any concrete recommendations for policy. The recommendations can be split into two groups.

The first group concerns the financial rentability of SRC. As long as SRC is not a financially interesting option, no farmer, relying on their farm to make a living, can be expected to take up cultivation in any form.

The second recommendation regards knowledge dissemination and guidance for farmers. It is interesting to note that most owners of SRC had little to no recommendations for policy. Even more stark, there was generally not much knowledge on the existing policies and legislation concerning SRC. One of the respondents had even planted the trees and only afterwards heard that what they were doing was in fact considered as SRC. This general lack of awareness is also a clear sign of how unknown the cultivation of SRC is, especially in Flanders. If farmers are interested in SRC, they should be able to get informed and guided by experts. This is especially the case for the intensive types which are more reliant on external expertise. The more intensive types that were visited all had guidance from Inagro and/or private companies. However, they report that this expertise is getting lost as Inagro is no longer focusing on SRC because the demand is too low. While some expertise is still present at INBO, especially concerning the best propagating material, farmers that are interested to install SRC in Flanders nowadays are mostly left to their own devices. In Wallonia the case is different where companies such as Phitech[27] and ValBiom[28], a government supported organisation, are actively informing farmers and organising regular field visits.

Policy recommendations based on our study

Should policymakers want to increase the agricultural and ecological resilience of the landscape while making woody biomass locally available and limiting the competition with food production, linear and extensive forms of SRC can provide this. Measures that should be taken to increase their uptake:

- Increasing the support for these types of SRC so that their management is no financial burden.
- Increase efficiency of managing these types of SRC through existing mechanisms that help farmers share in the financial and labour burdens such as shared ownership of materials or mechanisms such as the Flemish Loket Onderhoud Buitengebied[29].
- Depolarize the debate on nature versus agriculture by focusing on the instrumental values of good-functioning nature for agriculture, the relational value of a beautiful landscape full of fauna and flora and the intrinsic value of nature as its right to exist in harmony with or even as agriculture

[27] https://phitech.be/fr
[28] https://www.valbiom.be/
[29] https://www.regionalelandschappen.be/projecten/loket-onderhoud-buitengebied

- Provide more mental and financial space for farmers to experiment with different types of SRC to see what best fits their needs. This needs to be underpinned by a thorough revision of the CAP.

Should policymakers want to increase the amount of woody biomass available for the biobased industry rather than solely for the farmers' personal use, intensive and large-scale SRC can provide this, while still increasing the biodiversity potential of the agricultural landscape. To achieve this, measures that could be taken are:

- Increasing the demand for woody biomass through accelerating the shift to a biobased economy. This would make intensive SRC profitable for farmers that cannot use the biomass themselves.
- Increasing the price of alternatives to woody biomass such as fossil-fuel products, thereby also increasing the shift to a carbon neutral society.

However, there are clear potential dangers from large-scale SRC, such as competition with food production, increased pressure on agricultural land, loss of biodiversity and soil carbon stocks, that should be mitigated through the following measure:

- Any incentive for large-scale SRC should be coupled with a lower domestic and indirect land use for agriculture. This is necessary to avoid indirect land use effects that could be detrimental to biodiversity and climate change but also to avoid rising prices of agricultural land and land speculation. This can be achieved through following through on the commitments of the Green Deal which envision a dietary shift that would lead to less land being needed to feed the population. Priority should however still be given to local food production over the production of woody biomass.
- The locations where intensive SRC can be planted should be limited to landscapes that can incorporate them without negatively impacting the landscape identity and to those zones that would ecologically benefit from SRC, thereby excluding open areas reserved for farmland birds.

Central to stimulating the increased uptake of any type of SRC is the investment in knowledge dissemination and guidance for farmers.

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Appendix

INTERVIEW GUIDELINES

Intro

Op het INBO voeren we onderzoek naar de mogelijke rol van biomassa uit korte-omloophout in de energietransitie. Hiervoor interviewen we nu dus een aantal eigenaars van korte-omloophout om te bekijken welke vormen van KOH aanwezig zijn in België, hoe de teelt ervaren wordt en wat het beleid zou kunnen doen om de teelt te ondersteunen.

