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The Potential of Agroforestry for Rural Development in the European Union

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Wageningen, June 27, 2014

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Foreword

Agroforestry is a land-use system that has a long tradition in many regions throughout the world. The age-old practice of combining trees and agricultural production has been erased by the modern agriculture of monocropping practices. But in the last decades, agroforestry has been increasingly acknowledged as an alternative, sustainable agricultural systems which has multiple advantages when compared to conventional agriculture. However, to most experts and farmers, agroforestry techniques are only applicable and lucrative in tropical regions. This however is a wrong perception.
In order to untangle this wrong perception, this literature study will provide insights into the topic of agroforestry in the European Union. The diverse advantages of agroforestry have been increasingly acknowledged by the European Union and are currently included in rural development policies. However, the actual enhancement of policies is rather limited. This goes hand in hand with a lack of adequate information and knowledge about this subject. Conducting more research on the potential of agroforestry is therefore a necessity for its wider acceptance and establishment. This literature study aims to make a small contribution towards filling this knowledge gap.

One may ask him or herself why this topic has been chosen for a Bachelor thesis of the study International Development Studies, especially within the specialization of Sociology of Development. The answer to this question is rather simple. The interest in agroforestry has been developed through optional courses of agroecology and agricultural systems which broadened my perspective on agricultural systems. During my studies of International Development Studies, a major focus has been laid on the sociological point of view on agriculture. Consequently, the concept of rural development has been a concept which continuously influenced my way of thinking. Being able to combine these two concepts and areas of expertise within my final thesis therefore pleased but also challenged me. Driven by inspiration, enthusiasm but also frustration, I managed to overcome outdated literature, scattered or missing research data as well as technical formalities.
I want to thank my supervisor Dr. Ir. Dirk Roep who gave me the opportunity to conduct a literature study on this topic. Giving me the freedom to develop and work on my own ideas while advising me when needed, led to this ultimate result.

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Andrea Hain

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Acronyms and Abbreviations

CAP	Common Agricultural Policy
EAFRD	European Agricultural Fund for Rural Development
ENRD	European Network for Rural Development
EURAF	European Agroforestry Federation
ICRAF	International Centre for Research in Agroforestry
INRA	Institut National de la Recherche Agronomique (National Institute of Agronomic Research), France
OECD	Organization for Economic Co-Operation and Development
RDP	Rural Development Programs
SAF	Silvoarable Agroforestry Systems
SAFE	Silvoarable Agroforestry for Europe
WCED	World Commission on Environment and Development

Summary

Agroforestry systems are increasingly recognized as alternative land-use systems for sustainable development of the European agricultural sector. This literature study gives insights into the potential of agroforestry for enhancing rural development in the European Union. Rural development therefore serves as theoretical, paradigmatic underpinning which is defined as a socio-political and normative policy concept. The discourse of rural development is characterized by its opposition to the predominant agro-industrial dynamic of agricultural practices and its focus point of a sustainable, integrated, and regional development.

Agroforestry describes the combination of trees and crops or livestock on the same land area, providing especially ecological benefits. The concept includes manifold practices which are differing in their temporal and spatial scale. Due to the complexity of agroforestry practices, definitions and categorizations highly vary, adding to the difficulty of official registration and recognition. Throughout Europe, agroforestry is only limited to be found and actual data about the implementation status is restricted. This stands in contrast to the historical roots of agroforestry in Europe. Agroforestry practices go far back in the European history, being currently reintroduced as a viable alternative production system. The European Union increasingly recognizes the potential and benefits of agroforestry systems and supports its establishment by different means.

The benefits and the potential of agroforestry systems can be analyzed from different focus points. From an environmental perspective on agroforestry, several ecological benefits can be identified. Agroforestry can reduce problems caused by conventional agriculture including soil erosion, hydrology problems and loss of biodiversity. Especially in ecological terms, agroforestry can create synergies, enhancing the overall natural and social resources of an area. This goes hand in hand with economic potential of agroforestry. Economic considerations and benefits especially include the diversification of the farm income and the reduced environmental risks which make production a more secure practice. It is essential for agroforestry systems to be correctly implemented in order to be environmentally supportive and economically productive. Due to the multifunctional character of agroforestry, recreation and rural tourism is enhanced. This advances rural income but also benefits the wider society. This leads to the third focus point of agroforestry which concerns the social aspects. Agroforestry generally enhances landscape amenity through an increased aesthetic appeal of the countryside. Additionally, agroforestry practices maintain traditional farming practices which preserves the cultural heritage of an area.

These advantages have been acknowledged by the European Union in the last decades. Through the modification of the CAP, rural development has been recognized as fundamental for the agricultural sector. Through the Rural Development Regulations, agroforestry systems have been financially supported since the year 2005 on the EU level. National governments are currently responsible for supporting the acknowledgement of agroforestry within their borders. The EU furthermore supports agroforestry practices through the funding of research projects. These projects increase the data and understanding about agroforestry in Europe and aim at closing of the existing knowledge gap.

Concluding this research, the distinctive findings are as followed; generally, agroforestry has the potential to advance rural development in the European Union due to the combination of environmental, economic and social benefits. However, regardless of the support by EU governments, agroforestry implementation is limited to date. More research is needed in order to ascertain the advantages not only for the environment but also for the rural communities.

1. Introduction

According to the European Commission, rural areas currently cover approximately 80% to 90% of the total land of the European Union. These areas provide a space of living for more than half of the European population (European Commission 2013a). However, exact data about rural areas is difficult to gather as no single internationally accepted definition about rural areas exist (European Union 2010). But the fact that more than one third of the European landscape is characterized as rural area demonstrate that rural development and agricultural activities play a central role in the globalizing world and are objects of European policies. The European Union has a common rural development policy (European Commission 2013a) which influences the overall rural character and its development trajectories. As agriculture is increasingly considered as a "complex productive activity with a multi-functional purpose" (Cristóvão et al. 2006: p.97), agricultural production and rural development are becoming more and more connected and interwoven. The general trend towards more sustainable land use systems and the multifunctionality of agriculture leads to the acknowledgement of alternative production systems in the rural area.
Agroforestry can be seen as one of these alternative natural resource systems. Agroforestry systems are sustainable land management schemes that integrate the practices of agriculture and forestry on the same land base (Mosquera-Losada et al. 2009). Opportunities for cultural, social and economic benefits are provided by agroforestry while especially the removal of environmental harmful practices, thus the ecological aspects are highlighted (Rule et al. 2001). Sustainability aspects form an overall subject which is approached with agroforestry practices.
Agroforestry can be looked at as an innovation as it is currently reintroduced as discipline towards the development of sustainable farming systems. However, agroforestry is an old technique and has a long history, being part of human evolution (Dadheech et al. 2004, Gordon et al.1997). Whereas agroforestry practices are widely re-adapted and internationally propagated in the tropics and sub-tropics since the 1970s (Rocheleau 1999), agroforestry is at present only limited to be found in the European Union. Within the current official definitions of forestry and agriculture, agroforestry falls within these two categories which additionally hinder a wider implementation (Rigueiro-Rodríguez et al. 2009). This can also be explained by the "multidisciplinary nature of agroforestry" (Gordon et al. 1997: p.4): on the one hand this is characterized by the grey zone when trying to differentiate between agriculture and forestry and on the other hand by the difficulty to incorporate agroforestry into commodity-based approaches. However, the European Union is increasingly acknowledging that agroforestry systems have the potential to overcome some of the environmental, social, economic and sustainability problems existing in Europe's agricultural production (Rigueiro-Rodríguez et al. 2009). Special emphasize by the European Union is recently given to agroforestry in relation to rural development. At the same time, socio-political research is still fragmentary and scattered on agroforestry in the European Union, hampering a broader acknowledgement of the benefits agroforestry can provide (Eichhorn et al. 2006).

In order to gain an insight into the potential agroforestry can have for enhancing rural development in the European Union, the central research question is as followed:

In which ways and to what extend are agroforestry practices beneficial for rural development in the European Union?

But emphasize of this literature study is not only given to agroforestry practices and its different potential benefits but also to the encouragement of the EU towards these alternative practices. These insights will be given from a rural development perspective which therefore serves as leitmotif. In order to identify the connection of rural development, EU policies and agroforestry, the main research question can be specified into following sub-questions:

1. *What does the concept of rural development as a policy model imply?*
2. *How can agroforestry within the EU be characterized?*
    a. *How can the different agroforestry practices be defined?*
    b. *What is the current status of agroforestry in the EU?*
3. *What potential does agroforestry have for enhancing rural development in the EU?*
    a. *What are the potential environmental benefits of agroforestry?*
    b. *What are the potential economic benefits of agroforestry?*
    c. *What are the potential social benefits of agroforestry?*
4. *In which ways is agroforestry encouraged by the governance of the EU?*
    a. *To what extend are policies from the EU a stimulation factor for agroforestry?*
    b. *What role does research projects from the EU play for enhancing agroforestry practices?*

The analysis of these research questions is based on literature research. Existing literature, research reports and policy documents are analyzed and critically reviewed, linking and relating the different sub-questions to each other. This literature research will bring different studies and different development trajectories together, providing a deeper insight into the topic of agroforestry in the European Union. Restrictions in the resources and in the extent of the given insights are made due to time limitations of this literature study. Therefore, this thesis reflects only on narrowed trends and issues on the subject. Nevertheless, in depth analysis of the different sub-questions will provide answers to the main research question. Together, these sub-questions give a complex overview of the relationship of agroforestry and rural development in the European Union. This overview can be used to gain a better understanding of the current status of agroforestry in the European Union and to comprehend the potential of agroforestry for rural development in the European Union.

The research report is structured on basis of the sub-questions and is therefore outlined as followed: First, an introduction and the theoretical background of rural development as a policy discourse will be provided. Examining the characteristics and definitions of rural development as a policy model will provide the analytical framework of this report. Secondly, an overview and characterization of agroforestry will be given. This especially includes an outline of the different agroforestry practices which can be found in the European Union to date. Thirdly, closer insight into the current status of agroforestry in the European Union, including its historical background and contemporary practices, will enable a better understanding of the complex structure of agroforestry and its current implementation stage. Fourthly, an analysis of the ecological, economic and social benefits on rural

development will follow. This examination will provide an understanding of the potentials as well as restrictions of agroforestry. This will be the first key part to answer the central research question. Fifthly, this report will analyze the current policies and initiatives of the European Union and their encouraging effect on agroforestry systems. Special attention will be given to the influence of the Common Agricultural Policy, the European Rural Development Regulations as well as the SAFE and Agoforward research project. Sixthly, an overview of the dehesa in Spain will serve as a case study to consolidate the analysis of agroforestry systems. Seventhly, a discussion will deliberate to what extend the findings provide answers to the main research question as well as its belonging sub-questions. Finally, a conclusion will provide concrete answers to the main research questions and includes recommendations for future research. A reflection which considers and discusses the working process of this literature study will be the rounding up of the research report.

2. Theory and Concepts

The shift towards technological agriculture, introduced by the green revolution, has led to different social and environmental problems within the European Union (Dupraz & Newman 1997). Specialization, mechanization and intensification are key factors in the current agricultural system where historical practices of combining trees with agriculture are eliminated from the common practices (Dupraz & Newman 1997). However, the development of sustainable farming systems has been a trend to encounter the current agricultural system where special emphasize is given to the rural as a system. The rural is composed of farming as well as non-farming families which together shape the community livelihood system of the rural area (Doppler 2000). Taking these factors into account, the rural can be approached as a social construct which is meaningful as a place to the inhabitants. Not only rural actors but also EU policies have a major influence on the way in which rural areas are shaped and how they are connected to the wider global context (Woods 2013). This in turn means that rural development policies play a central role when looking at agricultural production and its rural setting. The involvement of the European Union with rural development questions leads to the idea of rural development as a political concept. From this starting point, rural development is approached as a policy model which can be conceptualized from different perspectives. These different perspectives and understandings of rural development will be introduced and analyzed in the following, constituting the analytical framework of this research.

2.1 Rural Development as Policy Discourse

Rural development is an integrated concept which has been defined and analyzed by several authors. Taking the different approaches of rural development into account, rural development can be perceived as a discourse (Hermans et al. 2010). A discourse is "an organized set of social representation, the terms through which people understand, explain and articulate the complex social and physical environment in which they are immersed" (Frouw 1998 in Hermans et al. 2010: p.48). This means that rural development as a discourse is produced and reproduced by different actors, institutions and scholars, leading to a complex and dynamic concept. In turn, this also holds that rural development cannot be defined by one single factor. On the one hand, rural development is approached as an alternative conception towards conventional agricultural practices, defining rural development as a paradigm for alternative development. On the other hand, current EU policies are based on rural development, defining rural development as a paradigm for policy questions. This indicates that different perspectives towards and thus through rural development can be achieved. Together they lead to the conceptualization of rural development as policy model which is a highly normative concept.

In this paper, rural development is acknowledged as a multilayered, multi-actor and multi-facetted model which focuses on a sustainable livelihood development. Following van der Ploeg *et al.* (2000), rural development is understood as a paradigm shift against agricultural modernization introduced by the green revolution. Perceived from an integrated rural development perspective, farming as

well as non-farming aspects together form the coherent picture of the rural area which leads to the acceptance of rural nature as social construct. Rural development includes different aspects of deployment where a focus lies on the alternative idea of the rural development dynamic as characterized by Marsden (2003). Moreover, movements towards sustainability in social, economic and environmental terms form a key factor of rural development. Rural development will be perceived as a underlying, normative perspective to analyze the potential benefits of agroforestry. A focus will therefore also be laid on the possibilities to modify the current practices in the rural area. This implies the reconstruction of agricultural practices, of the countryside and of European policies. For this reason, it is important to understand rural development as a combination of new and historical realities which are currently re-emerging into a heterogeneous development of the rural (Van der Ploeg 2008).

