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Feasibility study of Agroforestry systems in Lille-South water catchment area

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Table of content

Introduction. **1**

Chapter 1. Context of the study **3**

1.1 Agroforestry as a new paradigm 3

1.2 Agroforestry and protection of water resources 7

1.3 State of the art in terms of feasibility studies on agroforestry adoption 10

1.4 Agroforestry in Nord-Pas-de-Calais? 13

Chapter 2. Material and methods **18**

2.1 Problematic, objectives and research questions. 18

2.2 Study area and sampling 20

2.3 Methodological approach 22

Chapter 3. Results **29**

3.1 Sample presentation 29

3.2 Farmers' perception of trees and agroforestry systems 38

3.3 Farmers' typology according to the level of acceptance of AFS 41

3.4 Factor analysis of acceptation 44

3.5 Synthesis on the hypotheses 58

3.6 What do agricultural technicians think about agroforestry? 60

Chapter 4. Discussion **61**

4.1 Discussion about the method 61

4.2 Discussion about the results 64

4.3 Action plan 70

Chapter 5. Conclusion **72**

References.... .... **73**

List of abbreviations

AEM: Agri-environmental Measure

AF: Agroforestry

AFS: Agroforestry systems

CAP: Common Agricultural Policy

ICRAF: International Centre for Research in Agroforestry

ISA: Higher Institute of Agriculture

INRA: National Institute for Agriculture Research

NPDC: Nord-Pas-de-Calais region

PEA: Program for Water and Agriculture

PCA: Principal Component Analysis

UAA: Utilized Agricultural Area

SCOT: Territorial Coherence Program

SAFE: Silvoarable Agroforestry For Europe [project]

SAFER: Society for land tenure management and rural settlement

SOM: Soil Organic Matter

WCA: Water Catchment Area

WFD: Water Framework Directive

List of Tables

Table 1: Review of previous feasibility studies on agroforestry systems**Erreur ! Signet non défini.**
Table 2: Characteristics of Nord-Pas-de-Calais land use ....**Erreur ! Signet non défini.**
Table 3: The level of acceptance of agroforestry systems. H: Hedge; AF: intra-plot agroforestry (Adapted from Grandgirard et al 2012). ....**Erreur ! Signet non défini.**
Table 4: Example of the statistical analysis on statements sorting and Sparkline charts of means. M=mean; SE=standard error; 0=number of zeroes; P-set=all farmers; KW (p) =results of the Kruskall-Wallis test ....**Erreur ! Signet non défini.**
Table 5: Summary of the interview request ....**Erreur ! Signet non défini.**
Table 6: The level of acceptance of agroforestry systems. H: Hedge; AF: intra-plot agroforestry (Adapted from Grandgirard et al 2012). ....**Erreur ! Signet non défini.**
Table 7: Reminder of the hypotheses ....**Erreur ! Signet non défini.**
Table 8: Synthesis of the hypotheses...**Erreur ! Signet non défini.**
Table 9: List of the agricultural technicians met during the survey ....**Erreur ! Signet non défini.**
Table 10: Comparison of the results with other studies. AFS= agroforestry systems, env. = environment ....**Erreur ! Signet non défini.**
Table 11: Objectives, tools and target population for the territorial animation of the project on Lille-South water catchment area..**Erreur ! Signet non défini.**

List of Figures

Figure 1: Classification of agroforestry systems based on the type of components. Agrisilviculture - crops (including shrubs/vines) and trees. Silvopastoral - pasture/animals and trees. Agrosilvopastoral - crops, pasture/animals and trees. Adapted from Nair 1985 .... **Erreur ! Signet non défini.**

Figure 2: [left] orchard-meadow system (source: www.agroforesterie.fr) [right] hedgerows system (source: www.cartesfrance.fr) .... **Erreur ! Signet non défini.**

Figure 3: The Catchlight multi-functionnal alley cropping system combines perennial switchgrass with traditional loblolly pine for solid wood products and biofuels production. Source: Garrett et al. 2011 .... **Erreur ! Signet non défini.**

