



Database of agroforestry system descriptions

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1 Context

The aim of the AGFORWARD project (January 2014-December 2017) is to promote agroforestry practices in Europe that will advance sustainable rural development. Within the project there are four objectives:

1. to understand the context and extent of agroforestry in Europe,
2. to identify, develop and field-test innovations (through participatory research) to improve the benefits and viability of agroforestry systems in Europe,
3. to evaluate innovative agroforestry designs and practices at a field-, farm- and landscape scale, and
4. to promote the wider adoption of appropriate agroforestry systems in Europe through policy development and dissemination.

Work-package 6, which contributes to objective 3, focuses on the field- and farm-scale evaluation of systems and innovations. It aims to adapt and evaluate agroforestry designs and practices for locations where agroforestry is currently not-widely practised or is in decline, and to quantify the opportunities for uptake at a field- and farm-scale. One of tasks in this work-package is Task 6.3: To develop a database for consistent collection of agroforestry systems description. This document presents a working synthesis of the descriptions of the different systems that have been identified from the 40 agroforestry stakeholder groups created across Europe.

2 Executive summary

This report collates information regarding the systems to be addressed during the modelling tasks of the AGFORWARD project. The data focuses on systems description, site characteristics, management and technical options to create the scenario umbrella for the forthcoming modelling activities in work-package 6.

The report includes a wide variety of traditional and innovative agroforestry systems across Europe. The number of innovative systems highlights the potential for agroforestry and the role of modelling to predict the outputs of products and services. For some systems, data is missing and this is being addressed through the on-going work of the stakeholder groups.

In the first year of the AGFORWARD project, a total of 54 agroforestry systems were described (11 from WP2, 15 from WP3, 13 from WP4, and 15 from WP5). In this report, 27 of the systems are described in detail in the form of factsheets (five from WP2, eight from WP3, eight from WP4, and six from WP5). The inclusion of a "Hypothetical modelling combinations" section on the factsheets helps to define, together with the results from Milestone 27 (Palma et al. 2015), the modelling scenarios that are going to be explored. These scenarios include current management practices, innovative techniques, and new tree/crop/animals combinations.

3 Objectives

The main objective of this report (Milestone 28) is to organize the collected data and information on agroforestry systems description in order to support of parameterisation of models. It also details the appropriate contact for future data collection. In order to account for the large systems variability and dispersion around Europe, the database was designed with a range of criteria. These criteria were the need:

- to include agroforestry systems from work-packages 2 to 5,
- to include agroforestry systems distributed around Europe, that range for different agroclimatic regions,
- to include the description of both existing and innovative systems, the last being identified by the four participative research and development networks established by work-packages 2 to 5, and
- to include collected information regarding biophysical, economic and management information.

4 Methodology

The AGFORWARD project has categorised agroforestry practices in relation to four key land use sectors that are covered by four different work-packages (WP):

WP2: existing agroforestry systems of High Nature and Cultural Value (HNCV).

WP3: integrating livestock and crops into High Value Tree Systems (HVTS).

WP4: agroforestry for arable systems.

WP5: agroforestry for livestock systems.

During 2014, the partners within the AGFORWARD project facilitated about 40 stakeholder groups across Europe, each resulting in an initial stakeholder and research protocol reports. These stakeholder reports, and four synthesis reports on the innovations to be evaluated (Hermansen et al. 2015; Mirck et al. 2015; Moreno et al. 2015; Pantera et al. 2015), were used to determine: 1) the agroforestry practices being considered, and 2) the research and innovations that has been proposed. Building on these sources, the factsheets also contain more detailed information derived from a survey sent to each partner.

This report collates the systems identified during the stakeholders meetings and the detailed descriptions received from the partners regarding information of the systems. The description includes the basic elements that are part of the system: tree, crop and animal species; other biophysical attributes such as soil type; an estimation of the area occupied by the system; the main resulting products and other economic interest of the systems and the presence or not of experimental sites for the collection of more information if it is required. The contacts for each group are described in Annex A. The initial stakeholder reports and protocols of the stakeholder groups which may potentially still produce a factsheet report are listed in Annex B.

Related to the research and innovations proposed, Milestone 27 (Palma et al. 2015), categorised the research questions proposed during the stakeholder meetings that are amenable of being tackled with the support of modelling, and those that are not. For example some research questions are knowledge gaps which could be tackled through literature research.

5 Agroforestry systems

The stakeholder meetings organised by the AGFORWARD project led to the identification of 54 systems of which 11 systems were recognised for their high cultural and natural value (Table 1 and Figure 1 - red icons); 15 systems focused on the intercropping or grazing of high value trees such as orchards or olive grove (Table 2 and Figure 1 – orange icons); 13 systems were focused on agroforestry for arable farmers (Table 3 and Figure 1 - blue icons) and 15 systems focused on agroforestry for livestock farmers (Table 4 and Figure 1 - green icons).

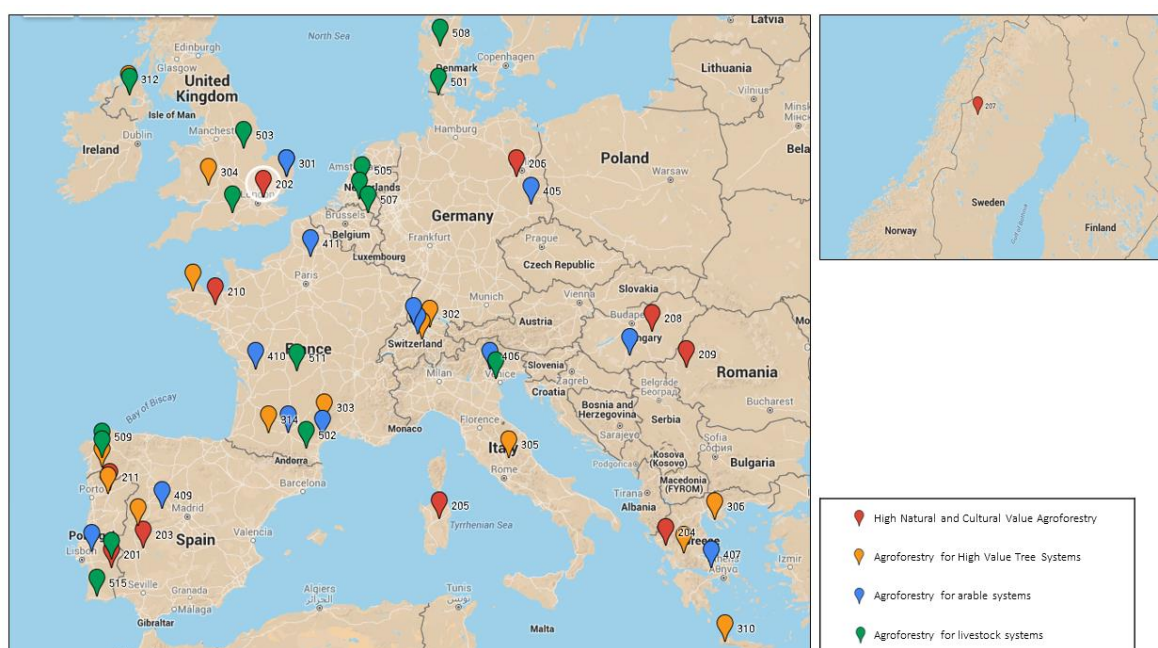


Figure 1. Approximate location of the agroforestry systems¹

5.1 High nature and cultural value (HNCV) agroforestry

Work-package 2 focuses on improving the resilience of existing agroforestry systems of high nature and cultural value (HNCV). Such systems are typically semi-natural agro-silvopastoral systems where cultivation and/or grazing have been practised. Prominent examples include the Dehesa and Montado systems in Spain and Portugal, grazed oak woodlands in Sardinia (Italy) and Valonia Oak silvopastoral systems in Greece. Agroforestry systems of high natural and cultural value in Northern and Eastern Europe include wood pastures and parklands in the UK, and wood pastures of Scandinavia, Germany and Romania.

Within this group were also included the hedgerow agroforestry system of the “bocage” of Brittany in North West France, the “Spreewald” systems in the flood plains in Eastern Germany and the “lameiros” systems located in Portugal. A short description of the systems, their location and the identification code within the project are presented in Table 1.

¹ This map is available at:

<https://www.google.com/maps/d/edit?mid=z1xoYw3gseS0.kOaFKCqmAN7s&usp=sharing>

Table 1. Agroforestry systems of high nature and cultural value: the ID, name, location and short description of the selected agroforestry systems

AF-ID	Name	Location	Short description
201	Montado	South and Central Portugal	Low density trees combined with agriculture or pastoral activities. The main tree species encountered are cork oak (<i>Quercus suber</i> L) and/or holm oak (<i>Quercus rotundifolia</i> L). Mixed stands with a combination of these species are also common. <i>Montado</i> occupies around 1 million hectares in Portugal.
202	Wood pastures and Parkland	UK	Wood pasture and parklands are traditional land uses often characterised by open-grown ancient or veteran trees (often pollarded), grazing livestock, and an understory of grassland or heathland. Around 10,000 to 20,000 ha in UK are in "working condition".
203	Dehesa	Central and South Spain	Agro-silvo-pastoral system formed from the clearing of evergreen woodlands where trees, native grasses, crops, and livestock interact positively under management. At present, <i>Dehesas</i> occupy 2.3 million hectares in Spain.
204	Valonia oak silvopastoral systems	Valonia, Greece	Traditional land use system in parts of Western Greece where livestock breeders use the valonia oak (<i>Quercus ithaburensis</i> subsp. <i>macrolepis</i> (Kotschy) Hedge and Yaltirik forest for grazing and the collection of acorns. Valonia oak forests cover about 29.630 ha in continental and insular Greece.
205	Grazed oak woodlands in Sardinia	Sardinia, Italy	Much of the Sardinian rural landscape is characterized by a mosaic of agroforestry systems including grazed forests and wooded grasslands where scattered <i>Quercus</i> species (holm oak, cork oak and deciduous oak trees) are mixed with permanent or temporary pastures or intercropped with cereals and/or fodder crops. Forests occupy about half million hectares in Sardinia, and about 30% (180.000 ha) are considered to be of high nature value.
206	Spreewald flood plain	Brandenburg, Germany	The Spreewald Biosphere Reserve covers about 47.500 ha and is situated in Brandenburg (East Germany). The area is dominated by a network of waterways, and the combination of land ownership and the installation of small transportation canals, that have later been planted with trees has resulted, in places, in tree-lined hedgerows that demarcate relatively small-sized fields. The dominant tree species are black alder (<i>Alnus glutinosa</i> (L.) Gaertn.), black poplar (<i>Populus nigra</i> L.) and bird cherry or hackberry (<i>Prunus padus</i> L.). The grassland is either mowed or grazed by cattle that are used for meat or milk production.
207	Wood pastures and reindeer in Sweden	Sweden	Near the Sami village Njaarke, much of the area is demarcated as Fennoscandian wooden pastures (EU Directive Habitats Code 9070). During the summer, reindeer (<i>Rangifer tarandus</i> L.) are kept in the non-forested mountain areas, but between October and April the reindeer are kept in the winter grazing area of wood pastures.
208	Wood pastures in Hungary	Hungary	Wood pastures in Hungary are currently declining and they are thought to cover about 5500 ha in Hungary. Traditional shepherding occurs in some of the remaining wood pastures, but this practice is threatened. Increasing formal recognition of the cultural and ecological value of wood-pastures has resulted in new types of managers and the emergence of new types of knowledge in the remaining wood pastures.
209	Wood pastures in Southern Transylvania, Romania	Southern Transylvania, Romania	Traditionally closed oak woodlands with pigs eating the acorns transformed in the second part of the 19th century in pastures, communally managed with scattered large trees such as oaks, pears, hornbeams and beech grazed by cattle and buffalo.
210	"Bocage" agroforestry in Brittany, France	Brittany, France	"Bocage" is an ancient agroforestry systems based on lines of high-stem and medium-stem trees accompanying successive cutting and redistribution of parcels linked to inheritance processes with the purpose of having sources of firewood and timber. Since 1950s, the agricultural modernization and intensification, accompanied with collective land reallocation programs, led to

AF-ID	Name	Location	Short description
			a general decrease in hedgerows density and from the 1990s, successive hedge planting schemes have been implemented aiming to maintain the cultural landscape but also to regulate nitrate and phosphorus pollution.
211	“Bordure” Trees in Portugal	Portugal	Bordure tree include trees with a diverse of usages and special arranges: randomly or in hedges, borders and/or in riparian forests lines. These areas are frequently designated as <i>Lameiros</i> : areas with bordures trees associated to natural pastures or improved pastures for animal grazing. These trees, traditionally built for field demarcation, are important for local fire wood consumption, animal fodder, soil protection from water or wind erosion and pasture improvement.

5.2 High Value Tree Systems

Related to high value tree systems, 15 systems were identified comprising apple orchards, olive and citrus groves, and high value walnut and chestnut trees. Currently, the removal of production-related subsidies threatens the financial sustainability of olive systems and some fruit orchards while potential innovations identified during the stakeholder meetings include legume intercrops to improve soil nutrition, companion planting to reduce pests and diseases, and using intercrops for grazing. The potential development of these systems will be developed within the Work-Package 3 of the project.

Table 2. Intercropping and grazing of high value tree systems: the ID, name, location and short description of the selected agroforestry systems

AF-ID	Name	Location	Short description
301	Apple trees with organic vegetables in UK	Suffolk, Gloucestershire and Devon, UK.	3 experimental sites located in Wakelyns Suffolk, Gloucestershire and Devon combining organic crop alleys between apple and other timber species rows.
302	Cherry trees alley cropping in Switzerland	Möhlin, Switzerland	Experimental site in Möhlin with 16 hectares with 80 cherry trees with rosehip (<i>Rosa rugosa</i>), sea buckthorn sanddorn (<i>Hippophae</i> sp.) and cornelian cherry (<i>Cornus mas</i>) are planted to produce wild berry juice.
303	Timber wood trees with cereals in France	Hérault Department, France	Different tree species, planted in 1995, associated with cereal. Trees in row (13 x 8 m). The main culture is winter durum wheat in rotation with winter protein pea. Sole crop and forestry controls are available. No block design, but large plots are compared. Tree growth and crop yield are monitored each year.
304	Grazed cider orchards in the UK	Herefordshire, UK.	There are 25,350 ha of 'traditional orchards' in England and Wales. Traditional orchards typically have open-grown trees (tree density of less than 150 trees per hectare), whilst bush orchards can have 600 trees/ha. Both types of orchard have grass understoreys which need to be kept short to enable apple harvest. Grazing is practiced in some traditional orchards, but the use of animals in mature bush orchards is less common.
305	Intercropping and grazing olive orchards in Italy	Italy	Over one million hectares of olive orchards (<i>Olea europea</i>) risk abandonment in Italy, since the low price of olive oil and the de-coupling of subsidies from production have reduced profitability and removing trees is illegal. The particular focus of this system is the intercropping of wild asparagus (<i>Asparagus acutifolius</i>), which naturally tends to grow in abandoned olive orchards. Grazing animals, particularly chickens, are proposed as an additional source of income while providing weed control and fertilization, thus lowering costs and impact of the orchard management.

AF-ID	Name	Location	Short description
306	Intercropping of olive orchards in Greece (2 groups)	Mostly in Macedonia, N. Greece and Central Greece	The combination of olive orchards with arable crops (cereals) in the same field is a traditional land use system in Greece. The combination of olives and cereals can stabilize the economic return in the context of variable weather conditions. Around 13,000 ha are located in Greece.
307	Grazing and intercropping of plantation trees in Spain	Spain	Olive, almond and carob orchards in Spain were traditionally either grazed or intercropped. However, these traditional agroforestry systems have become marginal and new agroforestry practices, based on plantations of quality timber trees such as cherry and walnuts on agricultural land are developing.
308	Chestnut systems in Galicia, Spain	Galicia, Spain	Chestnut (<i>Castanea sativa</i> Mille) agroforestry is a traditional land use system in O Courel, Galicia (NW Spain). The chestnuts are recognized under the label of Protected Geographical Indication (PGI), and are exported to markets in Europe.
309	Intercropping of walnut trees in Greece	Eurytania, Central Greece	In Eurytania in central Greece, farmers have historically integrated agriculture with high value tree species such as walnut and chestnut trees on the same plot.
310	Intercropping of orange groves with arable crops in Greece	Mostly in Western, Central and South Greece and Crete.	In Crete (Greece), farmers used to cultivate crops (mostly vegetables) in between citrus groves of orange, tangerine and lemon trees and after crown development intercrops are replaced by chickens grazing. They also used cypress trees as hedgerows to protect citrus trees from winds. Nowadays they prefer to switch to avocado monoculture for higher profit. In Crete, citrus cultivation covers about 4500 ha.
311	Grazed orchards in France	Normandy, Brittany and the north of the Loire river, France.	Meadow orchards in France were estimated to cover about 600,000 ha in 1950, but the current total area is about 150,000 ha. It is estimated that 43% of French pre-orchards are "cider" apple orchards located in Normandy, Brittany and the north of the Loire river. One of the new features being attempted by some growers is the grazing of "low-stem orchards" by Shropshire sheep, as the experience of some growers is that the Shropshire breed does not eat the bark of apple trees.
312	Grazed orchards in Northern Ireland, UK	Northern Ireland, UK	The apple industry in Northern Ireland has 223 independent growers farming 1506 ha of orchards, with a typical field size of 1.5 to 4 ha. The grass strips between trees are generally mowed. Between May and the end of July, the apple trees are also typically sprayed every 10-14 days with a fungicide to prevent apple scab (<i>Venturia inaequalis</i>). Grazing the orchard with sheep may provide a means of reducing mowing costs and may help with scab control.
313	Selva Chestnut system in Switzerland	Switzerland	<i>Selva</i> systems traditionally contains walnut orchards (<i>Juglans regia</i>) and sweet chestnut orchards (<i>Castanea sativa</i>). Particularly chestnut orchards south of the Swiss Alps are still frequent and well known.
314	"Bordure" Trees in France	France	Agroforestry systems can include rural hedges which often line the side of a road, and are sometimes associated with buffer strips. In France, the trees on the border of a field can be termed "Bordure" and include trees found in hedgerows, riparian forests, buffer strips (with woody vegetation) and wood edges.
315	Grazed chestnut tree stands for fruit (soutos) and/or wood (castinçais) production	Portugal	These areas include low tree density stands of <i>Castanea sativa</i> species, on average 89 trees per hectare and are managed for chestnut or high quality wood production in association to permanent pastures (natural or improved) for animal consumption. These areas are also frequently characterized by mixed stands with <i>Quercus pyrenaica</i> trees.

5.3 Agroforestry for arable farmers (*Silvoarable systems*)

Work-package 4 focuses on the application of agroforestry in arable systems. Arable agriculture provides large quantities of food, but it can be associated with reductions in soil and water quality, reduced biodiversity, and the release of greenhouse gases such as carbon dioxide and nitrous oxide. In some areas, continued arable crop production will be sensitive to climate change. The appropriate integration of trees in arable systems can provide benefits in terms of bioenergy production, improved resource efficiency, and increased biodiversity. Thirteen systems were identified mostly combining fruit (apple trees) or timber (poplar, walnut, willow, eucalyptus) trees alleys with cereal intercropping.