2.2 Rural Development as an Alternative to Conventional Agriculture

The rural development paradigm, based on the alternative understanding of rural development, is grounded on the assumption that rural nature is socially constructed. From a sociological perspective, rural development can be seen as an approach that shapes and constructs the rural reality while at the same time contesting current agricultural practices. Marsden (2003) developed a major characterization of rural development where the rural development model is seen as competing with the agro-industrial and the post-productivist dynamic. Marsden argues that the regulations of agriculture and the rural form an unsustainable system while also questioning the legitimacy of the rural development discourse from the European Union. This assertion is based on the argumentation that current rural development is based on an agro-industrial perspective. It is not in the scope of this paper to analyze the difference in alternative and conventional agriculture. However, it should be recognized that the agro-industrial paradigm describes agricultural systems which are grounded on capital intensity, commodification of agriculture as well as on the assumption that rural space is purely an agricultural space (Marsden 2003: p.4). This dynamic fits with the agricultural trends introduced by the green revolution which are still key to the current policies of the EU. The governance of rural space is therefore highly determined by the agro-industrial perspective as it "tends to reinforce the logic of agricultural productivist scale economies" (Marsden 2003: p.2). Consequently, the conception of rural development by Marsden differentiates from the one of the European Commission.

The rural development dynamic as characterized by Marsden serves as a an alternative approach towards the agro-industrial paradigm, thus conventional agricultural practices. Rural development emphasizes the heterogeneity of rural space while the complexity of rural governance is highly acknowledged. New policy structures are needed in order to support a re-structuring of the agricultural production chains and to enhance rural livelihoods. New forms of agricultural production which are based on ecological and local resources are therefore a key factor of this approach. In this context, rural development serves as integrated regional development trajectory where natural values and rural cultures are stressed. Altogether, Marsden (2003) argues that a "different set of organizing principles"(p.14) is needed where the different aspects which influence the rural area and agricultural production are rearranged.

Marsdens' understanding of rural development can be seen as a reflection of a general trend in rural development thinking. The Organization for Economic Co-Operation and Development (OECD) defines in their policy review (2006) the new rural development paradigm as a place-based approach which at the same time focuses on the competitiveness of rural areas. Agriculture is not seen as the single target sector but the rural economy in its whole is approached. For this reason, key actors in rural development can be found on all governmental levels where different stakeholders are involved. Due to the understanding of the rural development paradigm as a place-based approach, the rural development is associated with regional development in general. Therefore, rural development can be seen as closely connected to re-territorialization of the rural area where the construction of rural identities play a major role (Horlings & Marsden 2012).

Ellis and Biggs (2001) argue for "rural development as a participatory process"(p.443) where rural inhabitants take the control of change in the rural area. Taking this point of view, rural development can be analyzed from different angles as it is a multilayered phenomenon. This multi-levelled characteristic is also evident due to the rootedness of rural development in historical traditions. Van der Ploeg *et al.* (2000) argue that rural development emerged as a response to the paradigm of modernization. Rural development can thus be seen as the reconstitution of peasant farming, as an endogenous process, as well as a form of social struggle. It is a response of farmers to the squeeze on agriculture (Van der Ploeg 2008) where transformations of the agricultural enterprise take place. Through rural development, transformation of resources, the ecological and socio-cultural environment as well as the distribution and trading area occur. This means that a reconfiguration of resources and relations take place (Van der Ploeg et al. 2000). Rural development is therefore closely connected to the trajectories of multifunctional agriculture which include the practices of regrounding, broadening and deepening (Wiskerke 2004). Multifunctional agriculture is no longer seen as a "survival strategy for farmers" (Marsden & Sonnino 2008: p.423) but as an practice which is part of the rural development paradigm. The understanding about rural development from the 2000s onwards takes sustainable production and livelihoods into account where good governance plays a major role. Small farmers are favored where rural development also serves to support non-farm activities and rural networks (Ellis & Biggs 2001).

2.3 Rural Development as Livelihood Strategy

On account of these factors that shape rural development, agriculture and thus agroforestry are characterized by the diversification in the way of making a living. Rural development can therefore also be approached as a concept of livelihood strategies. A livelihood "comprises people, their capabilities and their means of living, including food, income and assets" (Chambers & Conway 1991: p.i). Livelihood strategies are thus the routes that farmers choose to make a living. As this literature study reviews the potential of agroforestry for rural development, diversification in livelihood strategies plays an important role. This diversification can be seen as the development towards a broad portfolio of earning an income, thus generating income through multiple activities. This is carried out in order to prevent or reduce the suffering from shocks or stress (Scoones 1998). Diversification in this regard can be approached as multifunctional agriculture. Multifunctionality

implies integrated and multi-dimensional activities which together influence the farming household as well as the rural region as a whole (Marsden & Sonnino 2008).
Rural development is closely connected to the perception of sustainable livelihoods and sustainable development. The World Commission on Environment and Development (WCED) defined sustainable development in 1988 as: "development that meets the needs of the current generation without comprising the ability of future generations to meet their own needs" (WCED 1988 in: Hermans et al. 2010: p.49). Sustainability concerns environmental as well as social capacities. The latter refers to the internal capacity to gain and maintain an decent livelihood while environmental sustainability takes the external influences of livelihoods on the global and local level into account (Chambers & Conway 1991). According to Franco *et al.* (2012), an ecological system is considered sustainable if following criteria are satisfied: (1) maintenance and improvement of soil fertility and productivity (2) fulfillment of human needs (3) economic feasibility (4) social acceptability (5) ecological adaption as well as (6) long-term resilience of the system (Franco et al. 2012: p.120).
But since sustainability is a normative concept, sustainable development cannot be evaluated within one universal framework. Different discourses on sustainable development make it a highly dynamic concept which changes within time (Hermans et al. 2010). Nevertheless, related to the definition of the WCED, a sustainable livelihood can generally be characterized as a way of living which maintains and enriches environmental as well as social capabilities for future generations (Chambers & Conway 1991).

2.4 Rural Development in EU Policies

Rural development is a paradigm which forms the foundation for policy regulations. Rural development is determined and stimulated by the European Commission where the EU Rural Development Policy is a common strategy to enhance the development of rural areas. Through rural development, the viability of rural areas is targeted. Rural areas are perceived as areas which have production, residential, environmental and heritage functions (European Citizens' Panel 2007). Rural development takes these functions into account but especially focuses on the preservation of rural landscapes and the creation of employment by means of "reintegrat[ing] agriculture into rural development" (Hildén et al. 2012: p.3391). This is closely connected to the livelihood conditions of farmers and the sustainability considerations which are part of the above described rural development paradigm. However, as argued by Marsden (2003), rural development as approached by the European Union is based on the agro-industrial paradigm. This means that the focus of rural development supports the commodification of agriculture, emphasizing economic profitability. This argumentation by Marsden is partly evident when looking at the EU strategic guidelines for rural development which provide the basis for national policies on rural development. These guidelines show the type of rural development which is enhanced through EU policies. The three key areas of the rural development guidelines focus on the development of the agrifood economy, the environment as well as the broader rural economy and population (ENRD 2014a). On basis of these guidelines, the rural development strategies and programs have been developed since the Rural Development Policy 2007-2013.

The EU Rural Development Policy in the period of 2014-2020 identifies the three following long-term strategic objectives of rural development (European Commission 2014a):

1. fostering the competitiveness of agriculture
2. ensuring the sustainable management of natural resources, and climate action
3. achieving a balanced territorial development of rural economies and communities including the creation and maintenance of employment

These objectives shape the direction of rural development which, despite of the common Rural Development Policy, still places control to the individual member states. The EU emphasizes an innovative and sustainable development of the rural which is in line with the objectives of the Common Agricultural Policy (CAP) reform 2014-2020 (European Commission 2013a). The objectives can be seen as addressing the intentions of economic growth, environmental sustainability and equity. Rural development is therefore perceived as a paradigm which combines and builds upon these objectives. Together they aim at a sustainable enhancement of rural areas which is in line with productivity and does not restrict the economic competitiveness of agriculture.
The reasons for special attention on rural development lies in the fact that agriculture and forestry are seen as crucial for the management of natural resources and the economy (European Commission 2013). The development of the rural economy and the support of rural communities is essential to guarantee the amenity of rural areas as stated by Fischler at a conference on rural development in 2003. He further argues that "rural development policy is the key community instrument to help all farmers and other rural actors face these challenges" (Fischler in Wiskerke 2004: p.56) where challenges are referred to as the continuously restructuring of the agricultural sector.

In the following, agroforestry will be defined and conceptualized which means that the basis to understand the complexity of agroforestry will be laid. For this reason, a general classification of agroforestry in Europe and an analysis of the current status of agroforestry in the European Union will be given. This overview will be rather decoupled from the above defined notion of rural development but this will be linked and analyzed in a later stage of this paper.

3. Agroforestry Systems: an Overview

Agroforestry is a complex conception which is defined by different authors in different ways. Generally speaking, agroforestry is an integrated system where a combination of trees and crops or livestock form the rural land resources management (Agriculture and Agri-Food Canada 2006). Related to the definition by the International Centre for Research in Agroforestry (ICRAF), Gordon *et al.* (1997) provide the following definition: "agroforestry is an approach to land-use that incorporates trees into farming systems, and allows for the production of trees and crops or livestock from the same piece of land" (p.1). Sommariba (1992) provides a more technical definition of agroforestry where agroforestry is defined as a practice of multiple cropping. Specific conditions need to be fulfilled in order to be acknowledged as an agroforestry system. These include that within the practice at least two species are biologically interacting, at least one woody perennial is present and at least one species used for crop production or forage is planted (in: McAdam et al. 2009).
For many scientists and practitioners agroforestry is mainly characterized by beneficial ecological interactions which have a positive influence on the production but also on the environment (Gordon et al. 1997). From this perspective, special emphasize is on the enhanced habitat function of agroforestry systems where the interaction of trees, crops and/or livestock creates a heterogeneous environment (McAdam et al. 2009). However, in recent definitions about agroforestry the acknowledgement of benefits with regard to environmental, social and economic aspects are highlighted. This goes hand in hand with the "multidisciplinary and multi-objective (..) nature" (Gordon et al. 1997: p.4) of agroforestry which illustrates its complexity. For this reason, Gordon *et al.* (1997) argues that agroforestry systems should not be limited to simplistic definitions or one-sided benefits where agroforestry is reduced to semantic discussions. Instead, its multidisciplinary nature should be acknowledged where integrated, diverse approaches to production are distinctive.
As Nair (2011) following Gold and Garrett (2009) argues, agroforestry is characterized by the following four words: intentional, intensive, integrated and interactive. This characterization shows that agroforestry goes beyond simplistic system structures but that it forms a dynamic, complex network within its wider context. It also indicates that European agroforestry needs to overcome the strict distinction of forestry and agriculture in order to be more easily incorporated in the current practices (this will be further elaborated in chapter 4 and 6).

Agroforestry systems have a temporal and a spatial scale which can differ from system to system. This means that agroforestry practices can be exerted continuously throughout the year or at different time spans. It also includes the fact that either a single practice or a combination of practices can be carried out which in turn has also an effect on the temporal scale. The arrangement of trees within the system refers to the spatial scale as the trees can be planted mixed or zoned. These different spatial and temporal arrangements depend on the purpose and the components of the agroforestry system (Mosquera-Losada et al. 2009, McAdam et al. 2009).
The production functions of the tree components are usually for human consumption such as fruit, oil and nuts, timber, firewood, cork and fodder. The crop components generally serve the production of grain and seeds, vegetables and fruit, biomass feedstock as well as fodder (McAdam et al. 2009). Furthermore, as agroforestry is "part of a multifunctional working landscape" (Jose 2009: p.1), different aims and benefits are in focus. Environmental aspects of soil, water and biodiversity, social considerations such landscape and culture enhancement as well as economic aspects of

diversification therefore play a role in the implemented type of agroforestry. Additionally, these aspects need to be seen in the context of their environmental surrounding as every area has its particular sociological and ecological characteristics (Kidd & Pimentel 1992). This in turn also means that the productivity of the agroforestry system depends not only on proper establishment and maintenance of the agroforestry system but especially on the environmental and climatic conditions of the area where the system is implemented (Mosquera-Losada et al. 2009). The multiple possible layouts in regard of tree arrangement and density of an agroforestry system therefore needs to be adapted to local conditions but also to individual preferences (Palma et al. 2007).

Agroforestry is an old practice which is currently being re-introduced into the existing farming techniques. Nair (1991) describes this reappearance as a new science of agroforestry while its art goes back in history (in: Nerlich et al. 2013). Traditional practices have been erased by modern agriculture in most parts of Europe while recently new agroforestry practices have been emerging. These new systems involve novel technologies which are adapted to modern agriculture where wide rows of trees still enable a certain degree of mechanization (Dupraz & Newman 1997; Palma et al. 2007). On basis of these new practices in combination with the spatial and the temporal pattern, current agroforestry systems can be grouped into categories (Kidd & Pimentel 1992). Generally, tropical and temperate agroforestry follow a comparable classification but nevertheless, differences in their actual application are evident (Gordon et al. 1997). As this paper focuses on agroforestry in the European Union, only a classification of agroforestry practices in Europe is provided (table 1). This classification is based on the main practices developed in America while a wider scope has been applied to the practices in Europe. Again it should be noted that these different practices can interrelate both in the temporal and spatial dimension. Combinations of agroforestry practices evolve on the one hand due to the long history of agroforestry in Europe and on the other hand because of the different climatic zones within the European Union (Mosquera-Losada et al. 2009).