Figure 4: Representation of the Land Equivalent Ration (LER). The plot on the top represents an agroforestry plot with the associated production (wheat and wood). The plot on the bottom represents the equivalent surface needed to obtain the same production in separated productions. Source: Liagre and Dupraz, 2008 .... **Erreur ! Signet non défini.**

Figure 5: Trees and crops root systems in agroforestry. .... **Erreur ! Signet non défini.**

Figure 6: Water cycle in agroforestry.. **Erreur ! Signet non défini.**

Figure 7: Percentage of farmers attracted by a silvoarable project according to the regions Source: SAFE 2005.. **Erreur ! Signet non défini.**

Figure 8: Location of Nord-Pas-de-Calais region .... **Erreur ! Signet non défini.**

Figure 9: Evolution of the number and the surface of farms between 1970 and 2008 in Nord-Pas-de-Calais region. Adapted from Agreste 2009. .... **Erreur ! Signet non défini.**

Figure 10: Technical-economical type of farms in Nord-Pas-de-Calais. Adapted from Agreste 2010 .... **Erreur ! Signet non défini.**

Figure 11: Land use in the Nord-Pas-de-Calais region, compared to the National and European land use. Adapted from Agreste 2008. .... **Erreur ! Signet non défini.**

Figure 12: Types of areas gained by urbanization. Adapted from DIREN 2008.**Erreur ! Signet non défini.**

Figure 13: Land use in Lille-South Water Catchment Area. Adapted from Studeis 2011**Erreur ! Signet non défini.**

Figure 14: External factors to the development of agroforestry. In red: potential brakes, in green: potential levers. .... **Erreur ! Signet non défini.**

Figure 15: Diagram illustrating the methodological approach of the study ..... **Erreur ! Signet non défini.**

Figure 16: Statistical approach used to explain the acceptability of agroforestry systems according to farmer's characteristics. env. = environment; AFS = agroforestry systems...... **Erreur ! Signet non défini.**

Figure 17: Age groups distribution .... **Erreur ! Signet non défini.**

Figure 18: Location of the farms during the survey... **Erreur ! Signet non défini.**

Figure 20: Presence of a successor for the farm.. **Erreur ! Signet non défini.**

Figure 19: Age groups distribution .... **Erreur ! Signet non défini.**
Figure 21: UAA of farms .... **Erreur ! Signet non défini.**
Figure 22: Soils issues... **Erreur ! Signet non défini.**
Figure 23: Land-use in the sample area.. **Erreur ! Signet non défini.**
Figure 24: Land-tenure status (% of fields' area).. **Erreur ! Signet non défini.**
Figure 25: Agricultural leases (% of farmers)... **Erreur ! Signet non défini.**
Figure 26: Land pressure perceptions .... **Erreur ! Signet non défini.**
Figure 27: Technical orientation of farms.. **Erreur ! Signet non défini.**
Figure 28: Agricultural production method.. **Erreur ! Signet non défini.**
Figure 29: Farms' turnover classes .... **Erreur ! Signet non défini.**
Figure 30: Farmers' involvement in groups of farmers and reasons explaining the involvement .. **Erreur ! Signet non défini.**
Figure 31: Sources of technical information .... **Erreur ! Signet non défini.**
Figure 32: Farmers' feeling about environmental categorization .... **Erreur ! Signet non défini.**
Figure 33: Motivations for the adoption of agricultural innovations. Total number of occurrences = 44 .... **Erreur ! Signet non défini.**
Figure 34: Brakes to the adoption of agricultural innovations. Total number of occurrences=35.. **Erreur ! Signet non défini.**
Figure 35: Farms' types .... **Erreur ! Signet non défini.**
Figure 36: Woody elements present on farms .... **Erreur ! Signet non défini.**
Figure 37: Farmers' knowledge about agroforestry systems and if so, the source of information.. **Erreur ! Signet non défini.**
Figure 38: Motivations for the implementations of agroforestry systems; Total number of occurrences = 53; env: environmental.. **Erreur ! Signet non défini.**
Figure 39: Brakes for the adoption of agroforestry systems; Total number of occurrences = 107 . **Erreur ! Signet non défini.**
Figure 40: Brakes and motivations toward agroforestry systems as perceived by farmers**Erreur ! Signet non défini.**
Figure 41: Farmers' prospect of implementing agroforestry systems on their fields**Erreur ! Signet non défini.**
Figure 42: Acceptation of the different types of agroforestry projects .... **Erreur ! Signet non défini.**
Figure 43: Farmers' typology according to their level of acceptation of agroforestry systems. ..... **Erreur ! Signet non défini.**
Figure 44: Average Utilized Agricultural Area (ha) and Workload (ha/Human Work Unit) for each level of acceptation of agroforestry.. **Erreur ! Signet non défini.**
Figure 45: Level of acceptation of agroforestry systems according the farm's financial health.... **Erreur ! Signet non défini.**