Table 3. Agroforestry for arable farms: the ID, name, location and short description of the selected systems

AF-ID	Name	Location	Short description
401	Integrating apple trees with arable crops in Switzerland.	Sursee, Central Switzerland	Innovative farm: 545 apple trees (varieties Boskoop and Spartan) were planted. The intermediate cultures consist of winter wheat, strawberries and sown flower strips.
402	Integrating poplar with arable crops in Switzerland.	Buus, NW Switzerland	Pioneer farmer: farm with a total area of 20 ha. In March 2011, 52 Aspen (<i>Populus tremula</i>) were planted. The area between the tree rows was first managed as grassland, is now intercropped with rye, corn and sorghum. The wood of the aspens should be harvested in 30 to 35 years as energy wood.
403	Apple trees or Short rotation coppice with cereals or legumes	Suffolk, UK.	Silvoarable systems are currently rare in the UK. The few systems that exist are usually based on an alley cropping design with arable crops in the alleys. The tree component consists either of top fruit trees (apples, pears and plums), timber trees, or coppice trees for wood fuel. Organic and conventional silvoarable systems with top fruit (apples, pears) and/or short rotation coppice for bioenergy, and arable crops in the alleys. Alleys are typically 12 to 24 m wide.
404	Mediterranean silvoarable systems in France	Southern France	The high seasonal variability of rainfall in the Mediterranean areas of southern France limits arable yields. There are periods of high rainfall in the autumn, and periods of water shortage in the spring and summer. In this situation, in areas where there are deep soils, that are able to retain water, silvoarable agroforestry (tree lines within the field) can improve water infiltration, limit soil evaporation, and limit crop water requirements.
405	German poplar/willow alley cropping in Germany	Lusatia, Germany.	Although agroforestry on arable farms is not a common practice in Germany, alley cropping systems for woody biomass production are receiving increasing interest due to the potential to produce biomass and agricultural crops at the same time. In Germany alley cropping systems combine rows of fast growing trees (for example poplar, willow or black locust) with agricultural crops.
406	Trees for timber intercropped with cereals in Italy	Veneto Region, NE Italy	Poplar hybrids and species have been intensively managed in Italy for timber production mostly in monoculture plantations, but often in intercropping systems (intercropping of arable crops in between young tree rows) and in linear plantations along field edges, drainage canals and streams. Poplar cultivation, in all the above cultivation models, is currently declining for stagnating domestic timber market.
407	Intercropping of poplar and walnut trees with cereals and beans in Greece	Mostly in northern Greece (Macedonia and Thrace).	Agroforestry is a traditional land use system in Voio (North Greece) where farmers have traditionally integrated arable production with tree species. In Voio, arable fields containing field beans, cereals and grassland are bordered by walnut trees and fast growing poplars.
408	Alley cropping in Hungary	Hungary	About 16.000 ha of windbreaks and shelterbelts are present in Hungary. Although alley cropping occurs in orchards, there is not wide use of the system in arable

AF-ID	Name	Location	Short description
			areas. One alley-cropping demonstration site is near in Fajsz, Bács-Kiskun County, in the Hungarian Great Plain. The agroforestry system consists of <i>Paulownia tomentosa</i> var. Continental E. in rows and alfalfa as intercrop.
409	Irrigated silvoarable systems in Spain and Portugal	Galicia, Spain and Central Portugal	Silvoarable agroforestry consists of widely-spaced trees intercropped with annual or perennial crops. In general, silvoarable production systems are very efficient in terms of resource use, and could introduce an innovative agricultural production system that will be both environment-friendly and economically profitable. In Portugal an ad-doc experimental plot is being established by a farmer under his intensive managed pivot irrigated maize plots. The interest of the innovation is to increase the marginal land around the corners, where the pivot irrigation does not reach. The assessment would estimate the yield of the trees which seem to progress at a potential yield. Different species were planted, including black walnuts and wild cherry.
410	Agroforestry for Arable Farmers in Western France	Western France	Between 2008 and 2013, 42 agroforestry establishment projects have been completed in the Poitou Charentes (Western France). In total the projects cover an area of 355 ha. The projects have mainly focused on fields that are farmed organically. The systems typically comprise three to five tree species (<i>Juglans nigra x regia</i> , <i>Juglans regia</i> , <i>Sorbus domestica</i> , <i>Sorbus torminalis</i> , <i>Prunus avium</i> , <i>Fraxinus excelsior</i> , <i>Acer pseudoplatanus</i> , and <i>Quercus</i> species). The density of trees ranges from 30 to 50 trees per hectare, typically with 27 m between rows which allows a 24 m cultivated area.
411	Agroforestry for Arable Farmers in Northern France	Picardy region, France	Since 2006, seven experimental silvoarable projects have started in Picardy in Northern France. In total 100 ha have been planted. The plot sizes varies between 5 ha and 30 ha. The sites are mainly located on loamy soils and the tree density ranges from 28 trees per hectare to 110 trees per hectare. Each plot has a wide range of tree species. The distance between the tree rows is typically 30 m, but ranges from 26 m to 50 m.
412	Agroforestry for Arable Farmers in South-West France	South-West France	In the Midi-Pyrénées region, integrating farming with trees is not a traditional land use system. However, with the support of an agroforestry-oriented development program financed by the French Region Midi-Pyrénées within-field agroforestry projects have been established. The project involves a wide range of systems. These include integrating trees with crop fields, poultry courses, pastures, livestock farming, market gardening, vineyard, arboriculture and beekeeping.
413	Alley cropping with Eucalyptus for biomass production in Portugal	Riba-tejo, Portugal	Eucalyptus is a typical forest specie. However, there is interest to evaluate what would be the yield of Eucalyptus under lower plantation densities that could provide a grass complement to enable grazing. This is a systems practiced in Brazil, but an evaluation is needed under temperate/Mediterranean climates.

5.4 Agroforestry for livestock farmers (Silvopastoral systems)

Agroforestry for livestock farmers basically considers the application of agroforestry in livestock systems across three sectors: i) poultry; ii) ruminants and iii) pigs. Work-package 5 will seek to identify innovations that address the bottlenecks identified by livestock farmers, with the aim of improving product quality and profitability whilst enhancing the environment. Meanwhile 15 systems were identified across Europe.

Table 4. Agroforestry for livestock farms: the ID, name, location and short description of the selected systems

AF-ID	Name	Location	Short description
501	Pigs in energy crops in Denmark	Jutland, DK	Consists in an integrated production of free-range pigs and energy crops. The energy crops are willow and/or poplar and are established in paddocks with lactating sows and piglets. The paddocks are organised so that they include two or more rows of poplar/willow in addition to an area with grass clover.
502	Wild cherry pastures in France	Aude Department France	Experimental site where two tree densities (100 trees /ha and 400 trees /ha) of different tree species were planted in 1988.
503	Woodland Eggs and Poultry in the UK	UK	Some of the eggs produced by hens with access to areas of trees are marketed as “woodland eggs”. To qualify as ‘woodland eggs’, the UK Woodland Trust, specifies that 20% cover in the free range area with some trees within a 20 m distance from the shed.
504	Woodland cattle in the UK	UK	The output of meat from poultry in the UK (£2.3 billion in 2013) is second only to cattle. Elm Farm is a silvopastoral experimental system in Berkshire UK where short rotation coppice willow (<i>Salix viminalis</i>) and alder (<i>Alnus glutinosa</i>) is planted in twin rows, with 24m pasture alleys in between tree rows.
505	Fodder trees for cattle and goats in the Netherlands	Duinboeren region , NL	Several dairy cow and goat farmers in the Duinboeren region of the Netherlands were participants of the Farms’ Network for Fodder Trees and Multifunctional Land Use (2012-2014). During that project four test sites with fodder trees were planted on four farms. Within the original project dairy goats and cows were allowed to browse on fodder trees such as willow (<i>Salix</i> spp).
506	Cherries and chickens in the Netherlands	The Netherlands	There are approximately 2,300 hectares used for free-range poultry in the Netherlands. However it is only since 1999, that farmers have looked at combinations of poultry with trees. In farmers’ network ‘Trees for chickens’ four poultry farmers have planted fruit trees. In another project, two poultry farmers have planted willow plantations. Independent from these projects, several other organic and free-range poultry farmers have planted walnut trees, fruit trees, Christmas trees, and willows in their free range areas.
507	Agroforestry for poultry in the Netherlands	The Netherlands	No description
508	Agroforestry for organic poultry and pig production in Denmark	Denmark	Velfærdsdelikatesser® (welfare delicacies) is a new initiative within organic meat production in Denmark. The initiative is seeking to promote natural and diverse livestock production (including the use of local breeds) on small organic farms. The meat is then sold directly to consumers in distinctive. The initiative offers potential for agroforestry systems where pigs and poultry are combined with fruit and vegetable production.
509	Agroforestry with pigs in Galicia, Spain	Galicia, Spain	Celtic pigs are an autochthonous pig breed of Galicia. The breed is believed to derive from northern-central European pig breeds. They are usually farmed in semi-extensive or extensive conditions in forest areas where chestnut (<i>Castanea sativa</i> Miller) and oak (<i>Quercus robur</i> L.) trees are dominant.

AF-ID	Name	Location	Short description
510	Free-range pigs with Energy Crops, Italy	Veneto region, Italy	Some farmers in the Veneto region of Italy have integrated trees with their free-range pig systems. Some systems are organic; some are conventional. A key driver for the integration is to provide shade for the pigs as the unshaded summer temperature can often reach 32-35 °C. Such high temperatures are understood to lead to increased risk of abortion in pregnant sows, sunburn, and a reduced number of piglets per litter.
511	Agroforestry with ruminants in France	France	Research stations and selected farmers across France have investigated the possibility of integrating trees in cattle, sheep and goat production.
512	Agroforestry with sheep in Galicia, Spain	Galicia, Spain	No description available
513	Agroforestry with ruminants in UK	UK	There are about 1.9 million sheep in Northern Ireland. These are managed by about 20,000 beef and sheep farmers (no distinction is made) and the average farm size is 35.5 ha that might be suitable for silvopastoral systems.
514	Agroforestry resistant to seedling browsing in Portugal	Alentejo, Portugal and France	Honey Locust (<i>Gleditsia triacanthos</i>) is leguminous tree, having a deep taproot growing down 3-6 m deep and few lateral roots that make it suitable for agroforestry systems. Furthermore, in young plants, stems bear very large, flat thorns and the young trees form very dense thorny thickets, providing defence to animal browsing, where coppice regrowth and pods are a valuable fodder. It begins bearing pods 3 years after planting and it can produce 20-75 kg pods/tree within 8 years. However this system is underutilized.
515	Carob Systems	Veneto Region, South Italy	Carob tree is native of the Mediterranean region. In the inland mountain region of Algarve, it is traditionally present in an agroforestry system currently affected by a degree of abandonment. Main purpose is seeds production, for human and/or animal consumption, combined with pasture.

6 Description of the agroforestry systems

This section describes selected agroforestry systems using the same framework described in Section 5. Tables are presented with the sources of information (stakeholder meeting or factsheet) and a contact person if more information is required during the evaluation process. The associated stakeholder report and research protocols are also shown.

6.1 High nature and cultural value (HNCV) agroforestry


Eleven systems were defined as high nature and cultural value systems (Table 5). The factsheets in this section describe four high natural and cultural value agroforestry systems in detail. These are the Portuguese systems of *Montado* and *Bordure* trees, wood pasture and parkland in the UK, the *Valonian oak Silvopastoral system* in Greece and the *Spreewald* flood plain system in Germany.

Table 5. Agroforestry systems of high nature and cultural value: the ID, name, location, contact person and if a stakeholder meeting report and/or a WP6 factsheet was produced.


AF-ID	Name	Location (country)	Responsible	Stakeholder meeting report	WP6 Factsheet
201	Montado	Portugal	Joana Amaral Paulo, ISA.	X	X
202	Wood pastures and Parkland	UK	Paul Burgess, CRAN.	X	X
203	Dehesa	Spain	Gerardo Moreno, UNEX.	X	
204	Valonia oak silvopastoral systems	Greece	Anastasia Pantera, TEI	X	X
205	Grazed oak woodlands in Sardinia	Italy	Antonello Franca, CNR-ISPAAM	X	
206	Spreewald flood plain	Germany	Jaconette Mirck and Penka Tsonkova, BTU	X	X
207	Wood pastures and reindeer in Sweden	Sweden	Erik Valinger SLU-EFI	X	
208	Wood pastures in Hungary	Hungary	Andrea Vityi and Anna Varga NYME	X	
209	Wood pastures in Southern Transylvania, Romania	Romania	Tibor Hartel UBB	X	
210	<i>Bocage</i> agroforestry in Brittany, France	France	Claudine Thenail, Valérie Viaud and Hongtao Hao, INRA- Rennes	X	
211	“Bordure” Trees in Portugal	Portugal	Joana Amaral Paulo, ISA	X	X



6.1.1 Montado

Basic agroforestry system information			
AF system ID	201	Name	Montado
AGFORWARD classification	X	High Natural and Cultural Value (WP2)	
		High Value Tree Systems (WP3)	
	X	Silvoarable (WP4)	
	X	Silvopastoral (WP5)	
Present location	Southern Portugal		
Description	Oaks (Cork oak or holm oak) with a mixing trend with stone pine at low density (30-70 trees ha ⁻¹) and low crown cover percentage (30-50%), in order to combine cork production with agriculture or grazing (natural or improved pasture or sown biodiverse pastures).		
Stakeholder report	Crous-Duran J, Amaral Paulo J, Palma J (2014). Initial Stakeholder Meeting Report: Montado in Portugal. 4 September 2014. 12 pp. Available online: http://www.agforward.eu/index.php/en/montado-in-portugal.html		
Research protocol report	Paulo JA, Faias SP, Tomé M, Palma JHN (2015). Research and Development Protocol for Cork Oak Woodlands in Portugal. February 2015. 10 pp. http://www.agforward.eu/index.php/en/montado-in-portugal.html		
Area occupied (estimation)	715,000 ha (in Portugal) classified as Cork and Holm oak forestry		
Soil type	Arenosols; leptosols; cambisols.		
Common/typical tree species	Holm oak (<i>Quercus rotundifolia</i>) Cork oak (<i>Quercus suber</i>) Stone pine (<i>Pinus pinea</i>)		
Common/typical crop species	Wheat (<i>Triticum spp.</i>) Oat (<i>Avena sativa</i>) Barley (<i>Hordeum vulgare</i>) Sunflower (<i>Helianthus annuus</i>). Natural pastures Improved pastures Sown biodiverse pastures		
Common/typical animal species	<i>(Especie – races)</i> Cattle – Exotic (Limousine, Charolês); Native (Alentejana, Mertolenga) Sheep - White Merino, Black Merino Goats – Serpentina, Charnequeira Pigs – Black Iberian pig (races Caldeira, Ervideira, Loira) Horses – Lusitano, Sorraia		
Products	From trees: cork, firewood, acorns, fodder From undercover: crops, meat, milk, cheese, wool, honey, mushrooms		
Economic interests	Around 18000 jobs related to the montado. Portugal is the first world cork producer (around 140.000 tons/year, 54% of the world production) and the cork industry represents around 3% of the national GDP.		
Other services	Soil protection, tourism, hunting, carbon sequestration, water cycle regulation, biodiversity, fire prevention (shrub control), and organic Matter improvement.		
Experimental sites for the project? Where?	Herdade do Freixo do Meio (Montemor-o-Novo, Portugal) Herdade da Cascavel (Coruche, Portugal) Herdade dos Clérigos (Arraiolos, Évora, Portugal) Herdade da Contenda (Moura, Portugal)		


Basic agroforestry system information			
AF system ID	201	Name	Montado
Photographs	 <p>Montado (Holm oak) Landscape: https://www.flickr.com/photos/agforward/13626081635/</p> <p>Cork oak + cereals (Wheat): https://www.flickr.com/photos/agforward/13626098903/</p> <p>Cork oak + broadbeans: https://www.flickr.com/photos/agforward/14112770584/</p> <p>Holm oak + turkeys: https://www.flickr.com/photos/agforward/13935639520/</p> <p>Holm oak + Iberian Pigs: https://www.flickr.com/photos/agforward/13626095783/</p> <p>Holm oak + goats: https://www.flickr.com/photos/agforward/13626096843/</p> <p>Holm oak + cattle: https://www.flickr.com/photos/agforward/13626443034/</p> <p>Holm oak + sheep: https://www.flickr.com/photos/agforward/13626442644/</p>		
AF System contact	Name	Joana A. Paulo (ISA) João Palma (ISA)	Email joanap@isa.ulisboa.pt joapalma@isa.ulisboa.pt
References (5 to 10)	<p>Palma, JHN., Paulo, JA., Tomé, M., 2014. Contribution to CO₂ sequestration of modern <i>Quercus suber</i> L. silvoarable agroforestry systems in Portugal: a YieldSAFE- based estimation, Agroforestry systems, in print.</p> <p>Canellas, I., Roig, S., Poblaciones, M.J., Gea-Izquierdo, G., Olea, L. 2007. An approach to acorn production in Iberian dehesas. Agroforestry Systems 70 (1):3-9</p> <p>Carevic, FS., Fernandez, M., Alejano, R., Vazquez-Pique, J., Tapias, R., Corral, E., Domingo, J. 2010. Plant water relations and edaphoclimatic conditions affecting acorn production in a holm oak (<i>Quercus ilex</i> L. ssp. <i>ballota</i>) open woodland. Agroforestry Systems 78 (3):299-308</p> <p>Garcia-Mozo, H., Dominguez-Vilches, E., Galan, C. 2012. A model to account for variations in holm-oak (<i>Quercus ilex</i> subsp. <i>ballota</i>) acorn production in southern Spain. Annals of Agricultural and Environmental Medicine 19 (3):403-408</p> <p>Pinto-Correia, T., Ribeiro, N., Potes, J. O Livro Verde dos Montados, ICAAM – Instituto de Ciências Agrárias e Ambientais Mediterrânicas.</p> <p>Rego, F.C., Vasco, I., Carvalho, J., Bugalho, M., Morgado, A., Silva, L.N., Sobreiro, uma barreira contra a desertificação, WWF/CABN report.</p>		
Hypothetical modelling combinations	<p><i>Q. suber</i> + cereal rotation (wheat-wheat-fallow).</p> <p><i>Q. suber</i> + permanent natural pastures + (Cattle, sheep, goat, pig, turkey).</p> <p><i>Q. suber</i> + permanent improved pastures + (Cattle, sheep, goat, pig, turkey).</p> <p><i>Q. suber</i> + sown biodiverse pastures.</p> <p>Same combinations with <i>Q. rotundifolia</i></p>		
Other comments	The montado system is also present in Spain where are called <i>dehesas</i> . A different factsheet will be prepared for <i>dehesas</i> .		