Agroforestry Practices	Brief Description
Silvoarable Agroforestry	Widely spaced trees inter-cropped with annual or perennial crops. It comprises alley cropping, scattered trees and line belts
Forest Farming	Forested areas used for production or harvest of natural standing specialty crops for medicinal, ornamental or culinary uses
Riparian Buffer Strips	Strips of perennial vegetation (trees/shrubs/grass) natural or planted between croplands/pastures and water resources such as streams, lakes, wetlands, and ponds to protect water quality
Improved Fallow	Fast growing, preferably leguminous woody species planted during fallow phase of shifting cultivation; the woody species improve soil fertility and may yield economic products
Multipurpose Trees	Fruit and other trees randomly or systematically planted in cropland or pasture for the purpose of providing fruit, fuel wood, fodder and timber, among other services, on farms and rangelands
Silvopasture	Combining trees with forage and animal production. It comprises forest or woodland grazing and open forest trees

***Table 1**: Agroforestry Practices in Europe. Source: Mosquera-Losada et al. (2009)*

Different authors group agroforestry practices into different categories which lead to many different classifications in the literature. Based on Mosquera-Losada *et al.* (2009), a short introduction of their classification will be given in the following. As stated above, this classification is related to other temperate agroforestry practices and takes the historical background into account. Generally it is agreed on that the most commonly used practices in Europe are silvopasture and silvoarable agroforestry (Mosquera-Losada et al. 2009). However, other practices are also present in parts of Europe and add to the complexity of agroforestry.

Silvoarable Agroforestry

Eichhorn *et al.* (2006) define silvoarable agroforestry systems (SAF) as "widely spaced trees inter-cropped with annual or perennial crops" (p.29). These systems focus on the agricultural component where crops are regularly harvested. For this reason, trees are most commonly planted in rows, so called alley cropping, or as scattered trees where their density is rather low. Additionally, line belts which in include forest belts, hedgerows, windbreaks and shelterbelts are part of this agroforestry category. Due to the tree arrangement, the usage of machinery for the production of annual as well as perennial crops is possible, eventually reducing farming costs.

Forest Farming

This agricultural practice is based on forested areas which are naturally used for the production of non-wood forest outputs. Under this classification, crops for medicinal, ornamental as well as culinary use are included which refer to products such as mushrooms, berries or truffles. As the harvesting of these products is typically unmanaged, the economic profitability is reduced. This is further influenced by the fact that harvesting is mostly done for the personal consumption. As the control over the plants is therefore only limited managed, crop damage is highly possible.

Riparian Buffer Strips

Agroforestry practices of riparian buffer strips are characterized by trees, shrubs and grasses which are usually planted in between streams or lakes and the cropland. This is done to protect the different water sources especially against nitrate contamination from agricultural practices but also against sedimentation and erosion. These planted trees or shrubs not only serve ecological purposes but also economic ones as the wood can in most cased be sold or serve as fodder for livestock. The trees stabilize the natural environment while at the same time serve as "corridors of flora and fauna" (Mosquera-Losada et al. 2009: p.8).

Improved Fallow

Improved fallow describes the planting of rapidly growing woody species during fallow phases of shifting cultivation. This is done in order to increase the soil fertility and therefore to possibly increase the following yield. Nonetheless that this method is proven to be effective, the practices are only limited carried out in recent times. Usage of artificial fertilizers and liming of acid soils replaced improved fallow due to labor intensiveness and therefore high labor costs.

Multipurpose Trees

This agroforestry system is defined by the systematic or random planting of trees in croplands or livestock meadows. These trees have the purpose of providing fuel wood, timber, fodder as well as fruits for both consumption and fodder. This practice is often interrelated with silvoarable

agroforestry where different authors make different distinctions. Whereas Mosquera-Losada *et al.* (2009) group traditional practices of Streuobst in Germany and the dehesas in Spain to multipurpose trees, Reisner *et al.* (2007) refer to these practices as silvoarable agroforestry. This shows again that the categorization of agroforestry is not taken as fixed constant and may change within time and space.

Silvopasture

Silvopasture is one of the most common agroforestry practices in Europe as it combines trees with livestock production. Forest or woodland grazing describes practices where a high density and natural forest is emphasized and where animals with a local background are produced. Open forest trees form another form of silvopasture where mainly domestic animals are produced within an area of low density forest. These areas are often reforested or freshly afforested.

4. Agroforestry Status in the European Union

The practice of agroforestry in the European Union is to date not widely spread. Most of the agroforestry systems can only be found in marginal areas where short-term sustainability is the main reason for the establishment (Rigueiro-Rodríguez et al. 2009). For this reason, agroforestry and its multifunctionality is generally practices on a small scale where its economic significance is not substantial for the current production system (Eichhorn et al. 2006). As agroforestry systems are highly diverse, differentiations of their practice and their historical patterns within the European Union are evident. This is highly influenced by the different climatic conditions within the European Union. For this reason, a more detailed classification of climatic zones is from importance in order to understand the different agroforestry practices in Europe. Figure 1 shows an approximate categorization of Europe into four different zones: Zone I: Mediterranean Europe, Zone II: Central Europe, Zone III: Atlantic Europe and Zone IV: East Europe (Nerlich et al. 2013).

Traditional practices of agroforestry still exist in Europe although their use is declining. They can be dated back to 4000 B.C. where cultivation of crops but especially the grazing of livestock on forested land was performed (Nair & Garrity 2012). The majority of the old as well as new practices can be found in the Mediterranean zones where olive plantations and vineyards are often still intercropped (Mosquera-Losada et al. 2012). Another example is the dehesa in Spain which is the largest and most important broad leave agroforestry system in Europe to date. The dehesa is a system where widely spaced oak trees are combined with cereal or fodder intercropping as well as the keeping of livestock (Dupraz & Newman 1997). The same system can be found in Portugal under the name montados. Together they cover an area of approximately 3.1 million hectares (Mosquera-Losada et al. 2012). They are acknowledged for their public benefits such as wildlife habitat and public recreation areas which increase their public and political interests (Campos et al. 2008).
Also trees as hedgerows or windbreaks, pollarding (the pruning of trees for fodder to feed livestock) and especially Streuobst, which describe a meadow with scattered fruit trees, go far back in history and are still practiced especially in regions of Central Europe today. Except for Streuobst, similar practices can also be found in the Atlantic zone while East Europe has less traditional agroforestry practices (Nerlich et al. 2013).

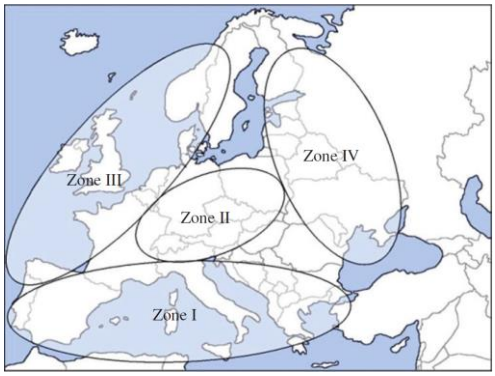

***Figure 1**: Map of climatic zones in Europe*
Zone I: Mediterranean Europe, Zone II: Central Europe, Zone III: Atlantic Europe and Zone IV: East Europe. Source: Nerlich et al. (2013)

4.1 Current Agroforestry Conditions and main Limitations

Information with regard to the actual status of agroforestry in the European Union is rather limited. Eichhorn *et al.* (2006) explain this lack of information due to the focus of European research and the institutional interest towards monoculture practices in agricultural production. This stands in direct connection with the dominant farming practices introduced by the green revolution where specialization, mechanization and intensification are in focus (Dupraz & Newman 1997). However, a shift from the European Union towards a more sustainable agriculture and rural land use encourages the funding of agroforestry research projects (Eichhorn et al. 2006). Different research projects have been carried out in temperate zones since the 1990s which identify new agroforestry practices as being compatible with modern technology while still maintaining environmental benefits associated with traditional agroforestry practices (Palma et al. 2007). By including agroforestry for the first time in the Rural Development policy in September 2005 and in the reviewed policy in 2013, the European Union increasingly recognizes the advantages of agroforestry systems not only for environmental reasons but for its multifaceted impacts.

Nevertheless, limitations in acknowledging that agroforestry can solve problems such as resource protection or endangered livelihoods are still evident (Reisner et al. 2007). This is the case for efforts ranging from national priorities and research programs as well as from individuals or families and communities (Kidd & Pimentel 1992). Looking at the micro-level, Nerlich *et al.* (2013) argue that farmers are "often unwilling to establish modern agroforestry systems to protect against problems in their current system" (p.484). In contrast, Graves *et al.* (2009) conducted a research in seven European Countries about silvoarable agroforestry where they concluded that many farmers have a positive perception towards possibilities of agroforestry and stand open towards a possible application. A reason for these differentiating findings could be the fact that knowledge distribution about agroforestry is uneven. Farmers are often unaware of the potential benefits of agroforestry practices which hinder the adoption of agroforestry practices (Nerlich et al. 2013).
This can be directly linked to a common governmental neglect of agroforestry in several European countries. Research organizations, universities and policy makers give only limited attention to traditional or new emerging agroforestry systems which deepens the unattractiveness to farmers (Dupraz 2005). Administrative structures of national governments often make strict distinctions between agriculture and forestry which influences the regulations of subsidies. Agroforestry systems fall in between the categories of agriculture and forestry which most of the time limits the qualifications for subsidy payments. This indirectly discourages the establishment and maintenance of agroforestry practices as financial support from the government is restricted to appointed agricultural practices or forestry (Eichhorn et al. 2006). Nerlich *et al.* (2013) following Smith *et al.* (2012) assumes that wider adoption of agroforestry systems is withheld due to the lack of policy support for agroforestry. Especially in the early years of establishing an agroforestry system, subsidies are from importance in order to bridge the time until the trees become productive (Sanchez 1995: in Nerlich et al. 2013).

4.2 Potential Agroforestry Areas

In order to encourage policy makers and farmers to engage with practices of agroforestry, the benefits of these systems need to be evident more clearly. This is in the first place connected to the question in which areas agroforestry is possible and beneficial due to climatic and environmental conditions. Reisner *et al.* (2007) conducted research on target regions for silvoarable agroforestry (SAF) in Europe in order to illustrate the potential of agroforestry on the continent. The aim was to define those European landscapes where trees cannot only grow on agricultural land but where they also have an economic significant yield and help to overcome environmental problems. This in turn then also have impacts on rural development. The target regions had to fulfil following characteristics: (1) they had to be arable landscapes (2) a potential productive tree growth needed to be ensured and (3) they had to suffer from environmental problems in form of soil erosion, nitrate leaching and landscape homogeneity which agroforestry could help to solve. Figure 2 indicates the identified target regions for silvoarable agroforestry in Europe for five different tree species (hybrid walnut, wild cherry, poplar, holm oak and stone pine).

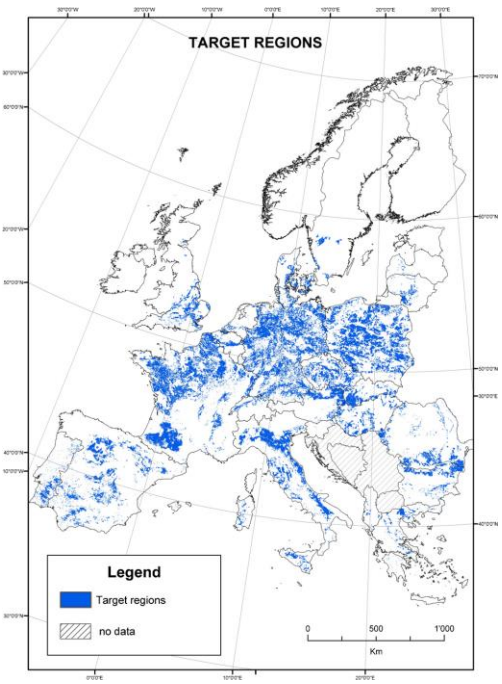

***Figure 2**: Target regions for SAF*
Source: Reisner et al. (2007)

As the map indicates, Europe provides manifold regions where SAF could be implemented in a beneficial way. In total, the identified target regions roughly cover 650.000 km^2 which corresponds to approximately 40% of arable land in Europe (Reisner et al. 2007: p.417). As environmental risks of soil erosion, nitrate leaching and low landscape diversity were key factors in determining the target regions, these identified areas could increase their environmental condition with the practice of agroforestry systems (further insight will be given in the following chapter).

Europe has a long tradition of combining trees and agricultural practices but traditional forms as well as newly emerging techniques can only be scattered found in the European Union. This means that the establishment of agroforestry is only limited pursued. The study from Reisner *et al.* (2007) indicates that SAF systems and thus agroforestry in general could be realized on a wider scale throughout Europe. Agroforestry systems therefore deserve more attention from governments and research institutions as they could overcome environmental problems caused by conventional agricultural production. Moreover, agroforestry systems do not only provide environmental benefits and opportunities but also economic and social ones (Gordon et al. 1997). Together these aspects can have a major influence on the different levels of rural development due to the integrated and interactive nature of agroforestry. In order to gain a deeper understanding of the potential of agroforestry for rural development, the following chapter will provide an analysis of the different factors of influence.