Figure 46: Synthesis of the factors influencing the acceptation of agroforestry systems in the study area, for each level of analysis .... **Erreur ! Signet non défini.**

Introduction

Since several years, agroforestry systems have gained interest in the agricultural professional sector. This agroecological practice, which combines trees and crops or livestock on the same land, was gradually marginalized over time. However, agroforestry systems have been revived thanks to the last scientific studies and recent favorable regulations. New forms of agroforestry, adapted to the modern agricultural constraints, have emerged.

The overall biomass production of an agroforestry system is higher than its two components grown separately but besides improved production, it also provides numerous agro-environmental services that are of interest for public authorities. When it comes to water resource protection, agroforestry has captured the interest of water agencies and watershed managers because it promotes a better management of the resource and limits diffuse pollutions from agriculture on the long term.

The Nord-Pas-de-Calais (NPDC) region has a high agricultural potential which makes it one of the first agricultural region in France for cash crops. On the other hand, the region suffers from increasing soil erosion and is classified as vulnerable in terms of nitrates. In addition, agriculture in the region suffers from the urban expansion and the regional council aims to increase the wooded area. Agroforestry appears to be a suitable solution to deal with these environmental and societal issues.

In this context, the Regional Council aims to support the development of agroforestry systems. The objective is to foster the emergence of agroforestry projects during 3 years (2013 to 2015), particularly within sensitive areas such as priority water catchment basins[1]. The present study will focus on the **Water Catchment Area of Lille-South** which is managed by the LMCU[2].

Eventually, this master thesis focuses on studying the conditions for the adoption of agroforestry by farmers, in a water catchment area where environmental issues are higher than average. This feasibility study is necessary to engage the dialogue with professional organizations. The breaks and levers farmers address will serve for coming development plans. In this development framework, on a voluntary basis, the acceptability of an innovative practice

[1] Priority catchments are selected according to their vulnerability in terms of water quality indicators (nitrates, pesticides, heavy metals…) and to their strategic positions (often priority catchments are providing water to big city) and they are given a particular attention.
[2] LMCU: Urban Community of Lille-Metropolis.

can be limited by different factors. Understanding brakes and motivations towards agroforestry systems is necessary to develop animation programs. Collecting farmers' viewpoints enables to orientate the development actions or communication to better fit local needs.

We can then come up with the following questions: What are the farm types in the study area? What is the interest of farmers towards innovative practices? What are their levels of knowledge about agroforestry? What are the conditions that favor (or disfavor) the development of agroforestry in this water catchment area? What are the development prospects for agroforestry projects?

In order to address these questions, the study is organized around four parts:

The first part focuses on the agricultural and socio-economical context of the study. We will develop the main characteristics of regional agriculture and issues regarding the land-use. We will also describe the main advantages and disadvantages of agroforestry systems and the previous studies about agroforestry's adoption.