6.1.2 Wood pasture and parkland in the UK

Basic agroforestry system information			
AF system ID	202	Name	Wood pasture and parkland in the UK
AGFORWARD classification	X	High Natural and Cultural Value (WP2)	
		High Value Tree Systems (WP3)	
		Silvoarable (WP4)	
	X	Silvopastoral (WP5)	
Present location	Throughout the UK		
Description	Wood pasture and parklands in the UK comprise open-grown (often pollarded) trees, grazing livestock, and typically an understory of grassland. The oldest wood pastures and parklands are valued for their veteran trees which have high landscape value as well as hosting a range of epiphytes and micro-organisms.		
Stakeholder report	Upson M, Burgess PJ (2014). Initial Stakeholder Meeting Report: Wood pasture and parkland in the UK. 2 October 2014. 10 pp. Available online: http://www.agforward.eu/index.php/en/wood-pasture-and-parkland-in-the-uk.html		
Research protocol report	Upson M, Burgess PJ (2015). Research and Development Protocol for the Wood Pastures and Parkland in the UK. April 2015. 9 pp. http://www.agforward.eu/index.php/en/wood-pasture-and-parkland-in-the-uk.html		
Area occupied (estimation)	The UK Biodiversity Steering Group reports an area of 10,000 to 20,000 ha of wood pasture and parklands in the UK in "working condition" (Maddock, 2008).		
Soil type	A range of soil types including cambisols and luvisols (including planosols)		
Common/typical tree species	Mixed broadleaf species, likely to include oak (<i>Quercus robur</i> and <i>petraea</i>), hornbeam (<i>Carpinus betulus</i>), beech (<i>Fagus sylvatica</i>), and ash		
Common/typical crop species	Grassland		
Common/typical animal species	Beef cattle – standard commercial beef breeds; if the focus is on conservation then beef breeds like Longhorn and Red polls may be favoured Sheep – standard commercial sheep breeds Parklands on estates may be used for horses or deer		
Products	From trees: firewood From undercover: meat		
Economic interests	UK conservation groups are particularly interested in the maintenance of wood pastures and parklands.		
Other services	Tourism and recreational opportunities, carbon sequestration, water cycle regulation, biodiversity, green space around cities.		
Experimental sites for the project? Where?	Epping Forest: 51°39'28.8"N 0°02'27.4"E (51.658002, 0.040944) Clapham Park, Bedfordshire 52°09'35.54" N, 0°28'24.57" W		
Photographs	 <p>Clapham Park (mature ash trees within Helen's Wood), Bedfordshire https://www.flickr.com/photos/agforward/albums/72157648938482482 Clapham Park: a new parkland five years after planting in 1998 https://www.flickr.com/photos/agforward/13965260132</p>		


Basic agroforestry system information				
AF system ID	202	Name	Wood pasture and parkland in the UK	
	 <p>Woburn Estate, Bedfordshire https://www.flickr.com/photos/agforward/albums/72157648537666230 Knepp Castle Estate Rewilding Project https://www.flickr.com/photos/agforward/albums/7215764895116955</p>			
	 <p>Geltsdale, Cumbria https://www.flickr.com/photos/agforward/albums/72157648539214728 Glenmara Wood Pasture, Cumbria https://www.flickr.com/photos/agforward/albums/72157648539100548</p>			
AF System contact	Name	Paul Burgess (CRAN)	Email	P.Burgess@cranfield.ac.uk
References (5 to 10)	<p>Delmer, A. (2015). Tree planting in pasture and soil organic carbon. Unpublished MSc thesis, Cranfield University, UK</p> <p>Durand, C. (2015). Effect of trees in grassland on water-related ecosystem services. Unpublished MSc thesis, Cranfield University, UK.</p> <p>Maddock A (Ed) (2008). Wood-Pasture and Parkland. In UK Biodiversity Action Plan; Priority Habitat Descriptions.</p> <p>Lopez Bernal, A. (2015). Wood-pasture sustainability at Epping Forest. Unpublished MSc thesis, Cranfield University, UK</p> <p>Upson, M.A. (2014). The Carbon Storage Benefits of Agroforestry and Farm Woodlands. PhD thesis. Cranfield University, UK. https://dspace.lib.cranfield.ac.uk/handle/1826/9298</p>			
Hypothetical modelling combinations	To model the effect of silvopastoral systems on above and below ground carbon sequestration to see if we can reproduce the results found by Upson (2014) and Delmer (2015).			
Other comments				

6.1.3 Valonian oak silvopastoral systems

Basic agroforestry system information				
AF system ID	204	Name	Valonia oak silvopastoral	
AGFORWARD classification	x	High Natural and Cultural Value (WP2)		
		High Value Tree Systems (WP3)		
		Silvoarable (WP4)		
	x	Silvopastoral (WP5)		
Present location	Xeromero, prefecture of Aetoloakarnania, W. Greece Kea, Aegean island, Greece; Alexandroupoli, NE Greece; Rethimno, Crete			
Description	Agroforestry and specifically silvopastoralism is a traditional land use system in Xeromero, Aetoloakarnania, Western Greece where livestock breeders use the valonia oak forest for grazing whilst collecting acorns from the oaks. In this way they ensured a steady and enhanced economic return each year irrespectively of weather conditions. The forest is characterized by the dominance of old valonia oak trees. The combined use of valonia oak forest and grazing is gradually being abandoned, sometimes being replaced with monocultures of olive groves.			
Stakeholder report	Pantera A (2014). Initial Stakeholder Meeting Report: Valonia oak silvopastoral systems in Greece. 17 September 2014. 9 pp. Available online: http://www.agforward.eu/index.php/en/valonia-oak-silvopastoral-systems-in-greece.html			
Research protocol report	Papadopoulos A, Pantera A, Mantzanas K, Papanastasis V (2015). Research and Development Protocol for Valonia oak silvopastoral system. March 2015. 12 pp. http://www.agforward.eu/index.php/en/valonia-oak-silvopastoral-systems-in-greece.html			
Area occupied (estimation)	29,630 ha in continental and insular Greece			
Soil type	Lithosols – Chromic Luvisols			
Common/typical tree species	<i>Quercus ithaburensis</i> subs. <i>macrolepis</i>			
Common/typical crop species	-			
Common/typical animal species	Sheep and goats			
Products	From trees: firewood, acorns, fodder From understorey: meat, dairy, cheese, wool, honey, mushrooms			
Economic interests				
Other services	Soil protection, tourism, hunting, carbon sequestration, water cycle regulation, biodiversity, fire prevention (shrub control), and organic Matter improvement.			
Experimental sites for the project? Where?	A possible site at 38 ^o 34'01 N 21 ^o 11'52 E			
Photographs	 <p>Images available at: https://www.flickr.com/photos/agforward/15657164207/ https://www.flickr.com/photos/agforward/15220641274/ https://www.flickr.com/photos/agforward/15656876769/ https://www.flickr.com/photos/agforward/15223213993/ https://www.flickr.com/photos/agforward/15840801731/</p>			
AF System contact	Name	Anastasia Pantera	Email	pantera@teiste.gr
References	Pantera A., Papadopoulos A., Fotiadis G., Papanastasis. V.P. (2008). Distribution and			

Basic agroforestry system information			
AF system ID	204	Name	Valonia oak silvopastoral
(5 to 10)	phytogeographical analysis of <i>Quercus ithaburensis</i> ssp. <i>macrolepis</i> in Greece. <i>Ecologia Mediterranea</i> 34:73-82.		
Hypothetical modelling combinations	<i>Q.ithaburensis</i> + permanent natural pastures + (sheep, goat)		
Other comments	The same system is found in many other areas of Greece. An interesting example is in the island of Kea where it is combined with natural and sown pastures.		

6.1.4 Spreewald

Basic agroforestry system information				
AF system ID	206	Name	Spreewald	
AGFORWARD classification	<input checked="" type="checkbox"/>	High Natural and Cultural Value (WP2)		
	<input type="checkbox"/>	High Value Tree Systems (WP3)		
	<input checked="" type="checkbox"/>	Silvoarable (WP4)		
	<input type="checkbox"/>	Silvopastoral (WP5)		
Present location	North-eastern Germany			
Description	Windbreaks or shelterbelts consist of tall and narrow trees and shrubs. The trees are usually a combination of fast and slow growing trees. The windbreak has the function to prevent soil erosion. Windbreaks have the best protection when they are between 40 and 50% solid.			
Stakeholder report	Tsonkova P, Mirck J (2014). Initial Stakeholder Meeting Report: Agroforestry in the Spreewald Flood Plain, Germany. 20 October 2014. 8 pp. Available online: http://www.agforward.eu/index.php/en/agroforestry-in-the-spreewald-flood-plain-germany.html			
Research protocol report	Tsonkova P, Mirck J (2015). Research and Development Protocol for Agroforestry in the Spreewald Floodplain, Germany. May 2015. 11 pp. http://www.agforward.eu/index.php/en/agroforestry-in-the-spreewald-flood-plain-germany.html			
Area occupied (estimation)	Unknown			
Soil type	Luvisols, podzoluvisols, gleysols, cambisols, podzols			
Common/typical tree species	<i>Populus spp.</i> , <i>Salix spp.</i> , <i>Alnus rubra</i>			
Common/typical crop species	Rye (<i>Secale cereale</i>), wheat (<i>Triticum spp.</i>), triticale (x <i>Triticosecale</i>), maize (<i>Zea mays</i>), alfalfa (<i>Medicago sativa</i>), barley (<i>Hordeum vulgare</i>)			
Common/typical animal species				
Products	From trees: Wood products, biomass feedstocks From undercover: crops			
Economic interests	Number of jobs? The crops can be used for a gasifier and the biomass for a combined heat and power plant			
Other services	Soil protection, C-sequestration, water quality, biodiversity, soil fertility/Organic Matter			
Experimental sites for the project? Where?	Neuholland-Freienhagen, Germany Spreewald, Germany			
Photographs	 <p>Images available at: https://www.flickr.com/photos/agforward/14891289061/ https://www.flickr.com/photos/agforward/14384135764/in/set-72157642842890493</p>			
AF System contact	Name	Jaconette Mirck	Email	jmirck@gmail.com

Basic agroforestry system information			
AF system ID	206	Name	Spreewald
References (5 to 10)			
Hypothetical modelling combinations	<i>Populus</i> spp. + cereal, maize, alfalfa rotation <i>Salix</i> spp. . + cereal, maize, alfalfa rotation		
Other comments			

6.1.5 Bordure trees in Portugal

Basic agroforestry system information			
AF system ID	211	Name	Bordure trees in Portugal
AGFORWARD classification	X	High Natural and Cultural Value (WP2)	
		High Value Tree Systems (WP3)	
		Silvoarable (WP4)	
		Silvopastoral (WP5)	
Present location	Mainly in north and interior regions of Portugal, associated with agricultural land		
	Scattered occurrences in other regions of the country		
Description	<p>Bordure tree include trees with a diverse of usages and special arranges: randomly or in hedges, borders and/or in riparian forests lines. These areas are frequently designated as <i>Lameiros</i>: areas with bordures trees associated to natural pastures or improved pastures for animal grazing. These trees, traditionally built for field demarcation, are important for local fire wood consumption, animal fodder, soil protection from water or wind erosion (Pereira et al. 2004), and pasture improvement (Pereira et al. 2005).</p> <p>These areas, although characterized by deep and fertile soils, have been suffering abandonment as grazing is reduced in these regions (INE 2014). In turn, the abandonment of grazing rapidly changes the composition of the herbaceous stratus composition, increasing the presence of species with low pasture interest (Amaro 2009). In addition, the trees are frequently removed thereby decreasing biodiversity. It is difficult to assess the area of such systems due the lack of official inventory data.</p>		
Stakeholder report			
Research protocol report			
Area occupied (estimation)	Unknown		
Soil type	Depth: Deep soils		
	Texture: medium		
	Others: Prefers mesotrophic soils		
Common/typical tree species	<p>The tree species are quite diverse and include: <i>Alnus glutinosa</i>, <i>Quercus pyrenaica</i>, <i>Quercus rotundifolia</i>, <i>Pistacia terebinthus</i>, <i>Acer monspessulanum</i>, <i>Fraxinus angustifolius</i>, <i>Fraxinus excelsior</i>, <i>Ruscus aculeatus</i>, <i>Celtis australis</i>, <i>Laurus nobilis</i>, <i>Malus sylvestris</i>, <i>Arbutus unedo</i>, <i>Ulmus minor</i>, <i>Ulmus procera</i>, <i>Crataegus monogyna</i>, <i>Pyrus bourgaena</i>, <i>Rosa canina</i>, <i>Salix alba</i>, and <i>Daphne gnidium</i>.</p>		
Common/typical crop species	Natural or improved pastures		
Common/typical animal species	Sheep and goat		
Products	Biomass for fire wood and forage for animal		
Economic interests	Forage for animal consumption especially in Summer period		
Other services	Improve pastures quality, water regulation, soil erosion protection, biodiversity, landscape		
Experimental sites for the project? Where?	No		

Basic agroforestry system information				
AF system ID	211	Name	Bordure trees in Portugal	
Photographs	 <p>Images available at: https://www.flickr.com/photos/agforward/21868747413/in/album-72157642842890493/ https://www.flickr.com/photos/agforward/22501014901/in/album-72157642842890493/ https://www.flickr.com/photos/agforward/22476588692/in/album-72157642842890493/</p>			
AF System contact	Name	Joana Amaral Paulo	Email	joanaap@isa.ulisboa.pt
References (5 to 10)	<p>Amaro, D. 2009. Maneio de lameiros. Direcção Regional de Agricultura e Pescas do Norte. 12 pp. Available in: http://www.drapn.min-agricultura.pt/drapn/conteudos/ela_di/folhetos/Br.%20Maneio%20de%20Lameiros.pdf</p> <p>INE (2014). Inquérito à Estrutura das Explorações Agrícolas 2013. Instituto Nacional de Estatística, I.P. Lisboa. 56 pp.</p> <p>Paulo, J.A., Crous-Duran, J. Palma, J. (2015). Initial stakeholder meeting report: Traditional agroforestry systems in Central and Northern Portugal. http://www.agforward.eu/index.php/en/montado-in-portugal.html</p> <p>Pereira, E. L., Madeira, M., Monteiro, M. L., Raimundo, F. (2004). Influence of ash tree (<i>Fraxinus angustifolia</i>, Vahl) on soil quality and herbaceous productivity in pastures of the Northeastern Portugal. Revista de Ciências Agrárias. Vo. XXVII. Número 1. 347 – 360.</p> <p>Pereira, E. L., Madeira, M., Monteiro, M. L. (2005). Assessment of shade and nutrients addition effects on biomass of natural pastures of Northeast Portugal. Revista de Ciências Agrárias. Vo. XXVIII. Número 2. 297 – 311.</p>			
Hypothetical modelling combinations				
Other comments				


6.2 High value tree agroforestry systems



Fifteen systems were identified as of High Natural Cultural Value systems (Table 6). Of these, eight systems are described in detail in the factsheets presented in this section.

Table 6. Agroforestry systems of high value tree systems: the name, location, contact person and if a stakeholder meeting report and/or a WP6 factsheet was produced.

AF-ID	Name	Location	Responsible	Stakeholder meeting report	WP6 Factsheet
301	Apple trees with organic vegetables in UK	UK	Jo Smith, ORC		X
302	Cherry trees alley cropping in Switzerland	Switzerland	Felix Herzog, Agroscope	X	X
303	Timber wood trees with cereals in France	France	Lydie Dufour, INRA	X	X
304	Grazed cider orchards in England and Wales in the UK	UK	Paul Burgess, CRAN	X	X
305	Intercropping and grazing olive orchards in Italy	Italy	Adolfo Rosati CRA-OLI	X	X
306	Intercropping of olive orchards in Greece (2 groups)	Greece	Anastasia Pantera, TEI, and Konstantinos Mantzanas, Aristotle Univ. of Thessaloniki	X	X
307	Grazing and intercropping of plantation trees in Spain	Spain	Gerardo Moreno, UNEX	X	X
308	Chestnut systems in Galicia, Spain (See System 315)	Spain	Rosa Mosquera Losada, USC	X	
309	Intercropping of walnut trees in Greece	Greece	Anastasia Pantera, TEI	X	
310	Intercropping of orange groves with arable crops in Greece	Greece	Anastasia Pantera, TEI	X	X
311	Grazed orchards in France	France	Nathalie Corroyer, INRA-Normandy	X	
312	Grazed orchards in Northern Ireland, UK (See System 304)	Northern Ireland, UK	Jim McAdam, AFBI	X	X
313	Chestnut system in Switzerland	Switzerland	Felix Herzog, Agroscope		
314	“Bordure” Trees in France	France	Nina Malignier, AFAF	X	
315	Grazed chestnut tree stands for fruit (soutos) and/or wood (castinçais) production	Portugal	Joana Amaral Paulo, ISA	X	X


6.2.1 Apple and timber trees with vegetables in the UK

Basic agroforestry system information			
AF system ID	301	Name	Apple and timber trees with veggies in the UK
AGFORWARD classification	<input type="checkbox"/>	High Natural and Cultural Value (WP2)	
	<input checked="" type="checkbox"/>	High Value Tree Systems (WP3)	
	<input checked="" type="checkbox"/>	Silvoarable (WP4)	
	<input type="checkbox"/>	Silvopastoral (WP5)	
Present Location	England		
Description	Organic silvoarable systems with top fruit (apples, pears) and/or timber species, and arable crops (but sometimes vegetables) in the alleys. Alleys typically 10-12 m wide.		
Stakeholder report			
Research protocol report			
Area occupied (estimation)	Very small nationally – probably less than 1000 ha		
Soil type	Variable		
Common/typical tree species	<i>Malus domestica</i> (apple); Timber from: small-leaved lime (<i>Tilia cordata</i>), hornbeam (<i>Carpinus betulus</i>), wild cherry (<i>Prunus avium</i>), Italian alder (<i>Alnus cordata</i>), ash (<i>Fraxinus excelsior</i>), oak (<i>Quercus petraea</i>), sycamore (<i>Acer pseudoplatanus</i>).		
Common/typical crop species	Wheat (<i>Triticum spp</i>): spring and winter varieties plus composite cross population. Barley (<i>Hordeum vulgare</i>), Oats (<i>Avena sativa</i>). Vegetables – potatoes, salads, beans, squashes etc. Legumes (white, red and crimson clovers: <i>Trifolium spp</i>) for fertility-building in organic systems		
Common/typical animal species	None		
Products	Trees: Top fruit (apples, pears, plums), timber. Agriculture: cereals, vegetables.		
Economic interests	Currently very small both at a national scale and on a farm scale. Enterprise diversification is a key economic aim for the producers.		
Other services	Biodiversity support including for functional biodiversity such as pollinators and natural pest control; soil protection (wind erosion, soil fertility, soil structure); shelter for crops		
Experimental sites for the project? Where?	<p><i>Experimental site</i>: Wakelyns Agroforestry, Suffolk – replicated blocks of 7 tree species (apple, lime, hornbeam, cherry, italian alder, ash, oak and sycamore) with 12m crop alleys between tree rows. Organic arable rotation.</p> <p><i>Producer systems (i.e. no independent replicates)</i>: Duchy Home Farm, Gloucestershire – very diverse apple system with a national collection of apple varieties, and organic vegetables grown in the alleys. Shillingford Organics, Devon – organic veg and arable production in 15 m wide alleys and apple trees</p>		
Photographs	<p>Wakelyns Agroforestry, Suffolk, UK:</p>  <p>Images available at: Wakelyns Agroforestry, Suffolk, UK: https://www.flickr.com/photos/agforward/15061984365/ https://www.flickr.com/photos/agforward/14875272348/</p>		

Basic agroforestry system information				
AF system ID	301	Name	Apple and timber trees with veggies in the UK	
	<p> https://www.flickr.com/photos/agforward/15061496222/ https://www.flickr.com/photos/agforward/15061848665/ https://www.flickr.com/photos/agforward/14875274608/ https://www.flickr.com/photos/agforward/14875272578/ https://www.flickr.com/photos/agforward/14875264228/ </p> <p>Shillingford Organics, Devon, UK:</p>  <p>Duchy Home Farm, Gloucestershire, UK:</p>  <p>Images of Shillingford Organics, Devon, UK:</p> <p> https://www.flickr.com/photos/agforward/14875136349/ https://www.flickr.com/photos/agforward/14875276468/ https://www.flickr.com/photos/agforward/14875137729/ https://www.flickr.com/photos/agforward/14875311947/ https://www.flickr.com/photos/agforward/15061853885/ https://www.flickr.com/photos/agforward/15061503212/ </p> <p>Duchy Home Farm, Gloucestershire, UK:</p> <p> https://www.flickr.com/photos/agforward/14875280528/ https://www.flickr.com/photos/agforward/15058831171/ </p>			
AF System contact	Name	Jo Smith	Email	jo.s@organicresearchcentre.com
References (5 to 10)	<p>Smith, J., Girling, R.D., Wolfe, M.S. and Pearce, B.D. (2014). Agroforestry: Integrating apple and arable production as an approach to reducing copper use in organic and low-input apple production. Agriculture and the Environment X, Delivering Multiple Benefits from our Land: Sustainable Development in Practice Pgs. 278-284. Link to pdf of poster.</p>			
Hypothetical Modelling combinations	<p>Mixed timber and apple with cereals (wheat, oats, barley). Mixed timber and apple with potatoes; Mixed timber and apple with legume ley. Apples and vegetables.</p>			
Other comments	<p>Wakelyns Agroforestry is our agroforestry research site so it is suitable for replicated experimental trials and we have staff on-site that can carry out assessments and regular measurements. We have been collecting microclimate data since 2012, and also have sporadic tree DBH measurements from a number of years, plus apple yields from 2012 and 2013, plus cereal yields for some years (when the cereals are in the alleys according to the crop rotation – 2 years in 7).</p>			





6.2.2 Cherry trees alley cropping in Switzerland

Basic agroforestry system information			
AF system ID	302	Name	Cherry trees alley cropping in CH
AGFORWARD classification	<input type="checkbox"/>	High Natural and Cultural Value (WP2)	
	<input checked="" type="checkbox"/>	High Value Tree Systems (WP3)	
	<input type="checkbox"/>	Silvoarable (WP4)	
	<input type="checkbox"/>	Silvopastoral (WP5)	
Present location	4313 Möhlin (north-western Switzerland)		
Description	<p>The parcel is located in the canton of Aargau and is located on an organic farm (BioSuisse) with a total area of 16 hectares. On the agroforestry plot there are a total of 80 trees. The cherry trees (varieties Morina, Coraline and Agate) were planted in October 2009 and 2010. In the tree rows shrubs such as rosehip (<i>Rosa rugosa</i>), sea buckthorn (sanddorn; <i>Hippophae sp.</i>) and cornelian cherry (<i>Cornus mas</i>) are planted to produce wild berry juice. Various vegetables are the main intercrop.</p> <p>The farmer primarily focuses on the environmental performance of its agroforestry plot. An additional motivation for the planting of trees was the vulnerability of the area to erosion, which is why the tree rows were aligned accordingly. For planting the trees he has teamed up with the local environment and Bird Protection Society and BirdLife Switzerland. He also signed a long-term contract with the Canton on ecological direct payments.</p>		
Stakeholder report	<p>Jäger M, Herzog F (2014). Initial Stakeholder Meeting Report Silvoarable systems with fruit and high value timber trees in Switzerland. 11 November 2014. 9 pp. Available online: http://www.agforward.eu/index.php/en/integrating-trees-with-arable-crops-switzerland.html</p>		
Research protocol report	<p>Herzog F, Jäger M, (2015). Research and Development Protocol for Integrating Trees with Arable Crops, Switzerland. 9 March 2015. 13 pp. Available online: http://agforward.eu/index.php/en/integrating-trees-with-arable-crops-switzerland.html</p>		
Area occupied (estimation)	2.4 ha		
Soil type	Luvisol, silty loam with slight humus content, skeleton free; detailed soil profile available.		
Common/typical tree species	Cherry (<i>Prunus avium</i>) rosehip (<i>Rosa rugosa</i>), sea buckthorn (sanddorn; <i>Hippophae sp.</i>) and cornelian cherry (<i>Cornus mas</i>) and other shrubs in the tree row		
Common/typical crop species	Various salads, peas, rhubarb (<i>R. rhabarbarum</i>), gourd (<i>Cucurbit asp.</i>), etc.		
Common/typical animal species	n.a.		
Products	Various vegetables, berries, cherries		
Economic interests	Vegetables, fruits and berries (direct marketing); direct payments for biodiversity		
Other services	Landscape scenery, biodiversity, erosion control		
Experimental sites for the project? Where?	That specific site as a farmer innovation. It is an organic farm and very innovative also with respect to marketing (direct marketing) and its organisation. The farmer is experimenting with community supported farming approaches.		