5. Potential Benefits of Agroforestry for Rural Development

Agroforestry systems can have different functions whereas these functions differ in their extent from area to area. From the perspective of different functions, an additional classification of agroforestry systems than the one introduced in table 1 can be made. Based on general functions, goods and services of agroforestry systems, a socio-economic classification was developed by McAdam *et al.* (2009). This classification takes the agroforestry functions of production, habitat, regulation and culture as a starting point and groups different agroforestry systems regarding their socio-economic characteristics. An advantage of this classification is the fact that it focuses more on the benefits and influences of agroforestry than on the actual tree and crop/livestock components. Therefore, wider analysis of agroforestry is made possible as the components and the functions of an agroforestry system can be more easily linked to its impacts and influences on different levels.
This way of looking at agroforestry potentially influences the application of agroforestry in a beneficial way. Kronick (1984) argues that the clarification of benefits and contributions to rural development are essential in order to succeed a wider application of agroforestry. He clarifies this perception with the fact that "agroforestry systems, when introduced in a region, are innovations that must be perceived as beneficial by the population before they will be adopted" (p.165). This shows that agroforestry systems have a social content which is build up by the socio-economic context of the areas. It includes not only cultural backgrounds but also elements such as commodity markets, land ownership as well as the political and economic landscapes (Rocheleau 1999). It is therefore important to understand the different factors which influence peoples' behavior which in turn shape agroforestry systems. By being part of a complex network of social relations, influences of agroforestry therefore go beyond pure environmental benefits (figure 3). Modifying environmental conditions results in better agricultural and forest resources which are directly linked to factors of rural development. But this complexity also brings difficulties to analyze its system because social, economic and ecological aspects interact in multifaceted relationships. These diverse relationships need to be understood in order to fully analyze not only the agroforestry system itself but also its wider impact on rural development (Kronick 1984).

Taking livelihood perspectives of farmers into account is a necessity when trying to sketch the full picture of agroforestry systems and its potential for rural development. Farmers and rural households make decisions based on complex criteria which take personal and environmental as well as exogenous factors into account (Pimentel & Wightman 1999). As different needs influence the choices of famers, it is appropriate to not only concentrate on the benefits of agroforestry but also on the needs of farmers which agroforestry can meet. Two different categories of needs of commercial farmers face can be identified; the first category refers to short/medium-term needs and the second one to long-term needs. As their names already indicate, they differentiate within the length of time. It is recognized that farmers often focus on the short-term needs and goals whereas agroforestry practices fall into the long-term category. This is an additional problem agroforestry needs to overcome which could be done by propagating the benefits of agroforestry systems and by supporting the farmers financially (McAdam 2005).
In order to grasp the needs and the socio-economic networks of farmers and thus of agroforestry, Kronick (1984) suggests a temporal systems approach to analyze agroforestry practices. This interdisciplinary approach "describes the occurrence of natural processes and human projects in

time, the sequence of these, and factors that constrain or enable both occurrence and sequence" (p.165). It identifies the present production and resources on a farm as well as the social interaction activities which then are linked to an agroforestry system. These in turn meet the rural development objectives. Moreover, this approach takes the temporal scale into account by differentiating between daily and seasonal activities while taking a long-term perspective. By doing so, the multifaceted relations of agroforestry and its embedding in the social-economic context are acknowledged. This approach therefore helps to understand agroforestry not only as a simple farming system but as a social practice which is highly complex and interactive (see also figure 3).

In order to gain a deeper insight into the actual benefits and opportunities associated with agroforestry systems, the following sections will describe the different perspectives of agroforestry on rural development. The chapter will be divided into ecological, economic and social factors of agroforestry systems. Together they will provide an understanding of the potential agroforestry can have in enhancing rural development in the European Union.

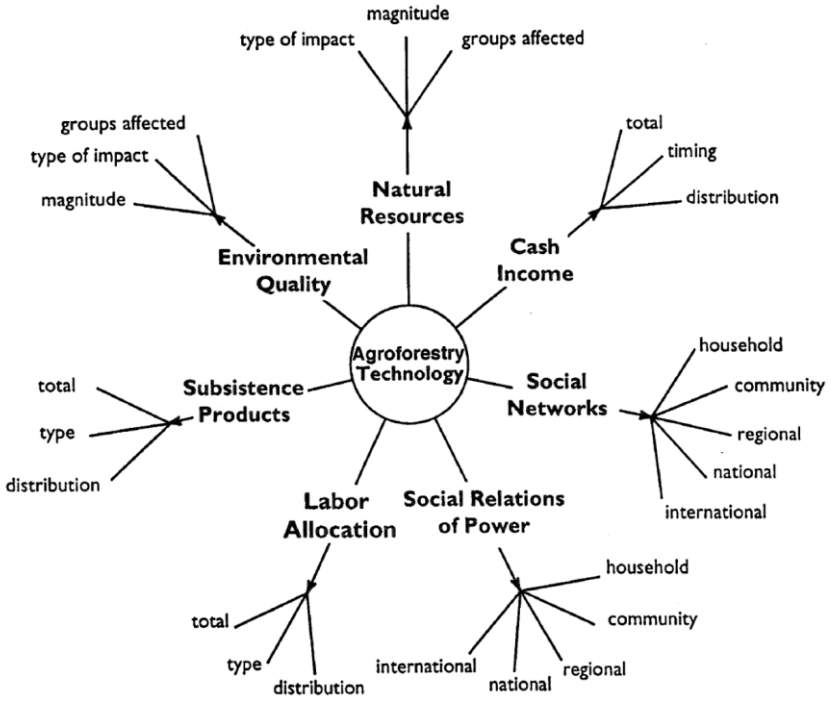

***Figure 3**: Social content and impacts of agroforestry. Source: Rocheleau (1999)*

5.1 Potential Environmental Benefits of Agroforestry

Agroforestry practices are suggested to be innovative agricultural systems which are environmentally friendly and which provide beneficial ecosystem services (Dupraz 2005). In a fact sheet, the National Institute of Agronomic Research (INRA), France refers to agroforestry as "an example of ecological intensification" (INRA n.d.: p.1) as different environmental services are provided while at the same time land productivity is increased. The study from Reisner *et al.* (2007) identifies arable regions in Europe which are in danger of environmental risk (introduced in chapter 4.2 of this paper). High risk for soil erosion on arable land was identified for 5% of the land, 52% of the land was defined as being in danger of nitrate leaching and lastly, 66% was classified as having a low landscape diversity (Reisner et al. 2007: p.417). These environmental risks can be addressed and potentially reduced on a large scale with the establishment of agroforestry systems.
The improved environmental aspects due to agroforestry impact rural development to that extend that the ecological conditions are being enhanced. Through this enhancement, resources are being used in different ways which facilitate new opportunities for socio-economic realities (Rocheleau 1999). Furthermore, rural development is influenced by ecological benefits due to sustainability reasons. Agroforestry systems are associated with sustainable land use practices which are therefore linked to ecological aspects. What kind of ecological benefits agroforestry provides, how environmental risks can be reduced and why sustainability issues play a role will be analyzed in the following.

Soil erosion is a major problem in the European Union. Especially erosion by water is a key cause for soil degradation which is linked to agricultural mismanagement, overgrazing and deforestation (Grimm et al. 2001). Soil erosion has impacts not only on the environmental condition but also on the socio-economic condition of farmers. The effectiveness and the productivity of the ecosystems are affected, resulting in lower performances of natural processes. Especially the Mediterranean regions are at high risk for soil degradation where agroforestry could produce relief by reducing erosion (Rigueiro-Rodríguez et al. 2009). Through trees or shrubs as vegetative cover, soil degradation can be reduced which leads to the improvement of the soil stability. Soil loss can therefore be lowered (Kidd & Pimentel 1992).
Additionally, as trees have generally deeper roots than agricultural crops, water may be drawn from deeper soil horizons. This means that the trees generally do not take water away from the crops but that they improve the water holding capacity of the soil. This has not only a beneficial effect on the soil structure but also on the hydrology of crop plants (Eichhorn et al. 2006). Soil organic matter is generally increased by the presence of trees in agricultural practices. Trees contribute to soil organic matter by the recycling of nutrients via leaf litter and root death. This enhancement in turn also has an effect on the physical conditions of the soil layers as high levels of soil organic matter benefit for example the soil structure or the moisture-holding capacity (Kidd & Pimentel 1992). The hydrological balance can be furthermore positively influenced due to reduced transpiration and evaporation losses. This is the case if the trees provide right amounts of shade and sunlight for the crops.

Agroforestry practices also serve as systems were nutrient losses are reduced due to decreased soil and water runoff. Reduction of nutrient leaching due to the uptake by tree roots, together with an increase in soil organic matter leads to an overall resource enhancement of the ecosystem (Eichhorn

et al. 2006). Moreover, under certain circumstances, trees can bring up nutrients from deeper soil layers to the topsoil, providing agricultural crops with additional nutrients (Nerlich et al. 2013).

Another positive benefit of agroforestry systems is the potential reduction in the usage of chemical inputs. As monocultural cropping systems are often maintained by using herbicides and pesticides, the water quality is negatively influenced (Rigueiro-Rodríguez et al. 2009). Agroforestry practices can reduce this water contamination in two ways; firstly, tree presence can reduce the pest dispersion, making use of biological pest control (Kidd & Pimentel 1992). Secondly, the deep roots of the trees uptake nutrients which otherwise would have polluted the water of rivers and streams. Especially nitrogen leaching can be countervailed in this way (Jose 2009).

Taking these environmental benefits into account, it can be said that trees and crops, when appropriately managed and sustained, create a synergy in the use of resources of water and soil nutrients. This increasingly enables farmers to cultivate poor soils as arable land (Reisner et al. 2007). Furthermore, agroforestry can also create beneficial resource use of light as trees can provide right amounts of shade which might be beneficial for certain crop species and certain agricultural regions. This protection goes hand in hand with sheltering crops from wind and rain (INRA n.d.).

The well-functioning and the environmental impacts of the system are highly dependent on the tree components (Mosquera-Losada et al. 2009). The trees not only provide the above mentioned environmental benefits but they also provide a habitat function for the ecosystem. By doing so, they create heterogeneity of the rural area. Heterogeneity is closely connected with biodiversity which can occur in direct as well as indirect ways (Rigueiro-Rodríguez et al. 2009). Diversity describes the incorporation of different species into the agricultural production system while the level reaches from field to farm to landscape level (Williams et al. 1997). In general, biodiversity through the natural habitat protection takes places while also the agrobiodiversity due to yield diversification is enriched. The rates of conversion of the natural habitat are being reduced when comparing the establishment of conventional and agroforestry system. Agroforestry therefore serves as a sustainable alternative which minimizes the level of disturbances of biodiversity (Jose 2009). The change in the environmental condition of the soil due to the woody components positively influences the micro climate. This especially increases the diversity of microbes, insects and the fauna.
The INRA (n.d.) argues that agroforestry therefore offers “corridors for wild species” (p.2) where the migration and movement of the natural inhabitants is made possible. This diversity adds to the complexity of the agroecosystem which stands in contrast to monocultural practices where opportunities for wildlife are rather limited (Williams et al. 1997).
The levels of biodiversity depend on the tree species as well as on the agroforestry practice. The most biodiverse artificial landscape in Europe is considered to be the dehesa in Spain. Silvoarable practices not only increase diversity in agricultural crops but also in woody and herbaceous species. Additionally, changing composition of plants and different microclimates allow for heterogeneity of animals and wild species. Silvopastoral practices can also enrich the variety of grazing livestock which in turn can sustain the genetic diversity of European breeds (Rigueiro-Rodríguez et al. 2009).
It has also been claimed by Rigueiro-Rodríguez *et al.* (2009) that silvopasture can protect biodiversity losses through fire risk prevention. This is especially the case for the Mediterranean areas of Europe where dry summers bring the danger of fire. Grazing animals remove dry understory vegetation which could otherwise fuel fires on a large scale.

The presence and extend of environmental benefits depend on the characteristics and management of the agroforestry system. Every agroforestry locality therefore differs in its ecological impacts which is also connected to the fact that agroforestry is highly diverse. However, in general it can be said that environmental benefits of silvoarable agroforestry were highest when implemented on large scale and on "high quality land, where current agricultural practices are most intensive and thus associated with higher levels of soil erosion and nitrogen leaching" (Palma et al. 2007: p.331).
Agroforestry systems in general are beneficial for most agricultural practices because soil, water, energy and biological resources are used in a more sustainable way than compared to monocropping practices. Kidd & Pimentel (1992) further argue that a "quality environment" (p.106) through agroforestry can be maintained by means of following practices:

- design and implementation of agroforestry systems on basis of local soil, water, climate and biota conditions
- effective usage of natural pest control, natural manures, biological resources as well as sustainable and natural farming practices such as crop rotation
- protection of the environment due to reduced artificial changes in the ecosystem
- reduction in the use of fossil energy for agricultural production

However, it should be kept in mind that agroforestry practices do not form a blueprint to protect or enhance environmental conditions. Especially with regard to increased biodiversity, interactions between the wildlife and the agricultural practices can have different outcomes. These outcomes can be positive when serving as natural pest control but they can also be highly negative when actually causing or worsening pest problems. Outcomes of agroforestry practices can also be rather inconspicuous as they do not always have direct influence on agricultural practices. These can be for example more balanced community structures of wildlife which are not directly recognized (Williams et al. 1997). These different outcomes again need to be seen in their local context. Environmental benefits of agroforestry systems greatly rely on the combination of trees and crops where unfavorable combinations can have negative impacts. Trees can compete for resources such as light, nutrients and water, leading to lowered agricultural production from the crops (Moreno & Pulido 2009). This might lead to unsustainable agricultural practices where under certain circumstances more agrochemical input is needed in order to sustain an intensive intercropped system (Eichhorn et al. 2006). This is often associated with economic factors which play an important role in the establishment of agroforestry practices. As the management of intercropped systems is often highly intensive and require more labor than conventional agriculture, environmental considerations such as usage of agrochemical inputs are made in connection with economic deliberations. Economic aspects of agroforestry are therefore significant when analyzing the potential of agroforestry on rural development.