The second part deals with the methodological approach and the means implemented to carry out the study. We will see how were structured the sample, the survey grids, the Q-method and the data analysis.

The third part presents the main results of the study. We will describe the main features of farming systems in the area, as well as farmers' perception towards innovative practices and specifically agroforestry. We will also identify a typology of farmers in order to establish farmers' profiles that are more or less favorable for agroforestry systems. Complemented with technicians' advices, this part also aims to identify agroforestry systems that could be more suitable to the local context.

The last part will discuss, through the highlighted results, the main ways to develop the animation of the territory, in order to promote the development of agroforestry practices that are adapted to local issues.

Chapter 1. Context of the study

1.1 Agroforestry as a new paradigm

1.1.1 What is agroforestry?

a) Definition

Agroforestry consists of a wide range of practices including the deliberate growing of woody perennials on the same unit of land as agricultural crops and/or animals, either in some form of spatial mixture or sequence. This is the definition adopted by the International Centre for Research in Agroforestry (ICRAF). There are different interspecific interactions between the woody component and the understory component. The desired interactions are positive but some of them can be negative and vary over time (Jose et al. 2004). More broadly, agroforestry systems are part of the agroecological practices (IAASTD 2009; Malézieux 2012).

This definition is broad and led some researchers to classify different agroforestry systems (Nair 1985, Sinclair 1999, Torquebiau 2000). The classification of agroforestry systems according to Nair (1985) is based on the following steps of criteria:

i. **The structural basis**: refers to the nature of the components as well as the spatial and temporal arrangement of these components.
ii. **The functional basis**: refers to the goal of the system, the role of the system, mainly the woody component. It can be productive (food, fodder, firewood…) or protective (windbreak, soil conservation…)
iii. **The socio-economic basis**: refers to the level of inputs and the economic objectives.
iv. **The ecological basis**: refers to the environmental conditions of the systems and his suitability. It is based on the fact that some systems can be more adapted to certain environmental conditions.

Although hundreds of agroforestry systems have been recorded, they can all be classified within three major categories: (i) **Agrisilviculture**: crops (including shrubs/vines) and trees; (ii) **Silvopastoralism**: pasture/animals and trees and (iii) **Agrosilvopastoralism**: crops, pasture/animals and trees (**Figure 1**).

In the Nord-Pas-de-Calais region, the orchard-meadow system and hedgerows (**Figure 2**) are what remains of traditional agroforestry systems. Indeed in Nord-Pas-de-Calais, just as in the rest of France, traditional agroforestry systems have been largely abandoned. Time-consuming tasks have been seen as unprofitable and extension policies have focused on specialization of agriculture. Trees have been uprooted from the fields because they were considered as obstacles to mechanization (Auclair and Cailliez 1994, Dupraz 1994).

b) Modern agroforestry systems: A relic from the past or a bridge to the future?

However, in recent years, the role of tree has been gradually reconsidered. Several measures designed to reintroduce trees within rural landscape have been implemented (Kleijn et al. 2003, Liagre 2005). This allowed to build new agroforestry systems compatible with modern agriculture and mechanization. The silvoarable system, also called alley cropping, comprises widely-spaced trees intercropped with arable crops (**Figure 3**). It is the most widely spread modern agroforestry system. In support of the European Common Agricultural Policy (CAP), the Silvoarable Agroforestry For Europe (SAFE) project provides models and databases for assessing the profitability of such systems, and will suggest unified European policy guidelines for implementing agroforestry.

1.1.2 Interests of agroforestry systems

a) Increased productivity per unit of land

The association of perennial and annual productions turns out to be more productive than both separated productions (Dupraz and Capillon 2005) **(Figure 4).** Then an agroforestry plot will produce 20% to 60% more biomass than a sole crop rotation (Dupraz et al. 2005b). The increased productivity is due to a better use of water, fertilizers and light. Indeed, trees and crops have a complementary use of these growth resources **in time** (difference of maturity) and **in space** (difference soil layers are used).