Basic agroforestry system information			
AF system ID	302	Name	Cherry trees alley cropping in CH
Photographs	 <p>Images available at: https://www.flickr.com/photos/agforward/22477126732/in/album-72157642842419595/ https://www.flickr.com/photos/agforward/22464530806/in/album-72157642842419595/ https://www.flickr.com/photos/agforward/22464535036/in/album-72157642842419595/ https://www.flickr.com/photos/agforward/22303718429/in/album-72157642842419595/</p>		
AF System contact	Name	Felix Herzog	Email Felix.Herzog@agroscope.admin.ch
References (5 to 10)	<p>Sereke F., Graves A., Dux D., Palma J., Herzog F. (2014) Innovative agroecosystem goods and services: key profitability drivers in Swiss agroforestry. <i>Agronomy for Sustainable Development</i> (almost in press)</p> <p>Kuster M., Herzog F., Rehnus M., Sorg J.-P. (2012) Innovative Agroforstsysteme - On farm monitoring von Chancen und Grenzen / Systèmes agroforestiers novateurs - monitoring des opportunités et limites. <i>Agrarforschung Schweiz / Recherche Agronomique Suisse</i> 3(10), 470 – 477.</p>		
Hypothetical Modelling combinations	<p>It would be extremely interesting – but challenging – to model this plot. I doubt that biophysical modelling is possible (Yield-SAFE) due to the complex and irregular rotation of the vegetables and to the shrubs in the tree row. An economic assessment might be possible because the farmer maintains (and shares with us) very detailed records of his inputs, yield, labour, machinery, etc.</p>		
Other comments	<p>Trees planted in 2009 & 2010; trees measured in 2011 and 2014 (will be measured every 3 years). The farmer maintains (and shares with us) very detailed records of his inputs, yield, labour, machinery, etc.</p>		


6.2.4 Timber wood trees with cereals in France

Basic agroforestry system information			
AF system ID	303	Name	Timber wood trees with cereals in France
AGFORWARD classification	<input type="checkbox"/>	High Natural and Cultural Value (WP2)	
	<input checked="" type="checkbox"/>	High Value Tree Systems (WP3)	
	<input checked="" type="checkbox"/>	Silvoarable (WP4)	
	<input type="checkbox"/>	Silvopastoral (WP5)	
Present location	Southern France – Hérault Department		
Description	Different tree species, planted in 1995, associated with cereal. Trees in row (13 m x 8 m). The main culture is winter durum wheat in rotation with winter protein pea. Sole crop and forestry controls are available. No block design, but large plots are compared. Tree growth and crop yield are monitored each year since the beginning. Besides the three main tree species (see below), many other tree species are included in an agroforestry arboretum (<i>Prunus avium</i> , <i>Fraxinus angustifolia</i> , <i>Pyrus communis</i> , <i>Acer platanoides</i>).		
Stakeholder report	Gosme M (2014). Initial Stakeholder Meeting Report: Mediterranean Silvoarable Systems in France. 8 October 2014. 12 pp. Available online: http://www.agforward.eu/index.php/en/mediterranean-silvoarable-systems-in-france.html		
Research protocol report	Gosme M, Desclaux D (2015). Research and Development Protocol for the Participatory Plant Breeding of Durum Wheat for Mediterranean Agroforestry Group. 2 March 2015. 13 pp. Available online: http://agforward.eu/index.php/en/mediterranean-silvoarable-systems-in-france.html Meziere D (2015). Research and Development Protocol for Weed Management in Mediterranean Silvoarable Group in France. 9 June 2015. 9 pp. Available online: http://agforward.eu/index.php/en/mediterranean-silvoarable-systems-in-france.html		
Area occupied (estimation)	20 ha on the Restinclières Estate (France)		
Soil type	Silty deep alluvial calcareous fluvisol (25 % clay and 60 % silt). Presence of a water table within reach of the roots of the trees		
Common/typical tree species	Hybrid walnut (<i>Juglans regia</i> X <i>Juglans nigra</i>) <i>Sorbus domestica</i> L. Poplar (<i>Populus spp</i>)		
Common/typical crop species	Winter durum wheat (<i>Triticum turgidum</i> L. subsp. <i>Durum</i>) cv Claudio Winter protein pea (<i>Pisum sativum</i> L) cv Blizzard		
Common/typical animal species	None, but wild boars roam.		
Products	From trees : timber wood when they are big enough (poplar harvested in 2015) From crop : grain and wheat straw		
Economic interests	Quality wood, growing faster than in a forestry system – High protein content wheat		
Other services	Tourism: public domain with many walkers, carbon sequestration, biodiversity improvement (i.e. bats and birds), hunting, water cycle regulation, fire prevention (shrub control), organic matter improvement.		
Experimental sites for the project? Where?	Anywhere in the domain, but the field with poplars gives the most important shade.		

Basic agroforestry system information			
AF system ID	303	Name	Timber wood trees with cereals in France
Photographs			
			
	Images available at: https://www.flickr.com/photos/127855997@N07/14912674314/ https://www.flickr.com/photos/127855997@N07/15530685941/ https://www.flickr.com/photos/127855997@N07/15347361437/ https://www.flickr.com/photos/127855997@N07/15530663781/ https://www.flickr.com/photos/127855997@N07/15530658961/		
AF System contact	Name	Lydie Dufour	Email dufourl@supagro.inra.fr
References (5 to 10)	Dufour L., Metay A., Talbot G., Dupraz C., 2013.- <u>Assessing Light Competition for Cereal Production in Temperate Agroforestry Systems using Experimentation and Crop Modelling.</u> J. Agron. Crop Sci. 199 (3) :217-227 Dupraz C., Liagre F., 2008.- Agroforesterie - Des arbres et des cultures. France Agricole. 413 p. Mulia R., Dupraz C., 2006.-Unusual fine root distributions of two deciduous tree species in southern France: What consequences for modelling of tree root dynamics? Plant and Soil. 281 (1-2) :71-85 Talbot G., Roux S., Graves A., Dupraz C., Marrou H., Wéry J., 2014.- Relative yield decomposition: A method for understanding the behaviour of complex crop models. Environ. Model. Softw. 51: 136-148		
Hypothetical Modelling combinations	Hybrid walnut / cereals		
Other comments	The agroforestry systems are not yet common in the French Mediterranean area. Another private estate experiments such a system since 2004 on 25 ha: The Perdiguier estate near Béziers. A separate factsheet will be prepared for the Perdiguier estate.		

6.2.5 Grazed cider orchards in the UK

Basic agroforestry system information			
AF system ID	304	Name	Grazed Orchards in the UK
AGFORWARD classification	<input type="checkbox"/>	High Natural and Cultural Value (WP2)	
	<input checked="" type="checkbox"/>	High Value Tree Systems (WP3)	
	<input type="checkbox"/>	Silvoarable (WP4)	
	<input type="checkbox"/>	Silvopastoral (WP5)	
Present location	Herefordshire, England; Loughgall, Northern Ireland; UK		
Description	Cider apple (<i>Malus domestica</i>) trees grown in rows of up to c.600 trees/ha (bush orchards) or widely spaces tree arranged on a grid of up to <150 trees/ha (traditional orchards), both with a grass understorey on which sheep are grazed.		
Stakeholder report	<p>Burgess PJ (2014). Initial Stakeholder Meeting Report: Grazed Orchards in the UK. 18 July 2014. 8 pp. Available online: http://www.agforward.eu/index.php/en/Grazed_Orchards.html</p> <p>McAdam J (2014). Initial Stakeholder Meeting Report: Grazed orchards in Northern Ireland, UK. 4 December 2014. 9 pp. Available online: http://www.agforward.eu/index.php/en/grazed-orchards-in-northern-ireland-uk.html</p>		
Research protocol report	<p>Upton M, Burgess PJ, Bevan T (2015). Research and Development protocol for Grazed Orchards in England and Wales. 11 February 2015. 17 pp. Available online: http://www.agforward.eu/index.php/en/Grazed_Orchards.html</p> <p>McAdam J, Ward F (2015). Research and Development protocol for Grazed Orchards in Northern Ireland. 17 February 2015. 15 pp. Available online: http://www.agforward.eu/index.php/en/grazed-orchards-in-northern-ireland-uk.html</p>		
Area occupied (estimation)	17,600--25,350 ha		
Soil type	Cambisols, Luvisols (Herefordshire)		
Common/typical tree species	Apple (<i>Malus domestica</i>)		
Common/typical crop species	Grass		
Common/typical animal species	Sheep (of particular interest are the Shropshire breed)		
Products	Apples for cider crop, sheep		
Economic interests	Apples for cider crop, sheep, saving in mowing costs, additional expense of animal management		
Other services			
Experimental sites for the project? Where?	Herefordshire, England; Loughgall, Northern Ireland		
Photographs	<p>Traditional Orchard:</p>  <p>Bush orchard:</p>		

Basic agroforestry system information			
AF system ID	304	Name	Grazed Orchards in the UK
	 <p>More images at: https://www.flickr.com/photos/agforward/15524546070/ https://www.flickr.com/photos/agforward/15524545920/ https://www.flickr.com/photos/agforward/15398422760/ https://www.flickr.com/photos/agforward/15524199947/ https://www.flickr.com/photos/agforward/15404315288/ https://www.flickr.com/photos/agforward/15398375420/</p>		
AF System contact	Name	Paul Burgess	Email P.Burgess@cranfield.ac.uk
References (5 to 10)	<p>Burrough AE, Oines CM, Oram SP, & Robertson HJ (2010). Traditional Orchard Project in England - The creation of an inventory to support the UK Habitat Action Plan. Natural England. Commissioned Reports, Number 077. Available Online.</p> <p>Decouzon J (2011). Introduction of Sheep in Commercial Cider Orchards: Sheep and orchards: a promising association for more sustainable cider apple production. Unpublished report.</p> <p>Defra (2012). Survey of Orchard Fruit at October 2012, England and Wales. 30 May 2013. Available Online.</p> <p>Geddes P, Kohl R (2009) Shropshire sheep control weeds in orchards. Pesticide News 86. Available Online.</p> <p>Mayr U, Spath S, Bruder A, Kohl R (2007). Report on the trial with Shropshire sheep grazing in apple orchards at the Research Centre for Fruit Growing, Lake Constance, Bavendorf, Germany, Obst und Garten, Issue 05/2007. 5. LUBW- Landesanstalt.</p> <p>Parrett S (2010). Public and private policy affecting the grazing of animals on commercial cider apple orchards in the UK. The Bulmer Foundation, University of Worcester. Report commissioned by Heineken UK Ltd.</p> <p>Shropshire Sheep Breeders' Association (2008). Two Crops from One Acre: A Comprehensive Guide to using Shropshire Sheep for Grazing Tree Plantations. Available Online.</p> <p>Townsend M (2012). Benefits of Trees on Livestock Farms. Woodland Trust Report. Grantham, Lincolnshire: Woodland Trust. Available Online.</p> <p>UK BAP Biodiversity Reporting and Information Group (BRIG) (2010) Traditional orchards In: UK Biodiversity Action Plan; Priority Habitat Descriptions 89-91 (Ed. Ant Maddock) (Updated July 2010). Available Online.</p> <p>Burgess, P.J. & Vylupek, O. (2011). Modelling of Cider Orchard Intercropping. Farm Woodland Forum Annual Meeting, Organic Research Centre. Peterborough, 30 June to 1 July 2011.</p> <p>Vlyupek O (2011) Modelling of cider orchard intercropping. Unpublished MSc Thesis. Cranfield University,</p>		
Hypothetical Modelling combinations	Apples and sheep		
Other comments			


6.2.6 Intercropping and grazing olive orchards in Italy

Basic agroforestry system information			
AF system ID	305	Name	Intercropping and grazing olive orchards in Italy
AGFORWARD classification	<input type="checkbox"/>	High Natural and Cultural Value (WP2)	
	<input checked="" type="checkbox"/>	High Value Tree Systems (WP3)	
	<input type="checkbox"/>	Silvoarable (WP4)	
	<input type="checkbox"/>	Silvopastoral (WP5)	
Present location	Castel Ritaldi, Perugia, Italy.		
Description	Olive trees (<i>Olea europaea</i>) is growing in rows of up to 1670 trees/ha. The asparagus plants are established only along the tree rows to allow the management practices, with density of 4950 plants/ha. The olive/asparagus rows are 4 meter spaced with a grass understorey available for poultry grazing.		
Stakeholder report	Rosati A (2014). Initial Stakeholder Meeting Report Intercropping and grazing of olive orchards in Italy. 6 August 2014. 7 pp. Available online: http://www.agforward.eu/index.php/en/intercropping-and-grazing-of-olive-orchards-in-italy.html		
Research protocol report	Rosati A, Mantovani D (2015). Research and Development Protocol for the Intercropping of Olive Orchards in Italy (2015). 11 March 2015. 9 pp. Available online: http://www.agforward.eu/index.php/en/intercropping-and-grazing-of-olive-orchards-in-italy.html		
Area occupied (estimation)	15 m x 15 m plot		
Soil type	Clayey soil (Fine texture)		
Common/typical tree species	Olive (<i>Olea europaea</i>)		
Common/typical crop species	The perennial shrub asparagus is planted along the trees rows, while in the interrow the grass is established.		
Common/typical animal species	Chicken		
Products	Olive for oil production, asparagus for edible spears, and chicken meat		
Economic interests	Since wild asparagus grows naturally in abandoned olive orchards, once established is a perennial low maintenance crop. The market for its spears is already established, with two to four times the price of cultivate (Benincasa et al. 2007).		
Other services	Poultry grazing as a pest and weed control and to reduce the use of fertilizer		
Experimental sites for the project? Where?	Castel Ritaldi, Perugia, Italy Location: 42.820525 N, 12.680626 E		
Photographs	Olive orchard and wild asparagus		

Basic agroforestry system information				
AF system ID	305	Name	Intercropping and grazing olive orchards in Italy	
				
AF System contact	Name	Dario Mantovani	email	mantdar2@gmail.com
References (5 to 10)	<p>Benincasa, P., Tei, F., & Rosati, A. (2007). Plant density and genotype effects on wild asparagus (<i>Asparagus acutifolius</i> L.) spear yield and quality. <i>HortScience</i>, 42(5), 1163-1166. Available Online.</p> <p>Grattan, S. R., Berenguer, M. J., Connell, J. H., Polito, V. S., & Vossen, P. M. (2006). Olive oil production as influenced by different quantities of applied water. <i>Agricultural water management</i>, 85(1), 133-140. Available Online.</p> <p>Camposeo, S., & Godini, A. (2010). Preliminary observations about the performance of 13 varieties according to the super high density olive culture training system in Apulia (southern Italy). <i>Advances in horticultural science</i>, 24, 16-20. Available Online.</p> <p>Testa, R., Di Trapani, A. M., Sgroi, F., & Tudisca, S. (2014). Economic analysis of process innovations in the management of olive farms. <i>Am. J. Appl. Sci</i>, 11(9), 1486-1491.</p> <p>Proietti, P., Nasini, L., & Ilarioni, L. (2012). Photosynthetic behavior of Spanish Arbequina and Italian Maurino olive (<i>Olea europaea</i> L.) cultivars under super-intensive grove conditions. <i>Photosynthetica</i>, 50(2), 239-246. Available Online.</p> <p>Villalobos, F. J., Testi, L., Hidalgo, J., Pastor, M., & Orgaz, F. (2006). Modelling potential growth and yield of olive (<i>Olea europaea</i> L.) canopies. <i>European journal of agronomy</i>, 24(4), 296-303. Available Online.</p>			
Hypothetical modelling combinations	Olive orchard and asparagus			
Other comments				

6.2.7 Intercropping of olive orchards in Greece


6.2.7.1 Intercropping of olive orchards in Greece with cereals

Basic agroforestry system information			
AF system ID	306	Name	Intercropping of olive groves in Greece
AGFORWARD classification	<input type="checkbox"/>	High Natural and Cultural Value (WP2)	
	<input checked="" type="checkbox"/>	High Value Tree Systems (WP3)	
	<input checked="" type="checkbox"/>	Silvoarable (WP4)	
	<input type="checkbox"/>	Silvopastoral (WP5)	
Present location	Mostly in coastal areas around the country and in the inland of west and south Greece (Epirus, Aitolokarnania, Peloponnese, Crete and in most islands of Ionian and Aegean sea).		
Description	The combination of olive orchards with arable crops (cereals) in the same field is a traditional land use system in Greece. The combination of olives and cereals can stabilize the economic return in the context of variable weather conditions.		
Stakeholder report	Pantera A (2014). Initial Stakeholder Meeting Report: Intercropping of olive groves in Greece (Kassandra). 20 October 2014. 8 pp. Available online: http://www.agforward.eu/index.php/en/intercropping-of-olive-groves-in-greece.html		
Research protocol report	Mantzas K, Papanastasis V, Pantera A, Papadopoulos A (2015a). Research and Development Protocol for Olive Agroforestry in Kassandra, Chalkidiki, Greece. 26 March 2015. 8 pp. Available online: http://www.agforward.eu/index.php/en/intercropping-of-olive-groves-in-greece.html		
Area occupied (estimation)	13,000 ha in Chalkidiki, approximately 10 ha in the present location		
Soil type	Luvisols		
Common/typical tree species	Olive (<i>Olea europea</i>)		
Common/typical crop species	Cereals (barley- <i>Hordeum vulgare</i>) and common vetch (<i>Vicia sativa</i>)		
Common/typical animal species	Occasionally sheep graze after harvest		
Products	From trees: Olives, olive oil From understory: cereal crops, hay		
Economic interests			
Other services	Soil protection, tourism, hunting, carbon sequestration, water cycle regulation, biodiversity, fire prevention (shrub control), and organic matter improvement.		
Experimental sites for the project? Where?	It is going to be used as a research site; a possible site at X 450089.747 and Y 4428217.075		
Photographs	 <p>Images available at: https://www.flickr.com/photos/agforward/15843342892/ https://www.flickr.com/photos/agforward/15657948329/ https://www.flickr.com/photos/agforward/15841940241/</p>		