5.2 Potential Economic Benefits of Agroforestry

Agroforestry practices and especially its environmental externalities occur over a range of spatial and temporal scales. This means that benefits "derived at the farm scale or landscape level are enjoyed by society at larger regional or global scales" (Jose 2009: p.2). But regardless of the acknowledged environmental benefits for the wider society, engagement with agroforestry depends on the decision of farmers and landowners who invest in land-use systems. Especially rural livelihood strategies play a central role in this connection. Livelihoods strategies determine the agricultural practices and include aspects such as financial and social infrastructures, institutions as well as personal assets (Kinsella et al. 2002). These decisions to engage with agroforestry practices further depend on the personal vision for the land, experiences and knowledge about land-use options and especially on the economic returns from the agricultural practices (Grado & Husak 2004). Economic considerations take available markets, interest rates and demand for certain products into account (Grado & Husak 2004). Investments play a major role for the establishment of agroforestry systems; the initial investments might be higher and the time of maturity of the investment requires flexibility of the farmer as financial returns of agroforestry systems generally require more time than conventional agricultural practices (Rigueiro-Rodríguez et al. 2009; Grado & Husak 2004).
Another aspect concerning the individual investment considerations involves the risks of establishing an agroforestry system. As research is still limited on agroforestry systems in Europe and as these systems cannot be systematically tested for individual areas, application of agroforestry systems always involve a certain degree of risk for the farmer (Pimentel & Wightman 1999).

Regardless of these constraints, agroforestry systems as land use alternatives have been identified not only as financial viable but also as economically attractive due to diversification motives (Alavalapati et al. 2004). These economic aspects stand in different connections with rural development because of the diverse economic influences and benefits. Overall it is acknowledged that agroforestry has a positive influence on rural development due to the creation of employment by multifunctional agriculture (McAdam et al. 2009). This multifunctionality also includes a diversification in the farm income. As stated by Reisner *et al.* (2007), agroforestry "diversifies the agricultural trade and market and reduces overproduction of agricultural commodities" (p.402). Trees serve the agrarian economy with the production of fruits, fodder and wood. For this reason, most of the trees in agroforestry systems have a dual-purpose where they not only provide seasonal products such as fruits but also valuable wood for timber and fodder (Eichhorn et al. 2006). The trees therefore provide a long-term income which can be combined with the annual income from arable crops or livestock. Furthermore, agroforestry often includes nature conservation and recreation which might serve as additional income source for the agricultural sector through means of leisure activities (Rigueiro-Rodríguez et al. 2009). Therefore it can be said, that the transformation of initial resources through agroforestry can lead to multifunctional agriculture which diversifies the farm income.

The income is furthermore influenced by the productivity of agroforestry systems. Due to the combination of long and short-term components and the balanced use of resources, the productivity can be increased based on the land equivalent ratio (McAdam et al. 2009). Measuring the land equivalent ratio, agroforestry in general but especially silvoarable practices have a higher

productivity when compared to conventional agricultural or forestry practices (Dupraz 2005). As a study from the INRA (n.d.) demonstrates, annual income can be increased by 50% if a fourth of the land area is used for the production of high quality timber agroforestry (service trees, pear, cherry, maple, walnut). High quality timber can be sold on the European market for high prices as there is a need for local sources of quality hardwoods in order to reduce dependence on tropic woods (Nerlich et al. 2013; Eichhorn et al. 2006). This is further advanced by the wider spacing of tree rows due to mechanization reasons. This increases not only the growth rate but can also enhance the form and length of the tree, leading to higher quality timber (Eichhorn et al. 2006).

Agroforestry has the potential to improve the overall profitability and efficiency of agricultural systems due to its multifunctional characteristics. Including trees in agricultural plots not only adds the direct products derived from the trees but the woody components additionally provide other socio-ecological services. Especially with regard to environmental benefits, agroforestry can turn marginal areas into landscapes which are economically more attractive (Reisner et al. 2007). Moreover, activities which enhance the ecological stability and productivity have a positive effect on the economic security of the agricultural productions as environmental risks are being reduced (Pimentel & Wigtman 1999). But besides these positive characteristics, agroforestry also has multiple restrictions in terms of economic vitality.
Although modern agroforestry practices are widely adapted to mechanization of agricultural production, the machines are often not sufficient compatible, causing damages to trees and crops (McAdam et al. 2009). The management of agroforestry systems is often intensive and usually requires more labor which increases the production costs. The trees need management in form of thinning and pruning which is most often done by manual work. Also practices such as cork cutting demands temporal labor while this form of seasonal employment often do not receive subsidy payments (Eichhorn et al 2006). The lack of subsidies also play a role in other respects; a case study from Carvalho *et al.* (2002) on Portuguese farmers indicates that many farmers consider economic support for agroforestry practices as essential. Given subsidies from agroforestry programs were either lacking or considered to be too low to justify the investment in an agroforestry system. The famers claimed that the subsidies need to cover the income losses in order to encourage them to consider agroforestry as a serious option.

The study illustrates the importance of economic considerations where the financial capacities as well as the individual enterprise visions play a major role. Furthermore, the actual economic potential of agroforestry is restricted by a lack of research and high variability of circumstances in different local areas. Economic benefits greatly vary according to the specific locality, the type of products and the period of time. This means that the temporal and spatial scale as well as the experiences and financial capacities of the farmer or landowner highly determine the economic impacts of agroforestry practices (Rigueiro-Rodríguez et al. 2009).

5.3 Potential Social Benefits of Agroforestry

A social perspective of agroforestry on rural development focuses in particular on the cultural and landscape value agroforestry facilitates. Social benefits of agroforestry are highly connected and based on the environmental and economic aspects of the alternative systems. Due to these, the value of the land increases which does not only bring advantages for the farmer or land owner but also for the society as a whole. As traditional practices and the attractiveness of the countryside are preserved, a higher enjoyment by the public is facilitated (Rigueiro-Rodríguez et al. 2009). This again is closely connected to economic aspects of agroforestry as rural tourism is often linked to the appreciation of the countryside. The broad social perspective forms a complex web of impacts which has different levels. As earlier demonstrated in figure 3, agroforestry systems have a social content that is not only connected to the social context but also to ecological and economic aspects. Agroforestry involves the interplay of landscapes, livelihoods and national as well as international political systems (Rocheleau 1999). In order to understand and disentangle this complexity, the above introduced social benefits will be analyzed separately in the following.

Social considerations and benefits are bound to localities as it is the case for environmental and economic aspects. Agroforestry systems need to be adapted to the farmer's preferences as well as to the local conditions which involve the traditional background (Palma et al. 2007). Many agroforestry practices have a long agricultural as well as forestry management history. Therefore, agroforestry practices can be described as being "historically important and culturally unique" (Eichhorn et al. 2006: p.44). By resorting to pure modernized agricultural practices, a considerable loss in tradition and heritage is evident as particular practices disappear from the production process (Ispikoudis & Sioliou 2005). These production processes shape the landscape and its characteristics which are connected to the local identities of many rural inhabitants. This means that landscapes can be described as "cultural landscapes" (Ispikoudis & Sioliou 2005: p.321) which are maintaining the traditional values.
Agroforestry therefore cannot only serve as a method to protect the rural landscapes in an ecological way but also to protect and manage them in a cultural manner. Culture and ecology are closely interwoven in agroforestry practices as traditional land usages are considered to be more sustainable and environmentally protective (Carvalho et al. 2002). Agroforestry practices are therefore not only remained or re-introduced because of their environmental or economic advantaged but also to maintain the cultural heritage of many European areas. An example is Streuobst as a form of multipurpose tree system which remains present and is protected in areas of Germany in order to preserve the traditional customs (Eichhorn et al. 2006).

Besides maintaining cultural heritage and traditional farming methods, agroforestry also serves as a technique to enhance the landscape amenity for the wider society. Because of the heterogeneity agroforestry systems create, the attractiveness of the rural landscape increases (McAdam et al. 2009). Recreation in the countryside is being strengthened because of landscape restoration which includes nature conservation. The "aesthetic appeal" (Eichhorn et al. 2006: p.41) of the landscape is enhanced which might also be beneficial for farmers engaged with agroforestry in terms of economic income. This leads back to the economic aspects of multifunctional agriculture which broadens the income of farmers and rural households. But the construction of recreation opportunities brings not only

income to the rural areas but also serves as a general gain to the public who can enjoy the environment. Recreation can take place in form of agro-tourism, hunting or activities such as bird watching (McAdam et al. 2009).

Following McAdam *et al.* (2009), cultural services such as conservation, amenity and recreation are key elements of the EU subsidy policy but the social perspective of agroforestry systems is to date rather limited researched. For this reason, not many benefits of agroforestry on the social level can be identified. As described above, agroforestry includes the maintenance of local cultural heritage, enhancement of the landscape and thus opportunities of recreation, including territory enjoyment (Rigueiro-Rodríguez et al. 2009). Unfortunately, not much research going beyond these social benefits of agroforestry practices in Europe has been carried out. For this reason, no conclusions can be drawn on the potential benefits agroforestry might have on for example the vitality and viability of rural community life or rural households.
However, on basis of research carried out on agroforestry in tropic and sub-tropic regions, several social benefits of agroforestry can be identified. These can also be derived from the environmental and economic benefits of agroforestry systems which have been acknowledged in the European Union. As agroforestry has the potential to reduce the environmental risks, economic risks of agroforestry systems can also potentially be reduced. This in turn also has a social benefit as the farmer can have an increased status of resilience. Furthermore, due to the connection of agroforestry and cultural heritage as well as landscape amenity, the sense of place from farmers might be enhanced. These assumptions can be made from a socially and ecologically place-based perspective on agroforestry as approached by Ispikoudis & Sioliou (2005). However, due to the lack of research not much can be definite said about the social benefits which are directly derived at the farm and individual level.

6. Agroforestry in the Policies of the European Union

After World War II, agriculture in Europe adapted an intensive large-scale production scheme which made use of synthetic fertilizers and mechanization. This intensification was enabled through new technologies introduced by the green revolution but also by the Common Agricultural Policy (CAP) of the European Union. The CAP pursued a self-sufficiency of agricultural production which further strengthened the incentives for agricultural intensification (van Zanten et al. 2013). Since the reform of the CAP in 1992, a two sided process can be identified. On the one hand, due to the transformation of the CAP from a subsidy system based on production towards a system based on producer support, a further intensification of agriculture is taking place. This is due to the fact that production and cost-efficiency led to scale enlargement in order to compete on the world market, leading to a homogenization of Europe's landscapes (van Zanten et al. 2013). On the other hand, since the reform of the CAP, EU governments have increasingly acknowledged the benefits of trees for agricultural production and provided encouragements to increase the number of trees on agricultural areas (Mosquera-Losada et al. 2012). These incentives are part of the rural development policies which have been introduced as part of the CAP.

The actual practice of agroforestry is still limited to be found in the European Union (Rigueiro-Rodríguez et al. 2009). Definite institutional and policy support for agroforestry is fragile and in some European countries non-existing. According to McAdam *et al.* (2009), this goes hand in hand with a lack of adequate skills regarding agroforestry practices. More tertiary education is needed in order to establish an understanding and exploitation of the benefits agroforestry can provide. In order to address this problem, the EU has funded different research projects on agroforestry.
The SAFE (Silvoarable Agroforestry in Europe) project lasting from 2001-2005 recommended a change in the European directives (Nerlich et al. 2013) which influenced the European perception on agroforestry. Also the new Rural Development Regulation 1305/2013 supports the establishment of agroforestry systems which therefore stands in direct connection with the current CAP. This institutional support from the EU is essential in order to encourage the establishment of agroforestry systems on a large scale. As shown in figure 4, institutional support plays a key role in the adoption of agroforestry practices as it provides needed resources for the producers and farmers establishing an agroforestry system. This includes not only information and technical support but especially funding and a platform for communication (Agriculture and Agri-Food Canada 2006).

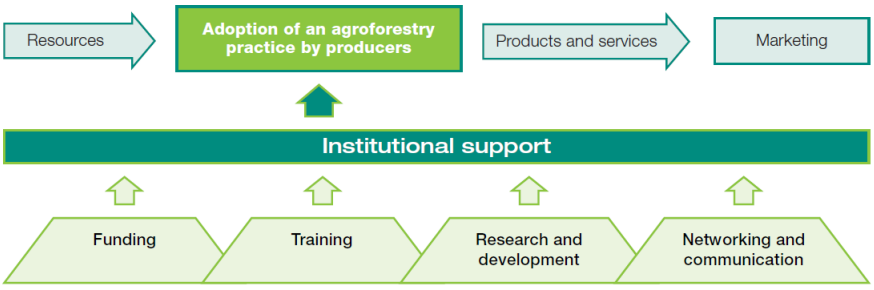

Figure 4: *Scheme for agroforestry adoption. Source: Agriculture and Agri-Food Canada (2006)*

In order to understand the relationship of agroforestry and the European policies, a detailed individual insight into the introduced topics will be given in the following. A closer look at the CAP and at the rural development policies will enable a better understanding of the stimulation factor the EU governance has or do not has on agroforestry implementation. Furthermore, two different research projects will be introduced to address the knowledge issue of agroforestry. This will provide a basis to understand the encouragement of the European Union towards agroforestry practices. Together with the environmental, economic and social analysis of agroforestry, conclusions can then be drawn regarding the potential of agroforestry to enhance rural development in the European Union.

6.1 The Common Agricultural Policy

The CAP is the agricultural policy of the European Union and serves as a system for the implementation of agricultural subsidies. It was established in 1962 and is defined by the European Commission (2012) as a "partnership between Europe and its farmers". It is furthermore characterized as a policy to "improve agricultural productivity, so that consumers have a stable supply of affordable food [and] to ensure that EU farmers can make a reasonable living". Since the early 1970s, the CAP is the main driver of agricultural practices and land-use practices more generally. Since the subsidies were production-driven in the past, intensification of agriculture has been the general trend (McAdam 2005). Although this intensification has led to negative environmental impacts and "production beyond consumption" (McAdam 2005: p.19), the CAP had and still has intentions of positive economic, environmental and territorial responses to the changes in the globalized market.