More than an increase of biomass production, it can be expected a better resilience to hazards, climatic hazard through the creation of a microclimate and the diversification of cultivated plants and market hazards through the diversification of products.

Beyond the productive aspect, farming systems are facing many environmental issues (soil erosion, nonpoint source pollution, biodiversity, use of fossil resources, landscape management…). The next part deals with the environmental benefits of agroforestry systems.

b) Environmental advantages of agroforestry systems

- **Soil quality**

Agroforestry systems (AFS) are known to stimulate below-ground biological activity. Fonte et al. (2010) showed that earthworm population under AFS increased in number and diversity compared to other agrosystems. This likely result from several factors: (i) the large quantity of litter and tree roots which provide food source for soil fauna; (ii) tree canopy and mulch layer regulate temperature and moisture fluctuations (Sanchez et al., 2006).

Amighi et al. (2013) also observed a clear improvement of Soil Organic Matter (SOM) content in agroforestry system in which wheat has been planted in-between olive trees. A spatial heterogeneity in SOM content is also found; the organic matter content is higher under trees alley than under crops. Trees use a greater volume of soil to build up SOM than herbaceous crops, as they are able to explore soils farther from the tree trunk and to a greater depth, assuming small tree density is used (Moreno et al. 2005, cited in Ramachandran Nair et al., 2009). The greater soil volume explored by tree roots enhances belowground organic matter depositions.

- **Biodiversity**

Habitat fragmentation is a direct consequence of modern agriculture and led to a separation between open fields and groves. The lack of connectivity between habitats prevents species' spread (Nair and Garrity 2012). AFS create corridors and improve this connectivity. Through other ecosystem services like the fight against soil erosion and pollution of surface water, agroforestry also helps to protect natural habitats of certain species populations (Jose 2009). Varah et al. (2013) also showed that is has a positive impact on birds and pollinating insects' populations.

- **Climate change**

There are two ways of acting on climate change: **attenuation** and **adaptation** (IPCC 2001). Agroforestry systems bring solutions for both strategies. The **attenuation** strategy deals with the causes of climate change (the accumulation of greenhouse gases in the atmosphere). At local and global scale, AFS have the potential to store carbon dioxide through the production of wood and organic matter and then mitigate global warming (Oelbermann et al. 2004, Montagnini et al. 2004, Mungai et al. 2006). On the other hand, the **adaptation** strategy aims to reduce the impacts of climate change. At a more local scale, AFS have the potential to create a microclimate that has a role of buffer zone in case of climatic hazard.

1.1.3 Attenuating negative ecological interactions

a) Yield

Some studies showed that crop yields are lower next to the tree row compared to the center of the cropped alley in tropical and temperate systems (Miller et al., 2001 cited in Oelbermann et al. 2004; Chander et al. 1998). An increasing density of trees leads to decreased yields of the understory field crops and the greatest crop yield was obtained in the treatment where no trees were planted. However, the resulting decreased yield can be low and can be delayed if the system is well thought, this implies a proper tree density and trees row orientation.

In addition, the decreasing yield should not be associated with a decrease of income. The decrease of the growth margin per hectare (crop sales) on the short term can be compensated in some cases by the trees sale and a decrease of charges.

b) Investment and maintenance costs

Planting trees represents a significant investment cost. The farmer requires enough saving to realize this investment and consider the long-term fields management. In France, the Ministry of Agriculture introduced an agri-environmental measure that provides an incentive for farmers who manage agroforestry systems. The payment compensate for the establishment and the maintenance costs due to the presence of trees (Cf. § 1.3.1).

c) Uncertainty on wood price

Marketing of products from agroforestry systems may be a problem for farmers. Wood, fruits, nuts and other agroforestry products will perhaps be new for farmers and so is the marketing of these products. In comparison with food products, the market chain (buying, transport, processing and selling) of wood products is less organized, especially for small amounts of woods and other non-conventional agroforestry products. Related to the disadvantage of long-term investment, investments in tree planting also means the dependency of future markets.