Basic agroforestry system information				
AF system ID	306	Name	Intercropping of olive groves in Greece	
AF System contact	Name	Konstantinos Mantzanas	Email	konman@for.auth.gr
References (5 to 10)	<p>Papanastasis, V.P., K. Mantzanas, O. Dini-Papanastasi and I. Ispikoudis. 2009. Traditional agroforestry systems and their evolution in Greece. In: Agroforestry in Europe: Current Status and Future Prospects (A. Rigueiro-Rodriguez et al., eds.). Springer Science, pp. 89-109.</p> <p>Schultz A.M., Papanastasis V.P., Katelman T., Tsiouvaras C., Kandrelis S., Nastis A. 1987. Agroforestry in Greece. Aristotle University of Thessaloniki, Thessaloniki, Greece</p>			
Hypothetical Modelling combinations	Olives with cereals Olives with a mixture of cereals and legumes			
Other comments				


6.2.7.2 Intercropping of olive orchards in Greece with legumes and aromatic plants

Basic agroforestry system information			
AF system ID	306b	Name	Intercropping of olive groves in Greece with legumes and aromatic plants
AGFORWARD classification	<input type="checkbox"/>	High Natural and Cultural Value (WP2)	
	<input checked="" type="checkbox"/>	High Value Tree Systems (WP3)	
	<input checked="" type="checkbox"/>	Silvoarable (WP4)	
	<input type="checkbox"/>	Silvopastoral (WP5)	
Present location	Mostly in Macedonia, N. Greece and Central Greece but throughout Greece in small scale.		
Description	Combination of olive orchards with legumes and aromatic plants in Greece.		
Stakeholder report	Pantera A (2014). Initial Stakeholder Meeting Report: Intercropping of olive groves in Greece (Molos). 20 October 2014. 9 pp. Available online: http://www.agforward.eu/index.php/en/intercropping-of-olive-groves-in-greece.html		
Research protocol report	Mantzanas K, Papanastasis V, Pantera A, Papadopoulos A (2015b). Research and Development Protocol for Olive Agroforestry in Molos, Central Greece. 26 March 2015. 10 pp. Available online: http://www.agforward.eu/index.php/en/intercropping-of-olive-groves-in-greece.html		
Area occupied (estimation)	20 ha in Greece, approximately 1 ha in the present location		
Soil type	Lithosols – Chromic Luvisols		
Common/typical tree species	Olive (<i>Olea europea</i>)		
Common/typical crop species	Cereals (<i>Triticum</i> spp.), peas (<i>Pisum sativum</i>) and aromatic plants		
Common/typical animal species	Occasionally sheep graze after harvest		
Products	From trees: Olives, olive oil, From undercover: vegetables		
Economic interests			
Other services	Soil protection, tourism, hunting, carbon sequestration, water cycle regulation, biodiversity, fire prevention (shrub control), and organic matter improvement.		
Experimental sites for the project? Where?	It is going to be used as a demonstration site; a possible site at X 379895.648 & Y 4298021.971		

Basic agroforestry system information			
AF system ID	306b	Name	Intercropping of olive groves in Greece with legumes and aromatic plants
Photographs	 <p>Images available at: https://www.flickr.com/photos/agforward/15658128457/ https://www.flickr.com/photos/agforward/15657889539/ https://www.flickr.com/photos/agforward/15841924621/</p>		
AF System contact	Name	Anastasia Pantera	Email pantera@teiste.gr
References (5-10)	<p>Papanastasis, V.P., K. Mantzanas, O. Dini-Papanastasi and I. Ispikoudis. 2009. Traditional agroforestry systems and their evolution in Greece. In: Agroforestry in Europe: Current Status and Future Prospects (A. Rigueiro-Rodriguez et al., eds.). Springer Science, pp. 89-109.</p> <p>Schultz A.M., Papanastasis V.P., Katelman T., Tsiouvaras C., Kandrelis S., Nastis A. 1987. Agroforestry in Greece. Aristotle University of Thessaloniki, Thessaloniki, Greece</p>		
Hypothetical modelling combinations	<p>Olives with legumes Olives with aromatic plants</p>		
Other comments			


6.2.8 Grazing and intercropping of plantation trees in Spain

Basic agroforestry system information			
AF system ID	307	Name	Grazing and intercropping of plantation trees in Spain
AGFORWARD classification	<input type="checkbox"/>	High Natural and Cultural Value (WP2)	
	<input checked="" type="checkbox"/>	High Value Tree Systems (WP3)	
	<input type="checkbox"/>	Silvoarable (WP4)	
	<input type="checkbox"/>	Silvopastoral (WP5)	
Present location	Walnut timber production is located throughout Spain		
Description	Spain has a shortage of quality wood. In the last decade, hardwood plantations have substantially increased in many Spanish regions. In order to grow trees for high quality timber in short rotations, an intensive management, based on high levels of energy consumption and inputs, has been adopted, with high economic and environmental costs. The control of competing herbaceous vegetation and fertilization are two of the most controversial management practices.		
Stakeholder report	Moreno G (2014). Initial Stakeholder Meeting Report Grazing and intercropping of plantation trees in Spain. 17 September 2014. 12 pp. Available online: http://www.agforward.eu/index.php/en/grazing-and-intercropping-of-plantation-trees-in-spain.html		
Research protocol report	Moreno G (2015). Research and Development Protocol for Cereal Production beneath Walnut in Spain. 20 March 2015. 7 pp. Available online: http://www.agforward.eu/index.php/en/silvoarable-systems-in-spain.html Moreno G, Lourdes López-Díaz M, Bertomeu García M (2015). Research and Development Protocol for Silvopastoral Management with Quality Wood Production in Spain. 20 March 2015. 10 pp. Available at: http://www.agforward.eu/index.php/en/grazing-and-intercropping-of-plantation-trees-in-spain.html		
Area occupied (estimation)	2500 hectares in Spain. Bosques Naturales S.A. owns 1300 hectares of walnut with forestry certification of FSC.		
Soil type	Cambisols		
Common/typical tree species	Hybrid walnut (<i>Juglans major x nigra mj 209xra</i>)		
Common/typical crop species	Herbaceous strata		
Common/typical animal species	Sheep (Merina)		
Products	High quality timber		
Economic interests			
Other services	Trees increase carbon storage. Trees in silvopastoral systems develop deeper root systems that reduce nitrate leaching. This system allow to explore new possibilities for sustainable development of farming and agricultural districts, where annual livestock production within the parameters of current animal welfare can be compatible with the medium-long term hardwood timber production, with great current and future demand, developing an environmentally efficient production system.		
Experimental sites for the project? Where?	9.72 ha. Nine replicates were used for each treatment of fertilization and control of herbaceous vegetation that results in 27 plots. Each plot (95x15m) comprised two rows of 20 trees. ETRS89 huso 20: X:298.303 Y:4.442326		

Basic agroforestry system information				
AF system ID	307	Name	Grazing and intercropping of plantation trees in Spain	
Photographs	 <p>Image available at: https://www.flickr.com/photos/agforward/22388377329/in/album-72157642842419595/</p>			
AF System contact	Name	Gerardo Moreno	Email	gmoreno@unex.es
References (5 to 10)				
Hypothetical modelling combinations	Legume sowing vs. grass strata (thereafter Fertilized Walnut) Grazing vs. ploughing or mowing (thereafter Grazed Walnut)			
Other comments				


6.2.9 Intercropping of orange groves with arable crops in Greece

Basic agroforestry system information			
AF system ID	310	Name	Intercropping of orange groves with arable crops in Greece
AGFORWARD classification	<input type="checkbox"/>	High Natural and Cultural Value (WP2)	
	<input checked="" type="checkbox"/>	High Value Tree Systems (WP3)	
	<input checked="" type="checkbox"/>	Silvoarable (WP4)	
	<input type="checkbox"/>	Silvopastoral (WP5)	
Present location	Mostly in Western, Central and South Greece.		
Description	Citrus groves of orange, tangerine and lemon trees are a characteristic land use system in Chania, Crete, Greece. In the past, farmers used to cultivate crops in between citrus trees after pollarding them to change varieties. They also used cypress trees as hedgerows to protect citrus trees from winds (as windbreaks). However nowadays they prefer to cut the cypress trees from the hedgerows or to uproot citrus trees and switch to avocado monoculture for higher profit. Only a few farmers still practice agroforestry as citrus trees with intercrops ensuring a steady economic return every year irrespectively of weather conditions or other type of hazards until tree crown fully develops to exclude any form of intercropping. Most of the intercrops are vegetables. After crown development intercrops are replaced by chickens grazing.		
Stakeholder report	Pantera A (2014). Initial Stakeholder Meeting Report Intercropping of Orange Groves in Greece. 18 November 2014. 7 pp. Available online: http://www.agforward.eu/index.php/en/intercropping-of-orange-groves-in-greece.html		
Research protocol report	Pantera A, Papanastasis V, Papanastasis V, Mantzanas K (2015). Research and Development Protocol for Agroforestry with Orange Groves in Crete, Greece. 26 March 2015. 5 pp. Available online: http://www.agforward.eu/index.php/en/intercropping-of-orange-groves-in-greece.html		
Area occupied (estimation)	2 ha in the present location		
Soil type	Lithosols – Chromic Luvisols		
Common/typical tree species	Orange (<i>Citrus sinensis</i>)		
Common/typical crop species	Cereals (<i>Triticum</i> spp.), beans (<i>Phaseolus vulgaris</i>), potatoes (<i>Solanum tuberosum</i>) and aromatic plants		
Common/typical animal species	Occasionally chicken graze after harvest		
Products	From trees: Oranges, orange juice, From undercover: vegetables		
Economic interests	Locals sell oranges in the various hotels during the summer season. It is of great interest however farmers are desperate due to the low product price. However it is a beautiful site with cultural value.		
Other services	Soil protection, tourism, hunting, carbon sequestration, water cycle regulation, biodiversity, fire prevention (shrub control), and organic Matter improvement.		
Experimental sites for the project? Where?	It is going to be used as a demonstration site; a possible site at X492509.365& Y 3920978.655		

Basic agroforestry system information				
AF system ID	310	Name	Intercropping of orange groves with arable crops in Greece	
Photographs	 <p>Images available at: https://www.flickr.com/photos/agforward/15659622969/ https://www.flickr.com/photos/agforward/15659614119/ https://www.flickr.com/photos/agforward/15845623635/ https://www.flickr.com/photos/agforward/15223335524/</p>			
AF System contact	Name	Anastasia Pantera	Email	pantera@teiste.gr
References (5 to 10)				
Hypothetical Modelling combinations	Orange with aromatic plants			
Other comments				

6.2.10 Grazed chestnut tree stands for fruit (*soutos*) and/or wood (*castiçais*) production

Basic agroforestry system information			
AF system ID	315	Name	Grazed chestnut tree stands for fruit (<i>soutos</i>) and/or wood (<i>castiçais</i>) production
AGFORWARD classification	<input type="checkbox"/>	High Natural and Cultural Value (WP2)	
	<input checked="" type="checkbox"/>	High Value Tree Systems (WP3)	
	<input type="checkbox"/>	Silvoarable (WP4)	
	<input type="checkbox"/>	Silvopastoral (WP5)	
Present location	Trás-os-Montes region (north interior Portugal)		
	Mountain regions		
Description	These areas include low tree density stands of <i>Castanea sativa</i> species, on average 89 trees per hectare according to AFN (2010), managed for chestnut or high quality wood production in association to permanent pastures (natural or improved) for animal consumption. These areas are also frequently characterized by mixed stands with <i>Quercus pyrenaica</i> trees.		
Stakeholder report	The following report describes grazed chestnuts in the Galicia region of Spain Mosquera Losada R, Ferreiro-Domínguez N, Fernández Lorenzo JL, González-Hernández P, Rigueiro Rodríguez A (2014). Initial Stakeholder Meeting Report: Chestnut agroforestry in Galicia, Spain. 23 September 2014. 9 pp. Available online: http://www.agforward.eu/index.php/en/chestnut-agroforestry-in-galicia-spain.html		
Research protocol report	The following report describes grazed chestnuts in the Galicia region of Spain Fernández Lorenzo JL, Rigueiro Rodríguez A, Ferreiro-Domínguez N, González-Hernández P, Burgess, PJ, Mosquera-Losada MR (2015). Research and Development Protocol for Chestnut Agroforestry in Spain. 15 June 2015. 7 pp. Available at: http://www.agforward.eu/index.php/en/chestnut-agroforestry-in-galicia-spain.html		
Area occupied (estimation)	According to the new forest inventory area assessment these systems are distributed along 41410 ha (ICNF 2013).		
Soil type	For fruit production: Texture: sandy soils (light, fresh), well drained Depth: deep soils Lithology: Granites, schist, gneisses		
	For wood production: The has for fruit production (above) but also viable in more shallow soils, in mountain areas presenting some erosion		
	Other characteristics: Calcifuge species; needs soils with medium to high levels of organic matter; not suitable for heavy texture soils		
Common/typical tree species	<i>Castanea sativa</i>		
Common/typical crop species	Natural pastures		
Common/typical animal species	Sheep and/or goats (traditional breads)		
Products	Fruit, wood, firewood (local consumption), direct and indirect animal products		
Economic interests	Fruit, wood, direct and indirect animal products		
Other services	Tourism		
Experimental sites for the project? Where?	No		

Basic agroforestry system information				
AF system ID	315	Name	Grazed chestnut tree stands for fruit (<i>soutos</i>) and/or wood (<i>castiçais</i>) production	
Photographs	 <p>Images available at: https://www.flickr.com/photos/agforward/21954666203/in/album-72157642842419595/ https://www.flickr.com/photos/agforward/21953120474/in/album-72157642842419595/ https://www.flickr.com/photos/agforward/22587088341/in/album-72157642842419595/</p>			
AF System contact	Name	Joana Amaral Paulo	Email	joanaap@isa.ulisboa.pt
References (5 to 10)	<p>AFN (2010). Inventário Florestal Nacional Portugal Continental IFN5, 2005 - 2006. Autoridade Florestal Nacional, Lisboa, 209 pp. (http://www.icnf.pt/portal/florestas/ifn).</p> <p>ICNF (2013). IFN6 – Áreas dos usos do solo e das espécies florestais de Portugal continental. Resultados preliminares. 34 pp. Instituto da Conservação da Natureza e das Florestas. Lisboa.</p> <p>https://bibliotecadigital.ipb.pt/bitstream/10198/3640/1/vol_V_capitulo%204.pdf http://www.icnf.pt/portal/naturaclas/rn2000/resource/rn-plan-set/hab/hab-9260 http://portal.ipb.pt:7778/pls/portal/docs/PAGE/CONFRARIA_DA_CASTANHA/DOSSIERS_TEMATICOS/SISTEMAS%20E%20T%C3%89CNICAS%20CULTURAIS/ECOLOGIA%20DO%20CASTANHEIRO.PDF</p>			
Hypothetical Modelling combinations	<p>1 - Fruit production and sheep grazing 2 – Wood production and sheep grazing</p>			
Other comments	<p>In the 1950's the total area in Portugal was 70.000 hectares: 65.000 for fruit production (<i>soutos</i>) and 5.000 hectares for high quality wood production (<i>castiçais</i>). The reduction of the total areas is related to diseases affecting the tree and the fruit production and the aging of the stands.</p>			


6.3 Agroforestry for arable farmers (*Silvoarable systems*)


Thirteen systems were identified as existing and potential innovations for silvoarable systems (Table 7). The factsheets below describe eight of these systems in detail.

Table 7. Agroforestry systems for arable farms: the ID, name, location, contact person and if a stakeholder meeting report and/or a WP6 factsheet was produced.


AF-ID	Name	Location	Responsible	Stakeholder meeting report	WP6 Factsheet
401	Integrating apple trees with arable crops in Switzerland.	Sursee, Central Switzerland	Felix Herzog, Agroscope	X	X
402	Integrating poplar with arable crops in Switzerland.	Buus, NW Switzerland	Felix Herzog, Agroscope	X	X
403	Apple trees or Short rotation coppice with cereals or legumes	Experimental site: Wakelyns Agroforestry, Suffolk, UK.	Jo Smith, ORC	X	X
404	Mediterranean silvoarable systems in France	Southern France	Marie Gosme, INRA	X	
405	German poplar/willow alley cropping in Germany	Lusatia, Germany.	Jaconette Mirck and Penka Tsonkova, BTU	X	X
406	Trees for timber intercropped with cereals in Italy	Veneto Region, NE Italy	Pierluigi Paris CNR-IBAF	X	X
407	Intercropping of poplar and walnut trees with cereals and beans in Greece	Mostly in northern Greece (Macedonia and Thrace).	Anastasia Pantera, TEI	X	X
408	Alley cropping in Hungary	Hungary	Andrea Vityi and Anna Varga NYME	X	
409	Irrigated silvoarable systems in Spain and Portugal	Galicia, Spain and Central Portugal	João Palma, Maria Rosa Mosquera Losada (USC)	X	X
410	Agroforestry for Arable Farmers in Western France	Western France	Eric Cirou, Chambres d'Agriculture of Charente-Maritime	X	
411	Agroforestry for Arable Farmers in Northern France	Picardy region, France	Régis Wartelle, Chambres d'Agriculture of Picardy	X	
412	Agroforestry for Arable Farmers in South-West France	South-West France	Nina Malignier, Association Française d'Agroforesterie (AFAF)	X	
413	Alley cropping with Eucalyptus for biomass production in Portugal	Riba-tejo, Portugal	Joana Amaral Paulo		X


6.3.1 Integrating apple trees with arable crops in Switzerland

Basic agroforestry system information			
AF system ID	401	Name	Integrating apple trees with arable crops in Switzerland.
AGFORWARD classification	<input type="checkbox"/>	High Natural and Cultural Value (WP2)	
	<input type="checkbox"/>	High Value Tree Systems (WP3)	
	<input checked="" type="checkbox"/>	Silvoarable (WP4)	
	<input type="checkbox"/>	Silvopastoral (WP5)	
Present location	6210 Sursee (central Switzerland)		
Description	<p>The plot is located in the canton of Lucerne, central Switzerland. The farm has an area of approximately 50 hectares. In 2009, 545 apple trees (varieties Boskoop and Spartan) were planted. The intermediate cultures consist of winter wheat, strawberries and sown flower strips.</p> <p>Since the farmer had to give up almost 15 hectares of his farmland for construction, the intensification of agricultural production was a primary goal. The apples should be marketed as a cider fruit. By integrating the sown flower strips ecological direct payments with premiums for eco-quality also can be obtained. Maximizing the subsidies is an additional objective.</p>		
Stakeholder report	<p>Jäger M, Herzog F (2014). Initial Stakeholder Meeting Report Silvoarable systems with fruit and high value timber trees in Switzerland. 11 November 2014. 9 pp. Available online: http://www.agforward.eu/index.php/en/integrating-trees-with-arable-crops-switzerland.html</p>		
Research protocol report	<p>Herzog F, Jäger M, (2015). Research and Development Protocol for Integrating Trees with Arable Crops, Switzerland. 9 March 2015. 13 pp. Available online: http://agforward.eu/index.php/en/integrating-trees-with-arable-crops-switzerland.html</p>		
Area occupied (estimation)	5.6 ha		
Soil type	Eutric cambisol, sandy loam with slight gley characteristics; detailed soil profile available.		
Common/typical tree species	Apple (<i>Malus domestica</i>),		
Common/typical crop species	Strawberry (<i>Fragaria × ananassa</i>), wheat (<i>Triticum aestivum</i>), rapeseed (<i>Brassica napus</i>), sown flower strip		
Common/typical animal species	n.a.		
Products	Strawberries for fresh marketing, arable crops, apple for juice production		
Economic interests	Crops; apple for juice; direct payments for biodiversity		
Other services	Landscape scenery, biodiversity		
Experimental sites for the project? Where?	That specific site as a farmer innovation. It is representative for many farmers in Switzerland who combine crops with trees. Most of them will choose fruit trees because they are entitled for direct payments as Ecological Focus Areas.		
Photographs			


Basic agroforestry system information				
AF system ID	401	Name	Integrating apple trees with arable crops in Switzerland.	
				