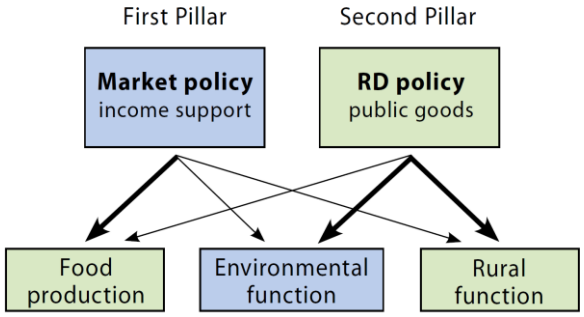

***Figure 5**: Structure of the CAP. Source: European Communities (2008)*

The CAP follows three long-term objectives which go along with the objectives of the rural development policy specified in chapter 2.2. The objectives include: viable food production, sustainable management of natural resources and balanced territorial development (European Commission 2013b). These objectives have been consistent over the years but different reforms have transformed the instruments being used to achieve these objectives. Since 2000, rural development policies are no longer only part of the CAP but form a separate policy which serves as a bridge between the two pillars of the CAP (figure 5). The first pillar covers market measures and direct

payments while the second pillar addresses Rural Development Programmes (ENRD 2014b). Before further elaborating the most recent CAP reform 2014-2020, a short introduction of the European Agroforestry Federation (EURAF) will be given. This is due to the fact that the EURAF had a significant influence on the inclusion of agroforestry in the current CAP policy.

The EURAF promotes the large-scale establishment of agroforestry in Europe with around 250 members from 18 different European countries (EURAF n.d.). In the past it has worked on CAP reform recommendations in order to advance agroforestry establishment in Europe as these have been overlooked in previous CAP schemes. Through the CAP organization of two pillars, incentives for agroforestry systems have been introduced by the CAP but the EURAF claimed that "conflicts between pillar 1 and pillar 2 rules have prevented European farmers to establish or maintain agroforestry systems" (EURAF n.d.). The federation proposed that agroforestry will contribute to the greening of the CAP and should therefore be supported under pillar 1 as an eligible land-use system. Furthermore, agroforestry should be supported under pillar 2 in form of the covering of maintenance costs of newly established agroforestry systems. These recommendations have been acknowledged in the new CAP reform which implementation is still in progress to date.

The CAP reform 2014-2020 continues to build on the organization of two pillars but tries to implement a more land-based approach where the "joint provision of public and private goods" (European Commission 2013b: p.5) is central to the policy. This includes a 'greening' of the first pillar which involves the financial rewarding of farmers who deliver environmental services to the wider public. Including this greening in the CAP leads to the fact that agroforestry practices have the possibility to fall into the subsidy scheme of Single Farm Payments as they can provide the targeted environmental services such as biodiversity and enhanced landscapes. Especially in the second pillar of the CAP, agroforestry receives special support trough Article 23 of the new Rural Development Regulation 1305/2013 which is devoted to the establishment of agroforestry systems (EURAF n.d.).

6.2 Rural Development Policies

Rural Development Policies are regulations at the European Union level but they are implemented through national and/or regional rural development programs (RDPs). All member states have to build their national RDPs based upon four out of the six following EU priorities (European Commission 2013b):

1. foster knowledge transfer and innovation in agriculture, forestry and rural areas
2. enhancing the viability / competitiveness of all types of agriculture, and promoting innovative farm technologies and sustainable forest management
3. promoting food chain organization, animal welfare and risk management in agriculture
4. restoring, preserving and enhancing ecosystems related to agriculture and forestry
5. promoting resource efficiency and supporting the shift toward a low-carbon and climate-resilient economy in the agriculture, food and forestry sectors
6. promoting social inclusion, poverty reduction and economic development in rural areas

These priorities together with the objectives regarding agricultural competitiveness, sustainable management of natural resources and the balanced territorial development of rural economies form the basis for rural development in the EU. Furthermore, rural development policies aim at agricultural modernization, encouragement of diversification of the rural economy as well as the improvement of the quality of life in rural areas (European Communities 2008). All these targets are part of the Rural Development Policy which was introduced into the EU as part of the CAP reforms under the reform action program called Agenda 2000. The policy was introduced to form pillar 2 of the new CAP (Smith 2010).

Agroforestry has been excluded from international policies until the introduction of the Rural Development Regulation. It is stated in the Rural Development Regulation (2007-2013) that Agroforestry systems have a *"high ecological and social value by combining extensive agriculture and forestry systems, aimed at the production of high-quality wood and other forest products. Their establishment should be supported"* (Council of the European Union 2005). In Article 44 of the Rural Development Regulation 1698/2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD), the establishment of agroforestry systems on agricultural land has been covered. The article states that *"support shall be granted to farmers to create agroforestry systems combining extensive agriculture and forestry systems. Support shall cover the establishment cost"* (Council of the European Union 2005). In the annex of the regulation, the support for establishing costs ranges from 70-80% depending on the region. The European Union therefore officially acknowledged the potential contribution of agroforestry for agricultural and rural development in the EU. Due to this regulation shift, nine European countries provided national support for agroforestry by the end of 2009 (Aertsens et al. 2012). However, because of different definitions of agroforestry and different conceptions about agricultural production in European countries, agroforestry remains contested in several countries with regard to Single Farm Payments. This contestation is debated by those who want to promote agroforestry systems on a broader scale throughout the European Union (McAdam et al. 2009). Whether this debate will be continued by means of the new Rural Development Regulation 1305/2013 is still unknown.
The new regulation of the European Parliament and Council of 17 December 2013 on support for rural development by the EAFRD is in progress of implementation to date. Agroforestry receives special support through Article 21 and Article 23 of the new regulation which goes beyond the support of the Rural Development Regulation 2007-2013. The establishment of agroforestry systems is approached as *"investments in forest area development and improvement of the viability of forests"* (Council of the European Union 2013). In Article 23, it is stated that agroforestry support *"shall be granted to private land-holders, municipalities and their associations and shall cover the costs of establishment and an annual premium per hectare to cover the costs of maintenance for a maximum period of five years".* The article furthermore states that the minimum and maximum number of trees on the agricultural land should be determined by the member states which need to take the local conditions as determination basis. The maximum support rate is fixed to 80% of the investments for the establishment of an agroforestry system (Council of the European Union 2013).

Agroforestry in the new Rural Development Regulation is therefore to be defined by the member states of the European Union themselves. While some agroforestry practices fall under the Single Farm Payment Scheme of pillar 1 of the CAP, others might not be recognized as eligible practices to receive financial support (Smith 2010). Subsidies can thus be given to different extents in different

countries which leads to agroforestry applications which are not homogenous throughout Europe (Mosquera-Losada et al. 2012). It is for this reason unknown whether agroforestry systems will become more extensive also because national and regional policies often still make strict distinctions between forestry and agricultural systems (Eichhorn et al. 2006). This has a major influence as funding for agroforestry systems is partly drawn from the EAFRD and partly from national and regional sources (European Commission 2014a). National and regional policies therefore have an essential function not only in the financial establishment support but also in improving agroforestry practices and their economic viability (Mosquera-Losada et al. 2012). This goes hand in hand with the "lack of institutions to inform and advise farmers" (Reeg 2011: p.49) about integrated land-use systems as it is the for example the case in Germany. Reeg (2011) argues that more research is needed in order to increase the knowledge of agroforestry systems. This in turn has then an effect on the application of agroforestry systems.

6.3 Research Projects

The European Union has acknowledged the knowledge gap of agroforestry in Europe and has funded several research projects to investigate the potential benefits of agroforestry practices. Two of these will be introduced in the following in order to sketch a picture of the current status as well as the impact of research projects.

The project Silvoarable Agroforestry For Europe (SAFE) was a research project coordinated by the INRA, France which was sponsored by the European Union in the period of August 2001 until January 2005. From eight European countries more than 70 scientists were involved in this project. The major aim of the project was to investigate how trees could be "maintained or re-introduced in agricultural systems of Europe" (Dupraz et al. 2005: p.9). More specifically, the objectives of the project were as followed (SAFE n.d.):

1. reduce the uncertainties concerning the validity of silvoarable systems
2. extrapolate plot-scale results to individual farms or sub-regions
3. suggest unified European policy guidelines for implementing agroforestry

The SAFE project had and still has a major influence on the agroforestry acknowledgement in the European Union. Most of the data about agroforestry in Europe result from this research project which also changed the agroforestry policies in the European Union with regard to the inclusion of agroforestry in the Rural Development Regulation. The project demonstrated that new agroforestry practices are compatible with modern agricultural techniques and that the loss of traditional agroforestry practices had tremendous consequences. These consequences especially involve the loss of knowledge by farmers, standardization and homogenization of landscapes, increased environmental problems and the loss of diversified income of farmers (Mosquera-Losada et al. 2012). Furthermore, the research project provided empirical data about the increased productivity and economic benefits agroforestry systems can provide. A survey of European farmers showed that approximately 40% of the farmers would be willing to implement agroforestry techniques on their

farm (Dupraz et al. 2005). However, this could only be achieved if the, at that point current, European policies would be changed so that crop payments would not be lost due to agroforestry practices and additional subsidies would be available. The SAFE project therefore proposed changes in the European policies to encourage farmers to get involved with agroforestry practices.
The propositions made in the final report of the SAFE project addressed amongst others the inclusion of a agroforestry definition in the European regulations, the legitimacy of agroforestry for the Single Payment Scheme of the CAP and the support of agroforestry by the Rural Development Regulation (Dupraz et al. 2005). As demonstrated in section 6.1 and 6.2, these recommendations, as well as the recommendations from the EURAF, have been acknowledged by the European Union. As the SAFE project provided the EU with valid data about agroforestry systems, adaptions in the policies have been realized. Additionally, the project served as a starting point for new research and development programs being set up on European as well as national level (Mosquera-Losada et al. 2012).

One of the new research projects is the research partnership *Agforward* which stands for agroforestry that will advance rural development. Agforward is a research project which is funded by the European Union's Seventh Framework Programme for Research and Technological Development. The project started in January 2014 and will continue until December 2017 (Agforward 2013). The project builds on current on-farm agroforestry trials and previous research projects such as the SAFE project while it is amongst others supported by the EURAF as a partner.
The overall goal of the research partnership is the promotion of agroforestry that will advance rural development. The objectives to achieve this goal of Agforward go a step further than the one from the SAFE project as more knowledge on agroforestry is already present. The objectives include the understanding of the context and the extend of agroforestry systems in Europe, the identification and development of innovations to improve the benefits and viability of agroforestry systems in Europe as well as to promote a wider adoption of agroforestry systems especially in locations where agroforestry is currently not-practiced or is declining (Agforward 2013).
In order to achieve these objectives and to create a deeper knowledge of agroforestry practices, Agforward works under eight different working packages which are specialized into individual topics. These include the existing agroforestry practices in Europe, values of agroforestry, different agroforestry practices for different type of farmers, evaluations of innovations as well as policy development. The findings of these topics will provide recommendations for farmers about the best practices on combining agriculture and trees. Furthermore, the results aim at guidance for individual countries on how they can implement aspects of the EU's Common Agricultural Policy such as agri-environment measures (Agforward 2013).

The SAFE project was an attempt and the beginning of targeting the knowledge gap of agroforestry systems in Europe. Increased knowledge is expected to advance the establishment of agroforestry systems on a larger scale throughout Europe. This is evident by the fact that due to more available data about agroforestry and the active promotion of agroforestry systems through various institutions, agroforestry has been acknowledged more increasingly by the European Union. It is however still unknown whether the current research project Agforward will actually help to further increase the agroforestry implementation throughout Europe.

7. Agroforestry: the Case of the Spanish Dehesa

The dehesa in Spain is a multipurpose agroforestry system which spreads across an area of 2.3 million hectares in the south-western Iberian Peninsula (Garcia del Barrio et al. 2014; Campos et al. 2008). It is known as the most widespread agroforestry system in Europe which belongs to the best preserved low-intensity farming systems in Europe. The dehesa describe a traditional agroforestry system where forestry, extensive livestock grazing and crop production are maintained on the same land (Moreno & Pulido 2009). The main goal of the land cultivation is the avoidance of shrub invasion of grasslands as well as the supply of fodder and grain for livestock (Olea & San Miguel-Ayanz 2006). By introducing and analyzing this agrosilvopastoral system, the environmental, economic and social as well as political perspectives on agroforestry can be applied to a case study which gives more insight into the actual topic of agroforestry potential within the European Union.

The Spanish dehesa describes the integration of "traditional land-use and biodiversity conservation" (Moreno & Pulido 2009: p.128) which practices can be dated back to the first written reference from 924 AD (Olea & San Miguel-Ayanz 2006). The landscape is dominated by Mediterranean evergreen holm oaks and cork oaks, woodland, pastureland as well as cropland and scrubland (Campos et al. 2008). These practices are influenced by the Mediterranean climate, the position on low fertility soils and an usually undulating topography which together are unsuitable for profitable arable farming (Garcia del Barrio et al. 2014). The landscapes are not only important in environmental and economic terms but especially from a historical and cultural perspective as they form a fundamental part of regional identity (Huntsinger et al. 2013). However, the dehesa increasingly faces problems which increase the risk potential of the landscape. These problems include the old age of the trees, increased mechanization and intensification through especially higher livestock density, depopulation of the rural areas and rising labor costs (Moreno & Pulido 2009; Campos et al. 2008). Especially the fact that the management of the dehesa landscapes is increasingly abandoned due to the depopulation trend and economic profitability reasons which take a short-term perspective, puts pressure on the existence and sustainability of the dehesa (García-Tejero et al. 2013).