However, in general it is expected that demands and hence the prices for temperate hardwood will rise in the future. The reasoning behind this is that there is an increasing demand for hardwood, while imports of tropical hardwood will be more and more restricted. There is also the possibility for farmers to valorize trees locally, through timber, ramial chipped wood or firewood.

1.2 Agroforestry and protection of water resources

Water quality preservation has been a major environmental issue during the last decade. Ground and surface water quality are at the heart of concerns whether at the European level or at the local level. In October 2000, the Water Framework Directive[3] (WFD) was established within European Union member states to commit them to achieve good qualitative and quantitative status of all water bodies by 2015. It introduces a legislative approach to managing and protecting water, based not on national or political boundaries but on natural geographical and hydrological formations: river basins. Water quality has been analyzed and each river basin district has to set up an action plan accordingly. The actions plans have been established in 2010 for the period 2010-2015 in each river basin district. They aim to reduce the quantity of polluting agents from human activities. Agriculture is, inter alia, a source of pollution for water bodies. The European Commission (2012) assesses that 60 to 100% of surface water bodies are affected by pollution pressures associated with agriculture (*Appendix 1*).

At the national scale, the Ministry of Ecology, Sustainable Development and Energy has established a list of 500 sensitive Water Catchment Areas (WCA), called "Grenelle Catchments". These catchments were selected according to their vulnerability in terms of water quality indicators (nitrates, pesticides, heavy metals…) and to their strategic positions (often grenelle catchement are providing water to big city) and they are given a particular attention. The WCA of Lille-South is classified has "Grenelle Catchment" (*Appendix 2 and 3*).

[3] Directive 2000/60/EC of the European Parliament and Council establishing a framework for Community action in the field of water policy. (http://ec.europa.eu/environment/water/water-framework/)

1.2.1 Prevention rather than cure

A central argument of reintroducing trees into agricultural landscapes is the fact that conventional agriculture leaks a large amount of water and soils are becoming more and more degraded (Ministry of Health–ARS–SISE-Eaux 2012). The main reason for dropping a water catchment area is linked to the water quality (41% of abandoned water catchment areas), especially nonpoint source pollution (herbicides, pesticides and fertilizers). These WCA are abandoned because polluted water treatment is too expensive and recovering a good water quality is a long term process (Ministry of Agriculture 2013). Generally speaking, it is preferable to take preventive rather than curative measures. This is especially true in catchment areas. The Water Agency (AESN 2011) has studied different scenarios in order to compare preventive measures to curative measures. Results shows that the cost of preventive measures is always lower than curative measures. To summarize, it is necessary to carry out preventive measures through the settlement of sustainable agricultural practices in water catchment areas.

1.2.2 The role of agroforestry

Agroforestry practices can contribute to the sustainability of agriculture, especially in terms of nutrient uptake and water flow management (Dupraz 2011). That is the reason why more and more water agencies are promoting agroforestry as a preventive measure to protect water resources. This part deals with the impacts of agroforestry practices on water management.

a) A more efficient management of water resources

The rooting pattern is critical to the success of water management in agroforestry (Lefroy et al.1999). The ideal tree root development is a small development on topsoil with an extensive lateral distribution below the rooting zone of annual crops (**Figure 5**). This phenomenon is called “natural root-pruning” (Liagre and Dupraz 2008); trees and crops do not delve into the same soil horizon. In addition, the National Institute for Agriculture Research (INRA) observed a windbreaker effect creating a micro-climate which reduces the evapotranspiration during droughts.