	Images available at: https://www.flickr.com/gp/agforward/v025X3 https://www.flickr.com/gp/agforward/V94vNu https://www.flickr.com/gp/agforward/x96G9g https://www.flickr.com/gp/agforward/2M3p01			
AF System contact	Name	Felix Herzog	Email	Felix.Herzog@agroscope.admin.ch
References (5 to 10)	Sereke F., Graves A., Dux D., Palma J., Herzog F. (2014) Innovative agroecosystem goods and services: key profitability drivers in Swiss agroforestry. <i>Agronomy for Sustainable Development</i> (In press) Kuster M., Herzog F., Rehnus M., Sorg J.-P. (2012) Innovative Agroforstsysteme - On farm monitoring von Chancen und Grenzen / Systèmes agroforestiers novateurs - monitoring des opportunités et limites. <i>Agrarforschung Schweiz / Recherche Agronomique Suisse</i> 3(10), 470 – 477.			
Hypothetical Modelling combinations	Silvo-arable system with fruit trees (challenge for modelling apple!), berries (another challenge), but otherwise a classical rotation.			
Other comments	Trees planted in 2009; trees measured in 2011 and 2014 (will be measured every 3 years). The farmer has annual data on productivity of intercrops and on inputs, etc., which he would make available.			

6.3.2 Integrating poplar with arable crops in Switzerland

Basic agroforestry system information			
AF system ID	402	Name	Integrating poplar with arable crops in Switzerland.
AGFORWARD classification	<input type="checkbox"/>	High Natural and Cultural Value (WP2)	
	<input type="checkbox"/>	High Value Tree Systems (WP3)	
	X	Silvoarable (WP4)	
	<input type="checkbox"/>	Silvopastoral (WP5)	
Present location	CH-4463 Buus (north-western Switzerland)		
Description	This is an individual plot planted by a pioneer farmer. It is located in the canton of Basel-Country on a farm with a total area of 20 hectares. In March 2011, 52 Aspen (<i>Populus tremula</i>) were planted. The area between the tree rows was first managed as grassland, is now intercropped with rye, corn and sorghum. The wood of the aspens should be harvested in 30 to 35 years as energy wood.		
Stakeholder report	Jäger M, Herzog F (2014). Initial Stakeholder Meeting Report Silvoarable systems with fruit and high value timber trees in Switzerland. 11 November 2014. 9 pp. Available online: http://www.agforward.eu/index.php/en/integrating-trees-with-arable-crops-switzerland.html		
Research protocol report	Herzog F, Jäger M, (2015). Research and Development Protocol for Integrating Trees with Arable Crops, Switzerland. 9 March 2015. 13 pp. Available online: http://agforward.eu/index.php/en/integrating-trees-with-arable-crops-switzerland.html		
Area occupied (estimation)	1 ha		
Soil type	Calcareous cambisol, slight humus content, clay loam, skeleton rich, moderately deep; detailed soil profile available. 5% inclination		
Common/typical tree species	Aspen (<i>Populus tremula</i>)		
Common/typical crop species	Winter rye (<i>Secale cereale</i>)		
Common/typical animal species	n.a.		
Products	Rye, silage maize for fodder; energy wood		
Economic interests	Fodder production for suckler cows; direct payments for biodiversity		
Other services	CO2 neutral energy production, biodiversity, landscape scenery		
Experimental sites for the project? Where?	That specific site as a farmer innovation with potential for uptake by other farmers. In the region, traditional orchards (cherry) are being abandoned / felled and alternatives are needed.		
Photographs			


Basic agroforestry system information				
AF system ID	402	Name	Integrating poplar with arable crops in Switzerland.	
	 <p>Images available at: https://www.flickr.com/gp/agforward/u70e7x https://www.flickr.com/gp/agforward/61518f https://www.flickr.com/gp/agforward/ORAB9d</p>			
AF System contact	Name	Felix Herzog	Email	Felix.Herzog@agroscope.admin.ch
References (5 to 10)	Kuster M., Herzog F., Rehnus M., Sorg J.-P. (2012) Innovative Agroforstsysteme - On farm monitoring von Chancen und Grenzen / Systèmes agroforestiers novateurs - monitoring des opportunités et limites. Agrarforschung Schweiz / Recherche Agronomique Suisse 3(10), 470 – 477.			
Hypothetical modelling combinations	"Classical" silvo-arable system with 35 year rotation; unique for Switzerland; CO ₂ balance would be of specific interest			
Other comments	Trees planted in 2011; trees measured in 2011 and 2014 (will be measured every 3 years); very co-operative and innovative young farmer who thinks about putting up a digester for transforming waste wood into black carbon which he wants to feed his suckler cows. Comparatively simple system for modelling.			

6.3.3 Apple trees or Short rotation coppice with cereals or legumes

Basic agroforestry system information			
AF system ID	403	Name	Silvoarable Systems in the UK
AGFORWARD classification	<input type="checkbox"/>	High Natural and Cultural Value (WP2)	
	<input type="checkbox"/>	High Value Tree Systems (WP3)	
	X	Silvoarable (WP4)	
	<input type="checkbox"/>	Silvopastoral (WP5)	
Present location	England		
Description	Organic and conventional silvoarable systems with top fruit (apples, pears) and/or short rotation coppice for bioenergy, and arable crops in the alleys. Alleys typically 12 to 24 m wide.		
Stakeholder report	Smith J, Wolfe M, Crossland M, Howlett S (2014). Initial Stakeholder Meeting Report: Silvoarable Agroforestry in the UK. 21 November 2014. 8 pp. Available online: http://www.agforward.eu/index.php/en/silvoarable-agroforestry-in-the-uk.html		
Research protocol report	Fradgley N, Smith J (2015). Research and Development Protocol for Silvoarable Agroforestry in the UK. 9 April 2015. 8 pp. Available online: http://agforward.eu/index.php/en/silvoarable-agroforestry-in-the-uk.html Smith J (2015). Research and Development Protocol for Silvoarable Agroforestry in the UK (part 2). 23 March 2015. 6 pp. Available online: http://www.agforward.eu/index.php/en/silvoarable-agroforestry-in-the-uk.html		
Area occupied (estimation)	Very small nationally – probably less than 1000 ha		
Soil type	Variable		
Common/typical tree species	<i>Malus domestica</i> (apple) SRC species: Willow (<i>Salix viminalis</i>), Hazel (<i>Corylus avellana</i>)		
Common/typical crop species	Wheat (spring and winter varieties plus composite cross population) (<i>Triticum spp</i>) Barley (<i>Hordeum vulgare</i>) Oats (<i>Avena sativa</i>)		
Common/typical animal species	None		
Products	Trees: Top fruit (apples, pears, plums), woodchip for bioenergy Agriculture: cereals		
Economic interests	Currently very small both at a national scale and on a farm scale. Enterprise diversification is a key economic aim for the producers.		
Other services	Biodiversity support including for functional biodiversity such as pollinators and natural pest control; soil protection (wind erosion, soil fertility, soil structure); shelter for crops		
Experimental sites for the project? Where?	Wakelyns Agroforestry, Suffolk – one field of hazel SRC with 12m crop alleys between tree rows; one field of willow SRC with 12m crop alleys between tree rows. Organic arable rotation. Producer systems: Whitehall Farm, Cambs (Stephen Briggs): 4500 semi-dwarf apples planted in 2009 3m apart in rows, with 24m crop alleys in between. Organic crop rotation. Home Farm, Creveton, Notts (David Rose): semi-dwarf apples planted in 2013, 3m apart in rows, with 24m crop alleys in between. Conventional.		
Photographs	<p>Wakelyns Agroforestry, Suffolk, UK.</p> 		

Basic agroforestry system information				
AF system ID	403	Name	Silvoarable Systems in the UK	
	 <p>Whitehall Farm, Cambridgeshire, UK</p>  <p>Images available at: https://flic.kr/p/oEtVWj https://flic.kr/p/oWYBBK https://flic.kr/p/oEuxwK</p>			
AF System contact	Name	Jo Smith	Email	jo.s@organicresearchcentre.com
References (5 to 10)				
Hypothetical modelling combinations	Apple with cereals (wheat, oats, barley) Apple with legume ley Short Rotation Coppice with cereals Short Rotation Coppice with legume ley			
Other comments	Wakelyns Agroforestry is our agroforestry research site so it is suitable for replicated experimental trials and we have staff on-site that can carry out assessments and regular measurements. We have been collecting microclimate data since 2012, and also have willow SRC yield from 2011 onwards, hazel SRC yield from 2014, plus apple yields from 2012 and 2013, plus cereal yields for some years (when the cereals are in the alleys according to the crop rotation – 2 years in 7). We also have some data from Whitehall Farm on biodiversity and cereal yields, and apple yields from 2014.			


6.3.4 Poplar/willow alley cropping in Germany

Basic agroforestry system information			
AF system ID	405	Name	Energy tree alley cropping in Germany
AGFORWARD classification	<input type="checkbox"/>	High Natural and Cultural Value (WP2)	
	<input type="checkbox"/>	High Value Tree Systems (WP3)	
	<input checked="" type="checkbox"/>	Silvoarable (WP4)	
	<input type="checkbox"/>	Silvopastoral (WP5)	
Present location	North-eastern Germany		
Description	Alley cropping is a method of planting in which rows of trees are interspersed with rows of crops, improving the soil and providing nutrients, particularly nitrogen, to the crops. The tree rows have the function to prevent soil erosion and create a microclimate for crops.		
Stakeholder report	Tsonkova P, Mirck J (2014). Initial Stakeholder Report: Alley Cropping Systems in Germany. 19 September 2014. 9 pp. Available online: http://www.agforward.eu/index.php/en/alley-cropping-systems-in-germany.html		
Research protocol report	Mirck J, Quickenstein A (2015). Research and Development Protocol for Alley Cropping in Germany. 9 March 2015. 11 pp. Available online: http://agforward.eu/index.php/en/alley-cropping-systems-in-germany.html		
Area occupied (estimation)	Forst: 70 ha, Welzo: 14 ha		
Soil type	Cambisols, potzols, gleysols, luvisols, histosols		
Common/typical tree species	<i>Populus</i> spp., <i>Robinia pseudoacacia</i>		
Common/typical crop species	Rye (<i>Secale cereale</i>), Perennial Rye (<i>Secale multicaule</i>), wheat (<i>Triticum</i> spp.), triticale (x <i>Triticosecale</i>), maize (<i>Zea mays</i>), alfalfa (<i>Medicago sativa</i>), barley (<i>Hordeum vulgare</i>), potato (<i>Solanum tuberosum</i>), sugar beet (<i>Beta vulgaris</i>), oat (<i>Avena sativa</i>), lupin (<i>Lupinus</i> spp.)		
Common/typical animal species			
Products	From trees: wood products, biomass feedstocks From undercover: crops		
Economic interests	Number of jobs? The crops can be used for a gasifier and the biomass for a combined heat and power plant		
Other services	Soil protection, C-sequestration, water quality, biodiversity, soil fertility/organic Matter		
Experimental sites for the project? Where?	Forst and Welzo South, Germany		
Photographs	 <p>Images available at: https://www.flickr.com/photos/agforward/14916082932/ https://www.flickr.com/photos/agforward/14916051902/</p>		

Basic agroforestry system information				
AF system ID	405	Name	Energy tree alley cropping in Germany	
AF System contact	Name	Jaconette Mirck	Email	jmirck@gmail.com
References (5 to 10)	<p>Bräsicke, N., Böhm, C. and Elmer, M. (2011). Energieholzanbau auf Rekultivierungsstandorten des Niederlausitzer Braunkohlereviere: Effekte unterschiedlicher Landnutzungssysteme auf die epigäische Webspinnenzönose (Arachnida: Araneae). <i>Mitteilungen der Gesellschaft für allgemeine angewandte Entomologie</i>. 18 187–192. [BibTex]</p> <p>Bärwolff, M., Vetter, A., Böhm, C., Hoffmann, J. and Schmidt, C. (2011). Projekt AgroForstEnergie – Was bringen Streifen-Kup?. <i>Energie Pflanzen</i>. 2 10–12. [BibTex]</p> <p>Böhm, C., Quinkenstein, A. and Freese, D. (2011). Effekte der Agrarholzproduktion auf den Kohlenstoff- und Nährstoffhaushalt des Bodens im Bereich der Lausitzer Bergbaufolgelandschaft. <i>Tagungsband der Jahrestagung der Deutschen Bodenkundlichen Gesellschaft (DBG) 2011: Böden verstehen – Böden nutzen – Böden fit machen, 03.-09.09.2011, Berlin, Germany</i> 1–4. [www] [BibTex]</p> <p>Böhm, C., Quinkenstein, A. and Freese, D. (2011). Chancen und Risiken der Agrarholzproduktion für den Gewässerschutz. <i>Korrespondenz Wasserwirtschaft</i>. 4 (12), 667–673. [BibTex]</p> <p>Freese, D., Böhm, C., Quinkenstein, A., Schneider, B. U. and Hüttl, R. F. (2010). Agroforst- flächenschonende Alternative für die Bioenergieproduktion: Feld und Wald auf einem Schlag. <i>Neue Landwirtschaft</i>. 9 76–78. [BibTex]</p> <p>Grünewald, H. (2005). Anbau schnellwachsender Gehölze für die energetische Verwertung in einem Alley-Cropping-System auf Kippsubstraten des Lausitzer Braunkohlereviere. <i>Brandenburgische Technische Universität Cottbus, Cottbuser Schriften zu Bodenschutz und Rekultivierung</i>. (28), 1–135. [BibTex]</p> <p>Grünewald, H., Bärwolff, M., Böhm, C., Schwarz, K.-U. and Schmidt, C. (2008). Ökologische und ökonomische Bewertung von Agroforstsystemen in der landwirtschaftlichen Praxis. <i>Cottbuser Schriften zur Ökosystemgenese und Landschaftsentwicklung</i>. 6 213–216. [BibTex]</p> <p>Quinkenstein, A., Böhm, C., Freese, D., Wöllecke, J., Grünewald, H., Schneider, B. U. and Hüttl, R. F. (2008). Alley-Cropping – Ein klima-adaptierbares Landnutzungssystem zur nachhaltigen Biomasseproduktion. <i>Forum der Forschung</i>. 21 131–138. [www] [BibTex]</p> <p>Quinkenstein, A., Freese, D., Böhm, C., Tsonkova, P. and Hüttl, R. F. (2012). Agroforestry for mine-land reclamation in Germany: capitalizing on carbon sequestration and bioenergy production. <i>Advances in Agroforestry: Agroforestry - The Future of Global Land Use</i> 9 313–339. [doi] [BibTex]</p> <p>Quinkenstein, A., Wöllecke, J., Böhm, C., Grünewald, H., Freese, D., Schneider, B. U. and Hüttl, R. F. (2009). Ecological benefits of the alley cropping agroforestry system in sensitive regions of Europe. <i>Environmental Science & Policy</i>. 12 1112–1121. [doi] [BibTex]</p> <p>Tsonkova, P., Böhm, C., Quinkenstein, A. and Freese, D. (2012). Ecological benefits provided by alley cropping systems for production of woody biomass in the temperate region: a review. <i>Agroforestry Systems</i>. 85 133–152. [doi] [BibTex]</p> <p>Tsonkova, P., Böhm, C., Quinkenstein, A. and Freese, D. (2012). Assessment of carbon sequestration provided by alley cropping systems for biomass production in Germany. Tagungsband der 12. Forstwissenschaftlichen Tagung: Wald, Umwelt, Energie, 19–22 September 2012 in München und Freising, Deutschland 269–269. [BibTex]</p>			
Hypothetical Modelling combinations	<p><i>Populus</i> spp. + cereal, maize, alfalfa rotation</p> <p><i>Robinia pseudoacacia</i> . + cereal, maize, alfalfa rotation</p>			
Other comments				


6.3.5 Trees for timber intercropped with cereals in Italy

Basic agroforestry system information			
AF system ID	406	Name	Trees for timber intercropped with cereals in Italy
AGFORWARD classification	<input type="checkbox"/>	High Natural and Cultural Value (WP2)	
	<input type="checkbox"/>	High Value Tree Systems (WP3)	
	<input checked="" type="checkbox"/>	Silvoarable (WP4)	
	<input type="checkbox"/>	Silvopastoral (WP5)	
Present location	Italy, Po Valley, plain and hilly areas of peninsular Italy		
Description	<p>Poplar hybrids and species has been intensively managed in Italy for timber production mostly in monoculture plantations, but often in intercropping systems (intercropping of arable crops in between young tree rows) and in linear plantations along field edges, drainage canals and streams. Poplar cultivation, in all the above cultivation models, is currently declining for stagnating domestic timber market. Urgent environmental concerns connected to Global Changes (Carbon sequestration, bioenergy, soil erosion control) should open new prospective for poplar silvoarable systems and linear plantations, combining local bioenergy production with food security and environmental amelioration, such as phytoremediation.</p>		
Stakeholder report	<p>Pisanelli A, Camilli F, Dalla Valle C, Paris P (2014). Initial Stakeholder Meeting Report: Trees for timber intercropped with cereals in Italy. 7 October 2014. 6 pp. Available online: http://www.agforward.eu/index.php/en/trees-for-timber-intercropped-with-cereals-445.html</p>		
Research protocol report	<p>Dalla Valle C, Paris P (2015). Research and Development Protocol for Timber Trees intercropped with Cereals in Italy. 2 April 2015. 9 pp. Available online: http://agforward.eu/index.php/en/trees-for-timber-intercropped-with-cereals-445.html</p>		
Area occupied (estimation)	<p>No reliable official statistics are available for intercropping systems. For linear plantations, just local regional statistics are available, often not homogeneous as time series, such the ones for Lombardia Region, reporting wood production from linear plantations, without stratification amongst tree species (e.g. <i>Populus</i>, <i>Platanus</i>, <i>Salix</i>). The last census in Lombardia (year 2000) reports 21,459 km of linear plantations (15.18 m/ha), producing annually 180.000 m³ of timber.</p>		
Soil type	Alluvial soils		
Common/typical tree species	<p>Poplar hybrids (<i>Populus x canadensis</i>) <i>Populus alba</i>, <i>Populus nigra</i></p>		
Common/typical crop species	<p>Corn (<i>Zea mays</i>), wheat (<i>Triticum spp.</i>), barley (<i>Hordeum vulgare</i>), soybean (<i>Glycine max</i>), sunflower (<i>Helianthus annuus</i>), alfalfa (<i>Medicago sativa</i>), clovers (<i>Trifolium spp.</i>)</p>		
Common/typical animal species	Occasional sheep grazing in peninsular Italy.		
Products	<p>From trees: timber (plywood, pallets, wooden fruit boxes), bioenergy; From undercover: crops, fodder.</p>		
Economic interests	<p>Traditionally poplar plantations have produced 50% of the domestic timber production in Italy, with a declining trend because of the imports competition. Forest certification and local bioenergy production could reverse the negative trend. Furthermore, new grants (from Rural Development Plans) for farmers establishing new silvoarable systems could be a new opportunity for implementing poplar based agroforestry.</p>		
Other services	Soil and water protection, carbon sequestration, biodiversity, phytoremediation.		
Experimental sites for the project? Where?	Farm "La Casaria" – Masi (Padova), Italy		