It is important to acknowledge the diversity of the Spanish dehesa in order to grasp the complexity of the agroforestry system. Because of its size, the landscape differs in climate, topography and soil conditions. Furthermore, the land ownership which can be common or private adds to the structural complexity (Garcia del Barrio et al. 2014; Campos et al. 2008). Therefore, different practices and management systems are present in the dehesa which also means that different problems exist to different extends.
Consequently, different typologies and classifications can be made to untangle the heterogeneity of the dehesa. Garcia del Barrio *et al.* (2014) conducted research on species diversity in the dehesa, dividing the area into climatic categories. The categories include the typical dehesa in the southern part, the dry dehesa which is located more centrally and the cold dehesa which is in the northern part of the area. These different parts of the dehesa indicate differentiated environmental characteristics which in turn have a tremendous effect on the agroforestry system.
In contrast, García-Tejero *et al.* (2013) divide the dehesa into three categories based on the existing agroforestry type and management scheme. This include traditionally managed dehesas with extensive grazing systems, long-time abandoned dehesas and lastly cleared dehesas which are

maintained by mechanical shrub cutting. The different management systems lead to diverse environmental structures, acknowledging not only the environmental but also socio-economic heterogeneity of the Spanish dehesa.
The complexity of the dehesas' categorization increases even more when taking the classification of agroforestry practices from table 1 into consideration. Different authors refer to the dehesa as different practices. This was earlier illustrated on the categorization of Mosquera-Losada *et al.* (2009) and Reisner *et al.* (2007) where the dehesa is defined as multipurpose trees and as silvoarable agroforestry. In contrast, most often the dehesa in general is acknowledged as agrosilvopastoral systems which combines silvoarable and silvopastoral agroforestry. Altogether, this illustrates the difficulty of defining what agroforestry is and in which categorization it falls.

The dehesa in Spain is most importantly characterized by the enhanced biodiversity on the local and regional scale due to its traditional management system. Additionally, endangered species and habitats are protected due to the maintenance of large mature trees (García-Tejero et al. 2013). Especially the regulation of the livestock pressure is essential not only for the retention of the biodiversity but also for the ecological balance of the dehesa more generally. Flora and fauna are diversified because of habitat heterogeneity and the "interaction between abiotic conditions and the extensive regime of use at different scales" (Garcia del Barrio et al. 2014: p.112). This indicates that human activities are inevitable to maintain the dehesa in its current form, making it an artificially preserved landscape. Traditional agrosilvopastoral practices are therefore important to work particularly against following problems: loss of diversity, increase in soil erosion rates and over-aged oak stands due to extended absence of regeneration (Moreno & Pulido 2009). This in turn means that the agroforestry practices of the dehesa in Spain feature several environmental benefits.
The trees of the dehesa can be perceived as the "ecosystem engineers" (Moreno & Pulido 2009: p.127) because they enable the conservation of grass production on poor soils in a semiarid climate. The trees influence the above and below-ground resources such as light, water, nutrients and biomass. Due to the Mediterranean climate, trees can serve as a regulator to lower air and soil temperature which in turn has positive effects on the water availability and the soil moisture. Furthermore, the microclimate and therefore also biodiversity of microorganism is enlarged. The soil properties involving the soil organic matter content are improved while mobilization of additional nutrients is enhanced (Moreno & Pulido 2009).
However, these positive environmental aspects are only achieved if the trees do not compete with crops or grass for resources. The right combination and composition of trees and crops or woodland need to be achieved where a symbiosis rather than a competition is accomplished. Moreno & Pulido (2009) describe the combination of holm oak with herbaceous plants as an example from the dehesa of competition avoidance. Following Rambal (1993), the authors identify evergreen oaks as "regulator species" (p.138) which have the potential to survive in dry environments while not requiring high amount of water which is needed for the plants beyond the canopy.

Overall, the dehesa can be described as an extensive but also labor-intensive land-use system which environmental condition is in danger due to profitability reasons. The economic situation of the Spanish dehesa is therefore characterized as being complex and ambiguous. The dehesa plays an important role in the overall economy of the rural areas in south-western Spain (Moreno & Pulido 2009) but the actual commercial profitability rates and the self-sufficiency are low (Campos et al.

2008). This situation has several dimensions which together shape the economic condition of the dehesa.
Livestock production is the dominant source of income for farmers operating in the dehesa. This is the case against the fact of a general dependence on external fodder, an increase in the salary of workers and a decrease of specialized hand labor. Because of subsidies, the livestock production is not only maintained but also increased, leading to greater direct income (Moreno & Pulido 2009). However, this has several negative impacts; livestock pressure on the environment can, depending on the region, decrease biodiversity as well as positive impacts generated by trees. Extensive livestock keeping often means that farmers do not regenerate holm or cork oaks but gradually let them disappear in favor of pasture land. By doing so, less investments need to be done while more livestock can be produced. This generates higher income with respect to the compared market prices for cork and other tree products. Consequently, this means that the regeneration of the oak trees is left behind, leading to aging trees which endanger the loss of the traditional dehesa landscape (Campos et al. 2008). The ageing of the trees is further reinforced by the fact that the generation who invest in the natural regeneration of the oak trees are usually not the one who derive direct returns from it. Regeneration of oak trees and investment in sustainability are often not profitable and mean a short-term income decrease which are not covered by a compensation scheme (Campos et al. 2008).
Nevertheless, due to its multipurpose character, the dehesa provides more products and economic benefits than only livestock production. The trees can provide pasture, acorns, cork and firewood. Also forest farming practices of honey production and exploitation of fungi as well as medicinal and herbal products serve as direct income. Furthermore, big game is increasingly recognized as a profitable source of income while the landscape value enables income from recreation activities. Especially agrotourism close to naturally protected areas is a favorable multifunctional activity of farmers in the dehesa (Moreno & Pulido 2009).

Maintaining the natural value of the dehesa is therefore not only beneficial for environmental services to the farmer but also for the provision of public benefits (Campos et al. 2008). Additionally, the regional identity can be preserved while cultural heritage and traditional practices of agricultural production in the dehesa are kept alive (Moreno & Pulido 2009). The dehesa is part of the “traditional transhumance routes” (García-Tejero et al. 2013: p.59) of pastureland and livestock keeping which have been practiced for centuries. This emphasizes the fact that the traditional management of the dehesa is connected to the cultural uniqueness of the landscape.
Due to the agroforestry practices, the landscape appreciation of the area increases. This indicates that natural and cultural values are closely interwoven which advance the aesthetic qualities of the landscape. Additional income through recreation and tourism can only be generated if the typical dehesa landscape is maintained. Although farmers and landowners are aware of the situation that investments in oak generation are crucial, it seems that self-consumption in the short term is considered to be more important than the long-term preservation of the area (Campos et al. 2008).

National policies specified to the dehesa can play an important role in acknowledging the importance of the traditional management to preserve the ecosystem which combines human usage and high biodiversity (García-Tejero et al. 2013). By correcting the lack of environmental regulations not only the sustainability but also the maintenance of the dehesa in the long term will be enhanced. These

national applied policies as well as subsidies for sustainable management by national agencies are lacking at this point of time (Moreno & Pulido 2009).
Because of the acknowledgement of the dehesa as a public good, the political interest about the area goes beyond Spanish borders and reaches European interest (Franco et al. 2012). The richness of the biodiversity qualifies the dehesa as being listed in the EU Habitat Directive (Moreno & Pulido 2009) which forms the “cornerstone of Europe's nature conservation policy” (European Commission 2014b). This directive protects European animal and plant species as well as in the case of the dehesa special habitat types which are of European importance.
But influences from the European Union have also been partly responsible for the current labile situation of the dehesa. The CAP introduced changes in the socio-economic and technological conditions which had a major influence of the practices in the dehesa. Through the subsidies payments of the CAP, intensification of agricultural production and especially the increase of livestock numbers was encouraged throughout the last decades (Moreno & Pulido 2009). This had a negative influence on the sustainability and the age of the oak trees because intensive agricultural systems received the majority of CAP subsidies. Through the CAP reform 2003 which introduced the Single Farm Payment for famers and later the increase in subsidies decoupled from production, led to a decrease in the amount of farmers who applied the traditional dehesa management (Franco et al. 2012). But in contrast to these negative impacts, the CAP also fostered oak plantations on retiring marginal croplands. Especially through the inclusion of rural development measurements into the CAP, new initiatives have been and are currently created. These initiatives seek to promote agroforestry practices such as the dehesa which reduce biodiversity loss and support sustainability (Campos et al. 2008). The Rural Development Policy does that by offering “change of potential government support for regeneration practices in European agroforestry practices” (Campos et al. 2008: p.511). This change can impact the Spanish national policies to support the sustainable development of the dehesa.

The need for applied policies which encourage and support the maintenance of traditional management practices in the dehesa is evident. However, in order to counteract the negative developments in sustainability, policies but especially different stakeholders need to cooperate (García-Tejero et al. 2013). Researcher and technicians identified the lack of oak tree conservation as a regeneration failure which influenced the long-term stability of the dehesa but direct actions have been limited. Landowners, farmers, policy-makers and administrative bodies need to work together and collaborate with each other. Long-term strategies which are specifically framed for the dehesa must be designed to promote conservation management practices (Moreno & Pulido 2009). Additionally, more interrelated research is needed to better understand the internal and external events of and in the dehesa. This also include aspects such as optimal tree density and population dynamics, actual data about regeneration of the dehesa as well as long-term climatic changes (Moreno & Pulido 2009).

The case of the Spanish dehesa illustrates the complex interrelation of environmental, economic, social and especially political aspects of agroforestry practices. These interrelated aspects influence but also shape agroforestry practices and together have an impact on the role agroforestry can play for rural development. The dehesa plays an important role for the rural development of the south-western parts of Spain. Environmental considerations are fundamental in this connection as the agroforestry practices enable agricultural production on marginal land which could otherwise not be

used for arable systems. The ecological conditions enrich the habitat function and therefore improve regional biodiversity. Rural development is also evident in economic terms because of its income generation and the possibility for farmers of creating a livelihood. Additionally, the protection of a cultural rich landscape and the possibility of multifunctionality has a positive impact on the social aspects of rural development.

Policies of the European Union have been rather counterproductive for the sustainable development of the dehesa in the history. The subsidy payments through the CAP had major influences on the development of the dehesa and did not support the traditional low-intensive management. This resulted in a situation where the current condition of the dehesa is questioned as being sustainable. However, personal decisions and economic trends allowed for this change in management, meaning that the policies of the European Union are not solely responsible. Current trends of the Rural Development Regulations aim towards the financial support for environmental and socio-economic sustainable practices which potentially have a positive effect on the dehesa maintenance in the future. This maintenance needs to go hand in hand not only with national policies but also with the collaboration and long-term perspective of especially farmers and landowners.

8. Discussion

This literature study provides an analysis of the potential benefits agroforestry can provide for rural development in the European Union. The central research question which answer will be deliberated in this discussion is as followed:

> *In which ways and to what extend are agroforestry practices beneficial for rural development in the European Union?*

Special emphasize is given to the role of the European Union, analyzing the encouragement of agroforestry by the formal institution. The sub-questions operationalized the main research question and identify the connection of rural development, EU policies and agroforestry. They address the characteristics of rural development as a policy model, the components and characteristics of agroforestry, the potential benefits of agroforestry towards rural development and the ways in which the European government encourages agroforestry practices. The findings to answer these sub-questions are used to gain an understanding of the current status of agroforestry in the European Union, enabling to find an overall conclusion on the main research question.
Due to the fact that these sub-questions are self-contained but nevertheless closely interwoven with each other, the discussion of its findings will not strictly follow the order of the sub-questions. This allows an in-depth discussion of the findings which have been generated through the literature review. By force of limited available literature, some research questions can only partially be answered. This indicates that the research findings contain knowledge gaps which could not be filled within the scope of this analysis.

The definite characterization of agroforestry within the European Union is complex and contested. The categorization of agroforestry can be done on basis of different focus points, leading to manifold classifications. However, the categorization from Mosquera-Losada *et al.* (2009) builds a general accepted foundation for agroforestry practices in Europe. Contrariwise, the actual definition of agroforestry is contested and is not agreed on by experts. Generally, agroforestry describes a complex set of agricultural systems which are characterized by the combination of agricultural and forestry practices. However, many different definitions about agroforestry exist not only in the literature but also in official documents such as the rural development policy. It is however discussed whether it is beneficial to have a single common definition about agroforestry. On the one hand, as argued by Gordon *et al.* (1997), the multidisciplinary nature of agroforestry is difficult to grasp in one single definition which would in turn only lead to semantic discussions. On the other hand, as argued by McAdam *et al.* (2009), an universal definition of agroforestry is needed in order to guarantee that agroforestry practices are not differently interpreted at the European level. Because of the fact that nations can define agroforestry systems themselves, subsidy payments and the actual application of agroforestry is highly uneven in the European Union. From this point of view, it would be therefore beneficial to create an initial situation where agroforestry is perceived in a homogenous way.
Generally it is acknowledged that agroforestry should not be reduced to simplistic tree and crop/livestock ratios. Instead, agroforestry systems should be perceived and evaluated in terms of their ecosystem functions as well as goods and services they can provide. This recognition could build the basis to define a flexible definition of agroforestry which does not only avoid formal discussions

but also serves as a valid concept in all European countries. By focusing on the advantages agroforestry can provide, a step is also made towards the acknowledgement of agroforestry as a viable alternative production system.