b) To fight against soil erosion and run-off

The presence of trees and grass strips can reduce wind and water erosion. It is possible through three principles: (i) they limit runoff; (ii) they favor water infiltration and (iii) they increase soil water storage (**Figure 6**). The alley cropping on slopping lands is particularly interesting to cope with soil erosion and water runoff. Roose et al. (1997) observed that water run-off is significantly reduced by agroforestry systems. The living hedges were able to restrict runoff and erosion risks efficiently on a 23% hillslope. It was not the cover, nor the stumps which have trapped runoff water and sediments, but a litter between hedges stumps made by weeds, crops residues and plants sown between edges.

c) *Toward a more efficient use of nutrients*

Probably the most important point in water catchment area, agroforestry practices reduce nitrogenous diffuse pollution. Dupraz et al. (2011) showed that trees are capable of filtering nitrogenous elements. An agroforestry plantation is able to reduce up to 75% of nutrient leaching[4] throughout the lifespan of trees. This result is based on two processes. First, trees contribute to reduce summer nitrogen mineralization, stimulate denitrifying bacteria and allow to reduce nitrogen inputs through the formation of aboveground and belowground litter. Secondly, trees are able to catch nutrients that are being leached to deep layers of soil (an even directly in the water table). The rooting system of trees operates as a “safety net” which intercepts leached nutrients and makes them rise to the surface. This process is also called the “nutrient pump” (Dupraz et al. 2011).

Finally, agroforestry is a promising practice for local authorities in charge of water protection. In terms of water quality, the return on investments is higher in agroforestry than for organic agriculture and afforestation (Dupraz et al. 2011). In fact, one euro invested in establishing agroforestry systems creates 29€ of water treatment savings, compared to 10€ for organic agriculture and 4€ for buying land and afforest them.

d) *Advantages of agroforestry vs. other inputs reduction measures*

In terms of **input reduction measures,** agroforestry systems can be a good alternative to other practices that are proposed to farmers on water catchment areas (e.g. grass strips, organic agriculture, contracts on reduced use of fertilizers or even afforestation). First, it is a productive establishment: the trees rows produce biomass, in comparison with grass strips. Secondly, it is a

[4] The tree begins to be efficient against nutrient leaching from a quarter of his lifespan. This efficiency is increasing over time. Hence 75% is a mean efficiency throughout the whole lifespan of the tree.

long-term settlement: this allows to fight against water pollution at the source, helping to avoid curative interventions. Thirdly, if the system is well designed, it does not question the actual technical operations of farmers, at plot's scale or at farm's scale. Finally, it allows to maintain the agricultural activity, instead of planting trees on former agricultural lands.

1.3 State of the art in terms of feasibility studies on agroforestry adoption

1.3.1 What determines innovation adoption by farmers?

Until recently, the choice of agricultural innovation available to farmers was largely dominated by the need to increase farm's productivity. Now agriculture has to fulfil diverse objectives: produce agricultural products of high quality while meeting sustainability goals (Viatte 2001 in OECD 2001). In addition to being profitable, farmers need to meet environmental standards and regulations, as well as deal with indirect consumer pressure.

We can differentiate between innovations that are new to the farmer, but already well-established in the sector, innovations that are early in their process of diffusion, and innovations that are new to the farmer's sector (Diederen et al. 2002). In our case, agroforestry systems can be classified as the second type in Nord-Pas-de-Calais.

The way farmers and land users make decisions and plan depends on many interacting variables (*factors*): what they aspire (*objectives*), what they believe to be true about the biophysical and social world (*knowledge and insight*), and what they are *able* and *allowed* to do (Leeuwis and van den Ban 2004). These variables define land user's perception, which in turn will result in certain decisions and actions.