Basic agroforestry system information				
AF system ID	406	Name	Trees for timber intercropped with cereals in Italy	
Photographs	 <p>Images available at: https://www.flickr.com/photos/agforward/15688904930/ https://www.flickr.com/photos/agforward/15690432297/ https://www.flickr.com/photos/agforward/15875453412/ https://flic.kr/p/pV1pxD</p>			
AF System contact	Name	Cristina Dalla Valle Pierluigi Paris	Email	cristina.dallavalle@venetoagricoltura.org piero.paris@ibaf.cnr.it
References (5 to 10)	<p>Eichhorn, M.P., Paris, P. et al. 2006. Silvoarable systems in Europe – past, present and future prospects. <i>Agroforestry Systems</i> (2006) 67:29–50.</p> <p>Lapietra G., Coaloa D. and Chiarabaglio P.M. 1991. Rapporto annuale sulla pioppicoltura 1990. <i>Cellulosa e Carta</i> 3: 20–23.</p> <p>Paris P., Mareschi L., Ecosse A., Pisanelli A., Sabatti M., Scarascia Mugnozza G., 2011. Comparing Hybrid Populus Clones For SRF Across Northern Italy After Two Biennial Rotations: Survival, Growth And Yield. <i>Biomass and Bioenergy</i>, 35:1524-1532. Doi: 10.1016/j.biombioe.2010.12.050.</p> <p>Sabatti, M., Fabbrini, F., Harfouche, A., Beritognolo, I., Mareschi, L., Carlini, M., Paris, P., Scarascia-Mugnozza, G. 2014. Evaluation of biomass production potential and heating value of hybrid poplar genotypes in a short-rotation culture in Italy. <i>Industrial Crops and Products</i>, <i>Products</i> 61: 62–73. Doi: 10.1016/j.indcrop.2014.06.043.</p> <p>Paris P, Mareschi L, Sabatti M, Tosi L, Scarascia-Mugnozza G, 2014. Nitrogen removal and its determinants in hybrid Populus clones for bioenergy plantations after two biennial rotations in two temperate sites in northern Italy. <i>iForest, Biogeosciences and Forestry</i> (in press).</p> <p>Bianconi, D., De Paolis, M., Agnello, A.C., Lippi, D., Pietrini, F., Zacchini, M., Polcaro, C., Donati, E., Paris, P., Spina, S., Massacci, A. (2011). Field-scale Rhizoremediation of a contaminated soil with hexachlorocyclohexane (HCH) isomers: the potential of poplars for environmental restoration and economic sustainability. In Ivan A. Golubev (ed): "Phytoremediation: Processes, Characteristics, and Applications. Nova Science</p>			

Basic agroforestry system information			
AF system ID	406	Name	Trees for timber intercropped with cereals in Italy
	<p>Publisher, Hauppauge. NY. Vol 10 pp.231-ISBN: 978-1-61728-753-4, 2010 Nova Science Publishers, Inc</p> <p>Coaloe, D., Chiarabaglio, P.M. (2003). Corridoi ecologici nella pianura Lombarda. "Alberi e foreste nella pianura", Milano 1-3 October 2003. Report from former Poplar Research Institute, Casale Monferrato.</p> <p>Lapietra, G., Coaloe, D., Sampietro, L. (1985). I FILARI DI PIANTE DA LEGNO DELLA PIANURA LOMBARDA. Quaderni di ricerca, SAF.</p>		
Hypothetical modelling combinations	<p>Hybrid poplar linear plantation + corn/wheat</p> <p>Hybrid poplars silvoarable system+corn/wheat</p>		
Other comments	<p>The same poplar based agroforestry systems are possible in many other European countries. So far we do not know if similar factsheets have been prepared by other project partners. We do believe that poplar linear plantations are one of the most common form of agroforestry systems across Europe, and therefore their biophysical and economic modelling should be an important aim for the Agforward Project.</p>		


6.3.6 Intercropping of poplar and walnut trees with cereals and beans in Greece

Basic agroforestry system information			
AF system ID	407	Name	Intercropping of poplar and walnut trees with cereals and beans
AGFORWARD classification	<input type="checkbox"/>	High Natural and Cultural Value (WP2)	
	<input checked="" type="checkbox"/>	High Value Tree Systems (WP3)	
	<input checked="" type="checkbox"/>	Silvoarable (WP4)	
	<input type="checkbox"/>	Silvopastoral (WP5)	
Present location	Mostly in northern Greece (Macedonia and Thrace).		
Description	Agroforestry is a traditional land use system in Voio in which farmers used to combine agricultural production with high value tree species in the same plot. In this way they ensured a steady economic return every year irrespectively of weather conditions or other type of hazards. The area is characterized by fast growing species (poplars) and walnuts at the edges combined with dry beans, cereals and pastures.		
Stakeholder report	Pantera A (2014). Initial Stakeholder Meeting Report: Trees with arable crops and grassland in Greece. 20 October 2014. 9 pp. Available online: http://www.agforward.eu/index.php/en/trees-with-arable-crops-and-grassland-in-greece.html		
Research protocol report	Mantzas K, Papanastasis V, Pantera A, Papadopoulos A (2015). Research and Development Protocol for Silvoarable Agroforestry Group in Greece. 30 March 2015. 6 pp. Available online: http://agforward.eu/index.php/en/trees-with-arable-crops-and-grassland-in-greece.html		
Area occupied (estimation)	400 ha in the present location		
Soil type	Lithosols – Campisols		
Common/typical tree species	Poplar (<i>Populus clones</i>), walnut (<i>Juglans regia</i>)		
Common/typical crop species	Cereals (wheat- <i>Triticum</i> spp., barley- <i>Hordeum vulgare</i>) and common beans (<i>Phaseolous vulgaris</i>)		
Common/typical animal species	Occasionally sheep graze after harvest		
Products	From trees: timber and nuts From understory: cereal crops and beans		
Economic interests			
Other services	Soil protection, tourism, hunting, carbon sequestration, water cycle regulation, biodiversity, fire prevention (shrub control), and organic Matter improvement.		
Experimental sites for the project? Where?	It is going to be used as a demonstration site; a possible site at N 40° 26' 10.56'' and E 21° 29' 39.56''		
Photographs			


Basic agroforestry system information				
AF system ID	407	Name	Intercropping of poplar and walnut trees with cereals and beans	
	 <p>Images available at: https://www.flickr.com/photos/agforward/15845410635/ https://www.flickr.com/photos/agforward/15659613007/ https://www.flickr.com/photos/agforward/15843365751/</p>			
AF System contact	Name	Konstantinos Mantzanas	Email	konman@for.auth.gr
References (5 to 10)	<p>Dupraz C., Burgess P., Gavaland A., Graves A., Herzog F., Incoll L., Jackson N., Keesman K., Lawson G., Lecomte I., Liagre F., Mantzanas K., Mayus M., Moreno G., Palma J., Papanastasis V., Paris P., Pilbeam D., Reisner, Y., Vincent G., Werf Van der W., 2005. Synthesis of the Silvoarable Agroforestry For Europe project. INRA-UMR System Editions, Montpellier, 254 p.</p> <p>Graves, A.R., P.J. Burgess, F. Liagre, A. Pisanelli, P. Paris, G. Moreno, M. Bellido, M. Mayus, M. Postma, B. Schindler, K. Mantzanas, V.P. Papanastasis and C. Dupraz. 2009. Farmer perceptions of silvoarable systems in seven European countries. In: Agroforestry in Europe: Current Status and Future Prospects (A. Rigueiro-Rodriguez et al., eds.). Springer Science, pp. 69-88.</p> <p>Mantzanas K., E. Tsatsiadis, E. Batianis. 2005. Traditional silvoarable systems in Greece: The case of Askio Municipality. In: Mantzanas K, Papanastasis VP (eds.) Silvoarable systems in Greece: Technical and policy considerations. Laboratory of Rangeland Ecology, Aristotle University, Thessaloniki, Greece, February 2005 (in Greek with English summary).</p> <p>Mantzanas, K., Tsatsiadis, E., Ispikoudis, I., Papanastasis, V.P. 2005. Traditional silvoarable systems and their evolution in Greece. In: Silvopastoralism and Sustainable Land Management (M.R. Mosquera-Losada, J. McAdam and A. Rigueiro-Rodriguez, eds.) CAB International, London, UK, pp. 53-54.</p> <p>Papanastasis V.P. 2005. Silvoarable systems and the European research project SAFE. In: Mantzanas K, Papanastasis VP (eds.) Silvoarable systems in Greece: Technical and policy considerations. Laboratory of Rangeland Ecology, Aristotle University, Thessaloniki, Greece, February 2005 (in Greek with English summary).</p>			
Hypothetical modelling combinations	<p>Poplars with cereals and beans Walnuts with cereals and beans</p>			
Other comments				

6.3.7 Irrigated silvoarable systems in Spain and Portugal

Basic agroforestry system information			
AF system ID	409	Name	Irrigated silvoarable systems in Spain and Portugal
AGFORWARD classification	<input type="checkbox"/>	High Natural and Cultural Value (WP2)	
	<input type="checkbox"/>	High Value Tree Systems (WP3)	
	<input checked="" type="checkbox"/>	Silvoarable (WP4)	
	<input type="checkbox"/>	Silvopastoral (WP5)	
Present location	Central Portugal		
	Galicia (NW Spain)		
Description	<p>Silvoarable systems established with <i>Juglans</i> clone + corn and <i>Prunus avium</i> L. + corn at different densities of plantation and with trees of different age in Spain.</p> <p>An ad-doc experimental plot is being established by a farmer in Portugal under his intensive managed pivot irrigated maize plots. The interest of the innovation is to increase the marginal land around the corners, where the pivot irrigation does not reach. The assessment would estimate the yield of the trees which seem to progress at a potential yield. Different species were planted, including black walnuts and wild cherry.</p>		
Stakeholder report	<p>Mosquera Losada MR, Ferreiro-Domínguez N, Fernández Lorenzo JL, González-Hernández P, Rigueiro Rodríguez A (2014). Initial Stakeholder Meeting Report Silvoarable Systems in Spain. 29 October 2014. 8 pp. Available online: http://www.agforward.eu/index.php/en/silvoarable-systems-in-spain.html</p> <p>Moreno G (2014). Initial Stakeholder Meeting Report Grazing and intercropping of plantation trees in Spain. 17 September 2014. 12 pp. Available online: http://www.agforward.eu/index.php/en/grazing-and-intercropping-of-plantation-trees-in-spain.html</p>		
Research protocol report	<p>Mosquera Losada MR, Ferreiro-Domínguez N, Fernández Lorenzo JL, González-Hernández P, Rigueiro Rodríguez A (2015). Research and Development Protocol for Silvoarable Systems in Galicia, Spain. 28 March 2015. 6 pp. Available online: http://agforward.eu/index.php/en/silvoarable-systems-in-spain.html</p>		
Area occupied (estimation)	Unknown		
Soil type	Humic cambisol		
Common/typical tree species	<i>Juglans</i> clones and <i>Prunus avium</i> L.		
Common/typical crop species	Corn, wheat, barley and triticale.		
Common/typical animal species			
Products	<p>From Trees: timber and fodder</p> <p>From undercover: cereals</p>		
Economic interests	Growing high quality trees in association with arable crops may improve the sustainability of farming systems, diversify farmers' incomes and provide new products to the wood industry		
Other services	Soil protection, novel landscapes of high value, carbon sequestration, water cycle regulation, organic matter improvement		
Experimental sites for the project? Where?	<p>Boimorto (A Coruña, Galicia, NW Spain)</p> <p>39°50'56"N 4°28'03"W (Spain)</p> <p>Quinta da Cholda (Portugal)</p>		

Basic agroforestry system information			
AF system ID	409	Name	Irrigated silvoarable systems in Spain and Portugal
Photographs	 <p>Images available at: https://goo.gl/photos/dJGELdAPQcru66V98 https://flic.kr/p/q9WiEs https://flic.kr/p/qcaiAs</p>		
AF System contact	Name	João Palma, Maria Rosa Mosquera Losada (USC) Gerardo Moreno (UEX)	Email
References (5 to 10)			
Hypothetical Modelling combinations	<i>Prunus avium</i> L. + corn <i>Juglans</i> clon + corn <i>Juglans</i> clon + wheat, barley or triticale		
Other comments			

6.3.8 Alley cropping with *Eucalyptus* for biomass production in Portugal

Basic agroforestry system information				
AF system ID	413	Name	Alley cropping with <i>Eucalyptus</i> for biomass production in Portugal	
AGFORWARD classification	<input type="checkbox"/>	High Natural and Cultural Value (WP2)		
	<input type="checkbox"/>	High Value Tree Systems (WP3)		
	<input checked="" type="checkbox"/>	Silvoarable (WP4)		
	<input checked="" type="checkbox"/>	Silvopastoral (WP5)		
Present location	Ribatejo and Estremadura regions (Portugal)			
Description	<p>In Portugal <i>Eucalyptus globulus</i> is managed as a forest specie for pulp production. Due to an increase demand of wood biomass, it is being increasingly being considered for biomass production.</p> <p>The production of wood biomass is being made in two alternative management regimes: high tree density forest stands and agroforestry areas installed in agriculture or marginal land. In this last alternative, tree biomass production is being made simultaneously with the production of leguminous crops (e.g. chickpea) or animal grazing in improved pastures. The last system described is practiced in e.g. Brazil, but it is still new and in need of evaluation under temperate/Mediterranean climates.</p>			
Stakeholder report				
Research protocol report				
Area occupied (estimation)	Unknown			
Soil type	For combination with leguminous crops: deep and fertile agriculture soils, well drained.			
	For combination with animal grazing: low demand			
	Other: prefers soils with a low limestone rate			
Common/typical tree species	<i>Eucalyptus globulus</i>			
Common/typical crop species	Leguminous species (e.g. chickpea)			
Common/typical animal species	Cows and/or sheep			
Products	Biomass, crops, animal products			
Economic interests	To maximize the water use available from the irrigation canal and to produce biomass and pasture			
Other services				
Experimental sites for the project? Where?	To be installed in Coruche (2015/2016)			
Photographs	Examples in Brazil			
	 <p>Images available at: http://www.portalacteo.com.br/wp-content/uploads/2012/09/silvipastoril-zoom-9.jpg http://www.boiapasto.com.br/upload/editor/images/ilpf%2057%281%29.jpg</p>			
AF System contact	Name	Joana Amaral Paulo	Email	joanaap@isa.ulisboa.pt
References (5 to 10)				

Basic agroforestry system information			
AF system ID	413	Name	Alley cropping with Eucalyptus for biomass production in Portugal
Hypothetical modelling combinations	Eucalyptus + pasture Eucalyptus + chickpea crop		
Other comments			


6.4 Agroforestry for livestock farmers (Silvopastoral systems)


Fifteen silvopastoral systems were identified during the stakeholder meetings as existing and potential innovations for livestock farmers. The factsheets below describe six of these systems in detail. These include the “Pigs in Energy crops in Denmark”, “Wild cherry pastures in Switzerland”, “Woodland eggs and poultry” and “Woodland cattle” in the UK and the two experimental systems identified in Portugal, “Agroforestry resistant to seedling browsing” and “Agroforestry with carob tree”.

Table 8: Agroforestry systems for livestock farmers: the ID, name, location, contact person and if a stakeholder meeting report and/or a WP6 factsheet was produced.


AF-ID	Name	Location	Responsible	Stakeholder meeting report	WP6 Factsheet
501	Pigs in energy crops in Denmark	Jutland, DK	Anne Grete Kongsted, AU	X	X
502	Wild cherry pastures in France	Aude Department France	Lydie Dufour, INRA		X
503	Woodland eggs and poultry in the UK	UK	Jo Smith, ORC	X	X
504	Woodland cattle in the UK	UK	Jo Smith, ORC	X	X
505	Fodder trees for cattle and goats in the Netherlands	Duinboeren region , NL	Boki Luske, LBI	X	
506	Cherries and chickens in the Netherlands	NL	Monique Bestman, LBI	X	
507	Agroforestry for poultry in the Netherlands	Netherlands	Monique Bestman, LBI	X	
508	Agroforestry for organic poultry and pig production in Denmark	Denmark	Anne Grete Kongsted, AU	X	
509	Agroforestry with pigs in Galicia, Spain	Galicia, Spain	Rosa Mosquera Losada, USC	X	
510	Free-range pigs with Energy Crops, Italy	Veneto region, Italy	Valerio Bondesan, VA	X	
511	Agroforestry with ruminants in France	France	Eric Pottier, ACTA-IDELE	X	
512	Agroforestry with sheep in Galicia, Spain	Galicia, Spain	Rosa Mosquera Losada, USC	??	
513	Agroforestry with ruminants in UK	UK	Jim McAdam, AFBI	X	
514	Agroforestry resistant to seedling browsing in Portugal	Alentejo, Portugal/ France	João Palma		X
515	Agroforestry with carob tree for sheep and goat	South Portugal	Joana Amaral Paulo		X

6.4.1 Pigs in energy crops in Denmark

Basic agroforestry system information			
AF system ID	501	Name	Pigs in energy crops in Denmark
AGFORWARD classification	<input type="checkbox"/>	High Natural and Cultural Value (WP2)	
	<input type="checkbox"/>	High Value Tree Systems (WP3)	
	<input type="checkbox"/>	Silvoarable (WP4)	
	<input checked="" type="checkbox"/>	Silvopastoral (WP5)	
Present location	Jutland, Denmark		
Description	Integrated production of free-range pigs and energy crops. The energy crops are willow and/or poplar. The energy crops are established in paddocks with lactating sows and piglets. The paddocks are organised so that they include two or more rows of poplar/willow in addition to an area with grass clover.		
Stakeholder report	Kongsted AG (2014b). Initial Stakeholder Meeting Report Free-range pigs integrated with energy crops in Denmark. 4 September 2014. Aarhus University, Denmark. 7 pp. Available online: http://www.agforward.eu/index.php/en/free-range-pigs-integrated-with-energy-crops.html		
Research protocol report	Kongsted AG, Hermansen JE (2015). Research and Development Protocol for Agroforestry for Free-Range Pig Production in Denmark. 10 March 2015. 7 pp. Available online: http://www.agforward.eu/index.php/en/free-range-pigs-integrated-with-energy-crops.html		
Area occupied (estimation)	Currently, this concept is practiced on two large-scale organic pig farms with 180 and 900 sows, respectively. On one farm in total 63 ha is used for paddocks for lactating sows where 13 ha are covered with poplar. Each year half of the area is used for sows, whereas the other half is used to grow barley undersown with grass clover. On the other farm, willow is established on a grass clover area of 6.8 ha and willow on a grass clover area of 1 ha.		
Soil type	Podzols		
Common/typical tree species	Poplar		
Common/typical crop species	Grass clover		
Common/typical animal species	Pigs (modern crossbreed Danish Landrace x Yorkshire x Duroc)		
Products	Pigs for slaughter – possible wood for energy purpose		
Economic interests	The revenue from the pigs sale are by far the most important		
Other services	Trees for shadow, alleviation of nitrate leaching to ground water from pigs manure deposition,		
Experimental sites for the project? Where?	Organic pig producer Bertel Hestbjerg, Nr. Feldingvej 100, 7500 Holstebro, Denmark. Organic pig producer Brian Holm, Ulvehøjvej 1, 6650 Brørup, Denmark.		
Photographs			

Basic agroforestry system information			
AF system ID	501	Name	Pigs in energy crops in Denmark
			
	<p>Images available at:</p> <p>www.flickr.com/photos/agforward/15422166920/</p> <p>www.flickr.com/photos/agforward/15421761027/</p> <p>www.flickr.com/photos/agforward/15422167110/</p> <p>www.flickr.com/photos/agforward/15605200701/ (video)</p>		
AF System contact	Name	Anne Grete Kongsted	Email anneg.kongsted@agro.au.dk
References (5 to 10)	<p>Horsted, K, Kongsted, A.G., Jørgensen, U., Sørensen J. (2012). Combined production of free-range pigs and energy crops—animal behaviour and crop damages. <i>Livestock Science</i> 150: 200-208.</p> <p>Kongsted, AG, Jørgensen, U, Sørensen, J & Horsted, K 2011, Combined pig and energy crop production – crop damage and animal behaviour. In: <i>Proceedings in the Third Scientific Conference of ISOFAR: Organic is life knowledge for tomorrow 28 September - 01 October, 2011. Vol 2: Socio-Economy, livestock, Food quality, agro-ecology and knowledge dissemination. 202-205</i></p> <p>SERUP (2012). Farefolde med beplantning til søer på friland. Økologisk Landsforening. 27 pp. [in Danish]</p>		
Hypothetical Modelling combinations	Poplar, grass clover and free-ranged lactating sows (every second year barley undersown with grass clover)		
Other comments			






6.4.2 Wild cherry pastures in France

Basic agroforestry system information				
AF system ID	502	Name	Wild cherry pastures in France	
AGFORWARD classification	<input type="checkbox"/>	High Natural and Cultural Value (WP2)		
	<input checked="" type="checkbox"/>	High Value Tree Systems (WP3)		
	<input type="checkbox"/>	Silvoarable (WP4)		
	<input checked="" type="checkbox"/>	Silvopastoral (WP5)		
Present location	Southern France – Aude Department			
Description	Different tree species planted in 1988 associated with pasture. Two trees densities: 100 trees /ha and 400 trees /ha were compared. A sole crop control and a forestry control were settled. Elevation = 570 m, field on a hillside			
Stakeholder report				
Research protocol report				
Area occupied (estimation)	2 ha on a 56 ha farm			
Soil type	23 % clay, 40 % silt, less than 15 % of stones, pH = 8.4			
Common/typical tree species	Wild cherry (<i>Prunus avium</i>) Other species were tested : Norway maple (<i>Acer platanoïdes</i> L.), Common walnut (<i>Juglans regia</i>), American locust (<i>Gleditsia inermis</i>), <i>Sophora japonica</i> , <i>Paulownia tormentosa</i>			
Common/typical crop species	Permanent grassland			
Common/typical animal species	Sheep (Bizet breed)			
Products	From trees : timber wood when they will be big enough From animals : meat (1.3 to 1.6 lamb/ewe/year)			
Economic interests	Protection of the grass against drought in summer: more green grass in summer. Protection of the animals against heat and cold			
Other services	Carbon sequestration, biodiversity improvement (bats, birds, ...), hunting, water cycle regulation, fire prevention (shrub control), organic Matter improvement			
Experimental sites for the project? Where?	.			
Photographs	 <p>Images available at: https://farm4.staticflickr.com/3935/15347504727_e0734788e1_m.jpg https://farm6.staticflickr.com/5606/15533530155_94ca5f540b_m.jpg</p>			
AF System contact	Name	Lydie Dufour	Email	dufourl@supagro.inra.fr
References (5 to 10)	<p>Dupraz C., 1994. Prospects for easing land tenure conflicts with agroforestry in Mediterranean France: a research approach for intercropped timber orchards. <i>Agrofor. Syst.</i> 25:181 – 192</p> <p>Dupraz C, Imbach C, 1986. Gestion mixte reboisement-pâturage en zone méditerranéenne: un nouvel outil, l'abri-serre. Eds Inra-Lecsa, Montpellier, 102 pp</p>			


Basic agroforestry system information			
AF system ID	502	Name	Wild cherry pastures in France
	<p>Dupraz C, 1987.- Pods of honeylocust (<i>Gleditsia triacanthos</i> L.) as a concentrated feed for sheep in winter. In: Mansat. P (ed) Proceedings of the fifth meeting of the FAt network for range- lands and fodder production, pp 79-85. Montpellier, France</p> <p>Dupraz C, Lagacherie M, 1990.- Culture de feuillus à bois précieux en vergers pâturés sur des terres agricoles du Languedoc-Roussillon: le réseau expérimental APPEL. Forêt Méditerranéenne 12(4): 447-457</p>		
Hypothetical modelling combinations	Wild cherry / grass		
Other comments	Others fields were settled in 1988 in the Languedoc-Roussillon region: APPEL (Aménagements Parcelles Pluristratifiés associant Elevage et Ligniculture) project.		