Through the acknowledgement of agroforestry as an alternative production system for conventional agriculture, a first acceptance of its potential for rural development has been made. Rural development is defined as a policy model which can be approached as a dynamic, normative paradigm. In this paper, rural development is characterized as an integrated development trajectory which stands in contrast to the current dominant agricultural practices. Rural development searches for place-based approaches which enhance the heterogeneity of rural areas through the reconstruction of the agricultural practices. This can potentially be achieved through agroforestry schemes which not only involve diversified practices but which also create heterogeneous environments through the interaction of trees, crops and/or livestock. Benefits can be achieved through the usage of natural mechanisms such as ecological symbiosis. By combining these elements, not only diversity of the ecosystem but also of the agricultural products and goods as well as of the landscape are created. Furthermore, a place-based development of the rural is predominately achieved because agroforestry systems are often adapted to local conditions and local resources. Accordingly, it can be concluded that the modification of agricultural production to regional conditions benefits rural development because of more sustainable land-use management.
Sustainability plays a major role in agroforestry practices and its potential for rural development. Because of the adaption to local resources and its production methods which reduce the disturbance of the natural ecosystem, agroforestry systems have been identified as more sustainable practices than conventional agriculture. However, as the case of the Spanish dehesa illustrates, the systems are dependent on human activities which are fundamental to develop and to uphold sustainability.

Generally, environmental benefits through agroforestry systems can be achieved. Environmental problems such as soil degradation, water and nutrient leaching, limited soil organic matter and reduced biodiversity have a tremendous impact not only on the ecosystem itself but also on the productivity. This in turn has impacts on the livelihoods of the farmers as well as of the rural households, leading to social and economic benefits. As illustrated by the study from Reisner *et al.* (2007), agroforestry has the potential to decrease environmental problems caused by conventional agriculture and to sustain a more healthy environment on 40% of the European arable land. But agroforestry not only benefits rural development due to more environmental sustainable production but also due to the creation of new socio-economic opportunities. These opportunities include the creation of multifunctional agriculture which comprises a diversified income for the producer. Additionally, the creation of employment through this multifunctionality is enhanced, leading to situation where the rural economy is eventually enriched. Furthermore, by providing the society with a rural area as a countryside which can be enjoyed and consumed, additional income due to recreation opportunities can be gained. Multifunctionality by means of agroforestry can therefore serve as a mechanism to enhance rural development.

Agroforestry is a traditional land-use system which has been erased by modern agricultural practices in most parts of Europe. However, as agroforestry is re-introduced, traditions and heritages are also preserved. This can be seen as connected to the process of re-peasantization which is part of rural development as argued by van der Ploeg (2008). Reconstitution of peasant farming is enhanced as

traditional farming practices are used to encounter pure modernized agricultural practices. However, this implies that farmers themselves want to adapt agroforestry practices and take initiative to establish alternative agricultural systems. The dehesa in Spain serves as an example where this form of initiatives and investments in sustainable agroforestry practices are lacking due to predominantly economic considerations. Farmer make decisions on their management system which are in this case fundamental for the continuous maintenance of the dehesa.
By taking this perspective, agroforestry systems can be approached as a processes which is constituted by endogenous processes as well as the institutional framework of the European Union. This also leads back to the characterization of agroforestry as an intentional, intensive, integrated and interactive practice. Without the personal intention of farmers and producers, agroforestry systems cannot be established. In addition, agroforestry always involve the integration in the socially constructed reality of the individual rural area. Agroforestry practices consequently need to be seen in their wider context, meaning that an understanding of the social networks and relations constituting agroforestry is fundamental. This understanding is important in order for agroforestry to have a positive influence on rural development. Through the neglect of the social content, agroforestry is reduced to a simple agricultural practice which does not have wider effects on the rural. For this reason, a better understanding and more research is needed in the domain of social sciences in connection with agroforestry.

Although differentiated research projects have been carried out to explore the potential of agroforestry, the social side has been generally neglected. Focus has been most often laid on the environmental benefits of agroforestry systems. Therefore, evidence not only about social benefits of agroforestry but also about the social impacts and influences themselves have been disregarded.
Research in general is still limited about agroforestry in Europe. Notwithstanding that expansive research projects such as the SAFE projects have been carried out, knowledge is still restricted. A major focus has been laid on silvoarable and silvopastoral agroforestry in Europe, leaving other agroforestry practices such as forest farming and riparian buffer strips marginal. It is for this reason that case studies with a scientific background which are not outdated or one-sided towards exclusively environmental aspects, are difficult to find. If the potential of agroforestry for rural development wants to be identified on scientific grounds, more research is therefore needed.

For this reason, universities and research institutions have a central function for agroforestry enhancement but also policies and financial support from the European Union play a key role. The acknowledgement of agroforestry for beneficial rural development is connected to the fact that support from different sides is needed in order to introduce agroforestry systems. Construction of knowledge and the organization of intersectoral coordination for better collaboration and policy coherence are therefore key targets. As indicated in figure 4, adoption of agroforestry practices by producers is dependent on institutional support but also aspects such as marketing of the provided goods and services are fundamental for the viability of agroforestry practices. For this reason, diverse stakeholders need to be part of the enhancement of agroforestry whose information and knowledge about the alternative production system therefore also needs to be improved. This has also been illustrated in the case of the Spanish dehesa where long-term strategies and collaboration are essential. Altogether this indicates that communication and networks are highly important to advance the establishment and maintenance of agroforestry systems. While the European Union

increasingly recognizes the potential of agroforestry, networks and sufficient communication platforms are still limited at the European Union level to date.

Since the last decade, agroforestry has been officially recognized by the European Union through the funding of research projects in order to gain more scientific knowledge into agroforestry systems in Europe. Furthermore, the European Union included the alternative production system in the Rural Development Policy. By doing so, the European Union financially supports the establishment and maintenance of agroforestry practices.
However, the support and acknowledgement of the multiple benefits agroforestry can provide is still limited by the European Union. The objectives of the Rural Development Policy include agricultural competitiveness, sustainable management of natural resources and a balanced territorial development of the rural economy. Together with the aim to modernize agriculture, to encourage diversification and to improve the quality of life in rural areas, agroforestry is not directly approached as a practice to target these objectives. Yet, these objectives could be partially met through agroforestry systems when taking the environmental, economic and social benefits into account. Agroforestry has the potential to modernize and restructure current agricultural practices, to invest in human and social capital, to produce high quality and value-added goods as well as to restore forestry potential. Furthermore, diversification of the rural economy and the preservation of the natural resources and rural landscape are key advantages of agroforestry practices. In this regard, the encouragement by the European Union towards agroforestry practices is still fragmentary.

The question which therefore arises addresses the focal point of the European agricultural and rural development policies. The European Union claims to support the sustainable management of the agricultural sector and the rural areas as indicated in the objectives of the Rural Development Policy. Also the reconstruction of the CAP leads to the assumption that the European Union strongly focuses on the increasing sustainability of the agricultural practices in the recent time. However, intensification and mechanization are still the leading practices and target development trajectories in the European Union. Agricultural competitiveness on national and international level stands central, indicating that the actual acknowledgement and support of alternative production systems is still limited to certain extents.
At this point of time, it is therefore questionable whether agroforestry systems, regardless of their potential benefits, will be realized on a large scale throughout the European Union. Because agroforestry practices fall into the category of alternative farming methods, their broad-scale application might be limited. A general change in the perception of agricultural production and rural areas need to be strengthened in order to create space and wider acceptance for alternative systems.

Taking this argumentation into consideration, the dependence of agroforestry systems on subsidy payments can also be contested. As argued by several authors and as indicated by the case studies of the Spanish dehesa, the establishment and maintenance of agroforestry systems are conditioned by the financial support of national or international payments. This has been targeted by the European Union by including agroforestry in the Rural Development Policy. However, when taking a perspective going beyond the European level, subsidies paid by the CAP often results in agricultural overproduction which have impacts on the global agricultural production prices. This fact leads to an ambivalent situation of agroforestry; on the one hand agroforestry systems, although being productive when correctly implemented, can reduce the overproduction of agricultural commodities.

On the other hand, agroforestry systems rely at this point of time on agricultural subsidies which generally encourage overproduction and the exportation of low-priced agricultural products.
The greening of the CAP and the expectation that from 2020 onwards subsidies will be exclusively given to those farmers who produce in tune with the environment, will most probably change the subsidy payments and therefore the agricultural landscape. Additionally, as the European Union increasingly recognizes the need for sustainable production and rural development, a shift in the main focus on agricultural production can be expected. Which role agroforestry will eventually play in this greening of the agricultural sector is still unknown.

9. Conclusion

This literature study on agroforestry practices in the European Union has explored the potential of agroforestry as a land-use system for enhancing rural development. Rural development has been framed as a heterogeneous, regional development trajectory which stands in contrast to the agro-industrial practices of agriculture. Through this framing, agroforestry has the potential to enhance rural development by different means. Agroforestry systems can modernize and restructure current agricultural practices, providing space for sustainable production and development. It can produce high quality and value-added products which serve as a diversified income of producers. Due to multifunctionality of agroforestry systems, the rural economy is potentially diversified which also improves the livelihood of producers. This strengthens the quality of life and serves as an investment in human and social capital. This is not only the case for landowners and producer but for the wider society because of landscape enhancement. Furthermore, the landscape potentially benefits from agroforestry by means of improvement and restoring of the natural environment. Taking these benefits together, it can be concluded that agroforestry has the potential to enhance rural development.
The encouragement of agroforestry by the European Union through means of adapted policies is in progress to date. Agroforestry practices have been included as viable practice in the Rural Development Regulations which cover establishment and maintenance costs. A general trend of the European Union towards a sustainable development of the agricultural sector potentially makes space for agroforestry as viable and accepted practice. A wider application of agroforestry is connected to research projects which enable a better understanding of the impacts this alternative land-use system can have.

The way forward for agroforestry practices in Europe therefore involves wider research projects on a national and regional scale. Because agroforestry practices are more complex land-use systems than exclusively agriculture or forestry, long-term studies are important. These studies need to demonstrate the synergies of agricultural and tree components on the European level. Through coordination between and within European countries, research networks need to be established in order to promote agroforestry systems on a larger scale. This also involves the development of education about agroforestry practices. Farmers need to have access to knowledge and education about alternative land-use systems which strengthens the decision making process to potentially engage with agroforestry practices. Furthermore, national governments need to adapt policies which support environmentally and socially sustainable agricultural practices. A general shift in the conception about agricultural practices in the European Union needs to be a long-term goal if a European sustainability in the agricultural sector wants to be reached. Agroforestry is one of these sustainable practices that has the potential to target sustainability issues and to advance rural development. This could be realized if the fields of policies and research combine into networks to promote the benefits of agroforestry on the European level.

Personal Reflections

Agroforestry systems are usually perceived as alternative production system which enable farmers in the tropics to make a living. That agroforestry practices also provide viable techniques for Europe is often not known. I gained insights into the topic of agroforestry during courses on agroecology and agricultural systems which was mainly applied to the European context. When thinking about a topic for my Bachelor thesis I was certain that I wanted to combine my sociological knowledge of my main studies with that of agroforestry. The fact that agroforestry, regardless of its historical roots in Europe, is only limited to be found in temperate zones made me wonder. I decided to specialize on agroforestry practices in the European Union and to combine agroforestry practices with the discourse of rural development.

The narrowing down of the actual research topic has been a first challenge due to limited availability of literature on agroforestry in Europe. My initial ideas about a topic have been either too broad or too narrow which would not have fit with the purpose of this Bachelor thesis. After finally defining the topic of the potential of agroforestry for rural development in the European Union, I started to deepen in the literature research. Several books and articles served as foundation to shape the structure of the thesis. Literature on agroforestry in Europe is often specialized on environmental aspects, leaving social considerations regularly disregarded. However, from several small pieces I managed to shape one picture about the different perspectives agroforestry embraces.
The working progress has been a steady and continuously one. Due to the fact that I am a rather organized person, I developed a scheme on the topic overview as well as a detailed time planning. This helped me to work towards intermediate goals, dividing the thesis into several more individual parts. As a result, I succeeded in a balanced commitment of working on the thesis which sometimes drove me into long working days and sometimes stopped me from working too much. During the process of writing this thesis, I managed to stick to the time planning as well as to the initial outline of the literature study for most parts.
The writing process itself has been a balanced course due to the detailed outline I developed beforehand. After a few days of gaining an insight into the topic through a literature review, I started to combine the process of writing and searching for literature. I tried to characterize this process through good organization of the literature in order to not lose track of the literature and data I wanted to use. Through the usage of a color scheme for the different topics of my thesis, I prevented to lose or to read literature manifold. This method furthermore enabled me to fit pieces from several articles into one literature study.

The fact that the Bachelor thesis enabled me to work on my own project and to develop my own ideas has been a significant experience for me. Being responsible for the research topic and outline, the working process as well as the critical assessment of the own work has been a challenge sometime. While I was one week convinced that the work I did so far was from good quality, other weeks I was more doubtful about my work. This imbalance in confidence about my work is something I need to work on in future projects in order to work more comfortable and confident on the long run.

Agroforestry is a topic which is increasingly recognized as a possible agricultural system in Europe. This makes it a topic which has become important especially in the recent time, making it an up to date topic. Working on a topic which can be from significance as a problem solving solution for current problems has been inspiring and served as a motivation. But its up-to-dateness, especially with regard to social and political aspects, also has been an obstacle. Scientific literature is only limited to be found, almost all concluding that more research in the future is needed. This conclusion has also been the main finding in this paper, indicating that potential for upcoming thesis's exist. This challenge I am eager to take on in the future because I am convinced that agroforestry systems have the potential to shape a sustainable land-use management especially in Europe.

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