Met de informatie uit deze interviews gaan we enerzijds een oefening doen om te kijken welke vormen van KOH waar eventueel gebruikt zou kunnen worden voor de duurzame productie van biomassa, anderzijds willen we hier ook beleidsaanbevelingen uit halen omtrent KOH.

Initiële vragen

1. Hoe lang heeft u voor het interview?
2. Kunnen we na of tijdens het interview naar het perceel gaan kijken?
3. Wilt u het consent formulier ondertekenen?

Vragen:

1. Wat zijn uw hoofdactiviteiten?

2. Waarom bent u gestart met KOH?

3. Hoeveel KOH hebt u momenteel?
    a. Is dit 1 groot perceel of meerdere kleine percelen?
    b. Wanneer hebt u dit aangeplant?
    c. Zou u willen uitbreiden? Waarom wel/niet?

4. Hoe en waarom heeft u de locatie voor KOH uitgekozen?

5. Waar heeft u basisinformatie over aanleg van KOH gehaald?

6. Welke boomsoorten gebruikt u en hoe bent u tot deze keuze gekomen?
    a. Waar heeft u het uitgangsmateriaal voor de KOH bekomen en was dit eenvoudig te bekomen?

7. Welke voordelen hebt u van de KOH? [open start, dan afchecken]
        i. Economisch rendement
        ii. Lage onderhoudskosten (materieel en mankracht)
        iii. Bodemverbetering

//

iv. Erosiepreventie
v. Wegspoelen van nutriënten tegengaan
vi. Meeropbrengst op aangrenzende percelen
vii. Habitat voor de jacht
viii. Verhoogde biodiversiteit
ix. Windbreking
x. …

b. en de omgeving?

8. Welke nadelen ondervindt u van de KOH [open start, dan afchecken]
   i. Economisch verlies
   ii. Hoge vatbaarheid voor plagen en ziekten van de plantage
   iii. Hoge onderhoudskosten (materieel en mankracht)
   iv. Verlies van bodemkwaliteit
   v. Verlaagde opbrengst bij aangrenzende percelen
   vi. Waterstress bij aangrenzende percelen
   vii. …

   b. En de omgeving?

9. Zijn er problemen bij het aanplanten en beheren van uw KOH? [open, niet afchecken]
   a. Vergunningen moeilijk te krijgen
   b. Regelgeving onduidelijk
   c. Weinig advies/voorbeelden te verkrijgen
   a. Machines moeilijk beschikbaar
   b. Uitgangsmateriaal moeilijk te verkrijgen
   c. Grondcompactatie bij aanplant
   d. Veel initiële sterfte
   e. Competitie met kruidlaag
   f. Machines moeilijk beschikbaar
   g. Slecht uitschieten van de stompen na oogst
   h. Kwaliteit van de nieuwe scheuten na oogst
   i. Zeer vatbaar voor ziekten, vb. Insectenschade kort na aanplant
   j. …

10. Kan u beschrijven hoe u het korte-omloophout beheert?
   a. Rotatielengte
   b. Gebruik van bemesting
   c. Gebruik van pesticiden/herbiciden
   d. Ondergroei stimuleren of weghalen
   e. Wat was de initiële situatie

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f. Oogstmethoden
=> Ook polsen naar motivaties van hun keuzes

11. Hoeveel opbrengst hebt u van de KOH
    a. Biomassa (ton)/periode

12. Wat doet u met het hout?
    a. Euro opbrengst/uitgespaarde euro inschatting

13. Wat is de vooropgestelde leeftijd dat u de plantage wilt stopzetten?

14. Wat zal u doen met het perceel na het stopzetten van de plantage?

15. Heb je al positieve of negatieve reacties gekregen op je KOH?

16. Als u één (of meerdere) tip kan geven aan toekomstige eigenaars van KOH, wat zou deze dan zijn?

17. Wat zou het beleid kunnen doen om het makkelijker te maken voor u om KOH te telen?

18. Hebt u nog andere dingen die u wilt vertellen?

19. Kent u andere landbouwers die bezig zijn met KOH - die zouden willen meewerken aan dit onderzoek?