6.4.3 Woodland eggs and poultry in the UK

Basic agroforestry system information			
AF system ID	503	Name	Woodland eggs and poultry in the UK
AGFORWARD classification	<input type="checkbox"/>	High Natural and Cultural Value (WP2)	
	<input type="checkbox"/>	High Value Tree Systems (WP3)	
	<input type="checkbox"/>	Silvoarable (WP4)	
	<input checked="" type="checkbox"/>	Silvopastoral (WP5)	
Present location	England		
Description	<p>Woodland chicken and egg systems. Sainsbury's first developed its Woodland brand for its free range and SO organic eggs in 2004, with 1p per dozen eggs sold donated to the Woodland Trust. This followed farmer John Widdowson's observations on how his hens preferred the shade and protection of trees. Sainsburys expanded the scheme to include meat birds in 2009, with 2p from every chicken sold donated to the Woodland Trust. All the free Woodland range and organic farms must be:</p> <ul style="list-style-type: none"> - planted with trees which cover at least 20% of the range area where the birds are free to roam outdoors - planted with a mixture of fast growing and slower native trees which are indigenous to the local area - have trees planted close to the house to encourage the hens outside to range - RSPCA Freedom Food standard approved 		
Stakeholder report	<p>Smith J, Vieweger A, Zaralis K (2014a). Initial Stakeholder Meeting Report: Woodland Eggs in the UK. 3 July 2014. Organic Research Centre, UK. 6 pp. Available online: http://www.agforward.eu/index.php/en/Poultry-systemUK.html</p> <p>Smith J, Vieweger A, Zaralis K (2014b). Initial Stakeholder Meeting Report: Woodland Poultry in the UK. 16 May 2014. Organic Research Centre, UK. 5 pp. Available online: http://www.agforward.eu/index.php/en/Poultry-systemUK.html</p>		
Research protocol report	<p>Smith J (2015a). Research and Development Protocol for Poultry Agroforestry Systems in the UK. 15 June 2015. 9 pp. Available online: http://www.agforward.eu/index.php/en/Poultry-systemUK.html</p>		
Area occupied (estimation)	180 farms in the Sainsburys Woodland Egg development group in the Woodland Chicken development group.		
Soil type	Variable		
Common/typical tree species	Mixed species – primarily native broadleaved such as oak, wild cherry, birch, alder, willow, hornbeam, aspen, rowan and field maple		
Common/typical crop species	Perennial rye grass/ Cocksfoot sward		
Common/typical animal species	Layers and broilers		
Products	<p>Meat birds</p> <p>Eggs</p> <p>The trees are not considered as productive components in most systems, but some farmers use woodchip or logs for bioenergy</p>		
Economic interests	<p>In 2013, the Woodland Trust reported the sale of about 400 million woodland eggs through Sainsbury's, equivalent to about 3.4% of the UK market. Other retailers also sell woodland eggs. There is a price premium of £0.15-0.20 per six eggs for woodland eggs.</p>		
Other services	Shelter for poultry		
Experimental sites for the project? Where?	<p>FAI Farm, Oxfordshire, UK. Replicate blocks of agroforestry, forestry and pasture only with layers (broilers possible).</p> <p>On-farm sites possible with the Sainsburys Woodland Egg and chicken development group</p>		

Basic agroforestry system information				
AF system ID	503	Name	Woodland eggs and poultry in the UK	
Photographs	Woodland Eggs, Fairburns Lincolnshire UK https://www.flickr.com/photos/agforward/15061664572/ https://www.flickr.com/photos/agforward/14875439748/ https://www.flickr.com/photos/agforward/14875363450/			
				
				
	Woodland chickens, Hollyfield Farm, Devon UK https://www.flickr.com/photos/agforward/15062019235/ https://www.flickr.com/photos/agforward/15058992971/			
				
AF System contact	Name	Jo Smith	Email	jo.s@organicresearchcentre.com
References (5 to 10)				
Hypothetical modelling combinations	Mixed broadleaf tree species with broilers or layers			
Other comments				


6.4.4 Woodland cattle in the UK

Basic agroforestry system information			
AF system ID	504	Name	Woodland cattle in the UK
AGFORWARD classification	<input type="checkbox"/>	High Natural and Cultural Value (WP2)	
	<input type="checkbox"/>	High Value Tree Systems (WP3)	
	<input type="checkbox"/>	Silvoarable (WP4)	
	<input checked="" type="checkbox"/>	Silvopastoral (WP5)	
Present location	England		
Description	Elm Farm Silvopastoral experimental system, Berkshire UK: short rotation coppice (SRC) (willow <i>Salix viminalis</i>) and alder (<i>Alnus glutinosa</i>) in twin rows, with 24m pasture alleys in between tree rows.		
Stakeholder report	Not available		
Research protocol report	Smith J (2015b). Research and Development Protocol for Agroforestry for Ruminants in in the UK. 2 June 2015. 8 pp. Available online: http://www.agforward.eu/index.php/en/agroforestry-with-ruminants-uk.html		
Area occupied (estimation)	3.5 ha		
Soil type	Wickham series, changing from heavy clay loam at top of slope to sandy loam at bottom		
Common/typical tree species	SRC species: Willow (<i>Salix viminalis</i>) and Alder (<i>Alnus glutinosa</i>)		
Common/typical crop species	Perennial rye grass Cocksfoot		
Common/typical animal species	Cattle (dairy young stock and beef)		
Products	Woodchip for bioenergy; tree fodder for livestock Silage Dairy (indirectly) and beef		
Economic interests	Experimental system so no economic interests currently		
Other services	Biodiversity support including for functional biodiversity such as pollinators and natural pest control; soil protection (reduce waterlogging, soil fertility, soil structure); shelter for livestock		
Experimental sites for the project? Where?	As described above. Replicated plots 50 m x 50m, each containing 3 tree rows (twin rows of SRC trees, planting densities are 0.7m between twin rows and 1.0m within rows 100 trees per 50 m strip), and 2 pasture alleys. Three species treatments: willow only, alder only, and mixed willow and alder. Three replicates of each treatment, plus three replicates of control (no trees, pasture only). Planted 2011, low rate of establishment so replanted 2012.		
Photographs			

Basic agroforestry system information				
AF system ID	504	Name		Woodland cattle in the UK
	 			
	Images available at: https://www.flickr.com/photos/agforward/14875441878/ https://www.flickr.com/photos/agforward/14875472087/ https://www.flickr.com/photos/agforward/15062016535/ https://www.flickr.com/photos/agforward/14875361450/			
AF System contact	Name	Jo Smith	Email	jo.s@organicresearchcentre.com
References (5 to 10)	Smith J, Leach K, Rinne M and Kuoppala K. (2012). Integrating willow-based bioenergy and organic dairy production – the role of tree fodder for feed supplementation. In: Rahmann, Gerold and Godinho, D (Eds.) Agriculture and Forestry Research (362), pp. 394-397			
Hypothetical Modelling combinations	SRC willow with pasture SRC alder with pasture SRC mixed alder/willow with pasture SRC willow with livestock SRC alder with livestock SRC mixed alder/willow with livestock			
Other comments	We have been recording productivity and species composition of the pasture prior to a silage cut in June every year since 2011, microclimate monthly, and tree establishment annually. There are plans to introduce cattle for the first time this autumn.			

6.4.5 Agroforestry resistant to seedling browsing in Portugal

Basic agroforestry system information			
AF system ID	514	Name	Gleditsia silvopastoral system
AGFORWARD classification	<input type="checkbox"/>	High Natural and Cultural Value (WP2)	
	<input type="checkbox"/>	High Value Tree Systems (WP3)	
	<input type="checkbox"/>	Silvoarable (WP4)	
	<input checked="" type="checkbox"/>	Silvopastoral (WP5)	
Present location	Centre and southern Portugal		
	Greece		
	France		
Description	<p>Honey Locust (<i>Gleditsia triacanthos</i>) is leguminous tree, having a deep taproot growing down 3-6 m deep and few lateral roots that make it suitable for agroforestry systems. Furthermore, in young plants, stems bear very large, flat thorns and the young trees form very dense thorny thickets, providing defence to animal browsing, where coppice regrowth and pods are a valuable fodder. It begins bearing pods 3 years after planting and it can produce 20-75 kg pods/tree within 8 years. However this system is underutilized.</p> <p><i>Gleditsia triacanthos</i> by nature has small, sparse foliage and a long period of leaf retention. The root system develops from a central taproot that can extend downward to 3-6 m permitting the tree to absorb water and nutrients of great depths. Moreover, it usually has fewer lateral roots than many other potential agroforestry trees, which minimizes its competition with the companion crop.</p> <p>These characteristics makes honeylocust interesting for inclusion in agroforestry systems. It succeeds on most soils, so long as they are well drained and can grow on nutritionally poor soils This species likes long hot summers and may thus not produce well in maritime climates. Research findings (Dupraz and Newman 1997) show the potential of <i>Gleditsia triacanthos</i> as a fodder tree for ruminants. It is estimated that on a deep soil with high water resources, an orchard at 200 trees/ha may produce about 2 ton of pod dry matter at age 10 years (Dupraz and Newman 1997). Trees show an alternate bearing pattern and some varieties are in opposite phases, making a mixture of clones necessary to achieve sustained yields.</p> <p>It is intolerant to shading, resistant to drought and highly resistant to flooding. Highly sensible to fire due to its thin bark.</p> <p>Young leaves of <i>Gleditsia</i> have a forage value near the values of Lucerne</p> <p>In central and southern Portugal it can be found along streets and roads and also in properties and cultures divisions</p>		
Stakeholder report	Not available		
Research protocol report	Not available		
Area occupied (estimation)	Unknown		
Soil type	It can grow on dry, sandy soils, but it doesn't develop on heavy or rocky soils. In the Mediterranean areas it needs moist, fertile and deep soils.		
	It is resistant to lime and salinity		
	Tolerates acid and alkaline soils		
Common/typical tree species	<i>Gleditsia triacanthos</i>		
Common/typical crop species	Natural or improved pasture		
Common/typical animal species	Sheep, Cattle,		
Products	Wood, fodder and pods for animal feeding, hedges (due to its thorns)		
Economic interests	Livestock weight gain		
Other services	Improvement of soil nitrogen (it's a leguminous tree)		

Basic agroforestry system information				
AF system ID	514	Name	Gleditsia silvopastoral system	
Experimental sites for the project? Where?	No			
Photographs	 <p>Sources: http://www.feedipedia.org/sites/default/files/images/gleditsia_triacanthos_thorns.JPG http://www.feedipedia.org/sites/default/files/images/gleditsia_triacanthos_seed_pod.jpg https://upload.wikimedia.org/wikipedia/commons/e/e1/ComputerHotline_-_Gleditsia-triacanthos-3_%28by%29.jpg https://www.google.com/maps/@39.0219293,-7.0789401,3a,75y,321.16h,88.94t/data=!3m6!1e1!3m4!1soy4ApRt0i2XiPsK-cirHXA!2e0!7i13312!8i6656</p>			
AF System contact	Name	João Palma	Email	joaopalma@isa.ulisboa.pt
References (5 to 10)	<p>Dupraz, C. and S.M. Newman. 1997. Temperate agroforestry: the European way. In: A.M. Gordon and S.M. Newman. Temperate agroforestry systems. CAB International. Wallingford, U.K.</p> <p>Postma M., 2005. It's all in the mix – Agroforestry, a prospective land use system for the Netherlands. Mémoire Master : Plant Production System, Wageningen University and Research, Netherlands, 212 p</p> <p>Bruno-Soares AM, Pereira BM, Abreu JM, 2002, Gleditsia triacanthus – Leguminosa Arbórea com interesse forrageiro. Caracterização química e nutricional. Pastagens e forragens 23, 53-67</p>			
Hypothetical Modelling combinations	Gleditsia with pasture. Estimate the carrying capacity including fodder from leaves and pods			
Other comments				

6.4.6 Agroforestry with carob tree for sheep and goat

Basic agroforestry system information			
AF system ID	515	Name	Agroforestry with carob tree for sheep and goat
AGFORWARD classification	<input type="checkbox"/>	High Natural and Cultural Value (WP2)	
	<input type="checkbox"/>	High Value Tree Systems (WP3)	
	<input type="checkbox"/>	Silvoarable (WP4)	
	<input checked="" type="checkbox"/>	Silvopastoral (WP5)	
Present location	Lower Alentejo (e.g. Mértola council) and Algarve regions		
Description	Carob tree is native of the Mediterranean region. In the inland mountain region of Algarve, it is traditionally present in an agroforestry system currently affected by a degree of abandonment. Main purpose is seeds production, for human and/or animal consumption, combined with pasture.		
Stakeholder report	Not available		
Research protocol report	Not available		
Area occupied (estimation)	Approximately 11000 ha (IFN6) distributed in: pure stands and mixed stands with other tree species for fruit production (olive trees, <i>Prunus</i> spp, and <i>Ficus</i> spp)		
Soil type			
Common/typical tree species	<i>Ceratonia siliqua</i>		
Common/typical crop species			
Common/typical animal species	Sheep and goats		
Products	Fruit for animal consumption, fruit for human consumption, animal products.		
Economic interests	Increase production in marginal and low productive rural land.		
Other services	Soil protection: reforestation of poor, shallow soils, affected by erosion and/or wild fires.		
Experimental sites for the project? Where?	No		

7 Final considerations

This report summarises data collected on some of the agroforestry systems being examined in the AGFORWARD project. The report provides information which can be used in the modelling tasks of the project in work-package 6. The report includes a wide variety of traditional and innovative agroforestry systems around Europe, and this variety reinforces the need for a modelling approach that can address a wide range of variability.

The inclusion of a "Hypothetical modelling combinations" section is useful, together with the results from Milestone 27 (Palma et al. 2015), the modelling scenarios that are going to be developed and presented in deliverable 6.18. This report also help to identify further data requirements that are needed for modelling. These will be collected during close-to-partners modelling workshops, and presented in future reports.

8 Acknowledgements

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9 References

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- Hermansen JE, Kongsted AG, Bestman M, Bondesan V, Gonzalez P, Luske B, McAdam J, Mosquera-Losada R, Novak S, Pottier E, Smith J, van Eekeren N, Vonk M (2015) Agroforestry Innovations to be evaluated for Livestock Farmers - AGFORWARD Milestone 5.2 (MS21) report.
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<http://www.agforward.eu/index.php/en/agroforestry-innovations-to-be-evaluated-for-arable-farmers.html>
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Annex A. Source of data and contact for each agroforestry system

AF-ID	Stakeholder meeting	Fact Sheet	Contact	Email
201	X	X	Joana Amaral Paulo, João Palma, ISA, Portugal	joanaap@isa.ulisboa.pt joaopalma@isa.ulisboa.pt
202	X	X	Paul Burgess, CRAN, UK	p.burgess@cranfield.ac.uk
203	X		Gerardo Moreno, UNEX, Spain	gmoreno@unex.es
204	X	X	Anastasia Pantera, TEI, Greece	pantera@teiste.gr
205	X		Antonello Franca, CNR-ISPAAM, Italy	a.franca@cspm.ss.cnr.it
206	X	X	Jaconette Mirck and Penka Tsonkova, BTU, Germany	jmirck@tu-cottbus.de penka.tsonkova@tu-cottbus.de
207	X		Erik Valinger SLU-EFI, Sweden	erik.valinger@slu.se
208	X		Andrea Vityi and Anna Varga NYME, Hungary	vityi.andrea@emk.nyme.hu varga.anna@gmail.com
209	X		Tibor Hartel UBB, Romania	hartel.tibor@gmail.com
210	X		Claudine Thenail and Valérie Viaud, INRA- Rennes, France	Claudine.thenail@rennes.inra.fr Valerie.viaud@rennes.inra.fr
211		X	Joana Amaral Paulo,	joanaap@isa.ulisboa.pt
301		X	Jo Smith, ORC, UK.	jo.s@organicresearchcentre.com
302		X	Felix Herzog, Agroscope, CH,	felix.herzog@agroscope.admin.ch
303		X	Lydie Dufour, INRA, FR	dufourl@supagro.inra.fr
304	X	X	Paul Burgess, CRAN, UK.	p.burgess@cranfield.ac.uk
305	X		Adolfo Rosati CRA-OLI, IT.	adolfo.rosati@entecra.it
306	X	X	Anastasia Pantera, TEI, GR and Konstantinos Mantzanas, Aristotle Univ. of Thessaloniki, GR	pantera@teiste.gr konman@for.auth.gr
307	X		Gerardo Moreno, UNEX, SP	gmoreno@unex.es
308	X		Rosa Mosquera Losada, USC, SP	mrosa.mosquera.losada@usc.es
309	X		Anastasia Pantera, TEI, GR	pantera@teiste.gr
310	X	X	Anastasia Pantera, TEI, GR	pantera@teiste.gr
311	X		Nathalie Corroyer, INRA- Normandy, France	nathalie.corroyer@seine-maritime.chambagri.fr
312	X		Jim McAdam, AFBI, UK.	jim.mcadam@afbini.gov.uk
313		X	Felix Herzog, Agroscope, CH,	felix.herzog@agroscope.admin.ch
314	X		Nina Malignier , AFAF, France	rd@agroforesterie.fr
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Annex B. Stakeholder and protocol reports covering systems which may be added to the database

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