One suitable way to collect the variables needed for the present study (understanding of local practices, social and cultural perceptions of innovations and available tools for enabling change, as well as cultural, economic, or institutional obstacles to such adaptive change) is the **survey** (Caswell 2001 in OECD 2001; Sarker et al. 2009)

An individual's decision to change behavior is a complex function, but one important part of this function is related to the **perception of the new practice (**Greiner et al. 2009; Blackstock et al. 2010; Reimer et al. 2012). A deep understanding of this process can be achieved through the **Q-methodology** (Addams et al. 2000; Previte et al. 2007; Pereira 2011; Forouzani et al. 2013)

1.3.2 State of the art: feasibility studies of agroforestry

During the 90's there was a growing interest on agroforestry research (Buck et al. 1999). First researches in agroforestry focused on understanding the bio-physical processes and the efficiency of such systems. These researches suggest that agroforestry may have potential as a multiple land-use system in temperate areas. However in some cases, the reasons explaining the adoption of agroforestry systems are not only related to the economic and technical aspects, but are also related to **social representations** and **sociological values** (Kamal 2004; Pereira 2011).

When studying the potential of agroforestry as an innovative land-use, it is interesting to analyze what has been done previously and within other territories. Montambault et al. (2005) showed that the number of socio-economic studies on the adoption of AFS is increasing in temperate areas.

So far, several studies have been conducted in Europe. The results of these studies are summarized in the **Table 1**, but this list is not intended to be exhaustive. The review of agroforestry's adoption literature pointed out general opportunities and constraints.

The opportunities are often related to:

i. **Socio-economic factors:** diversification of the income, capitalization, farmers' image in the society.
ii. **Agronomic and environmental factors:** soil conservation, soil fertility, reducing the environmental impact of agriculture, added value for landscape and biodiversity.
iii. **Others to a lesser extent:** animal welfare, experimental approach.

On the other hand, the constraints are often related to:

i. **Socio-economic factors:** loss of annual crop yield, increasing labor and management costs, long-term investments.
ii. **Agronomic and practical factors:** AF is not adapted to mechanization, soils condition, irrigation, drainage, small and fragmented plots.
iii. **Structural factors:** lack of knowledge and skills, lack of local references, land-tenure status, agricultural policies.
iv. **Others:** the age and to a lesser extent the uncertainties about market outlets.

The major reference for agroforestry adoption in Europe is the SAFE[5] project (Liagre et al. 2005) carried out in seven European countries. Overall, they have shown surprising results. Farmers are relatively open to the prospect of adopting agroforestry systems. They found out that one third of farmers are disposed to invest in agroforestry. This result has to be considered according to the regions due to a strong heterogeneity in the answers (**Figure 7**). In Due to cultural differences and farming systems differences, Mediterranean regions farmers are more likely to set up agroforestry than in Northern Countries. But even in some intensive agricultural region, where one cannot observe any trees in the fields, one third of the farmers are interested.

Although the studies have been carried out in temperate climate, they are representative of a local soils, climate conditions, agricultural and social context and then cannot be generalized as a common rule. It merely provides us some general patterns to the adoption of agroforestry practices that are interesting to consider for the present study and more particularly to come up with appropriate theme of study in the questionnaire. The larger context in which a farm operates may influence adoption decisions as well, including the availability of government funds, biophysical and social watershed characteristics, past outreach and commodity prices.

[5] SAFE: Silvoarable Agroforestry For Europe. Seven countries have been involved (Spain, France, England, Italy, Greece, Germany and Netherlands) which represents 14 provinces in total.

1.4 Agroforestry in Nord-Pas-de-Calais?

1.4.1 The project

The present master thesis work was carried out within a project called *"Initiating the development of agroforestry in the Nord-Pas-de-Calais".* This project is part of the **"Plan Forêt Régional"** (Regional Forest Plan), which aims to greatly increase the wooded area in the region. To do so, the regional council finances the development of two types of projects: afforestation of agricultural lands and **agroforestry systems.** The study bureau Agroof[6] has been appointed for the animation of agroforestry projects in the region.

The **objectives** are: (i) to assess the answers agroforestry can bring to local agricultural and environmental issues and (ii) to assist agroforestry projects managers in developing pilot systems and then (iii) to develop a territorial coordination through awareness, technical support and training in order to ensure the durability of this practice in the region.

The **expected agroforestry projects** must comply with the following criteria to be financed:

i. The total area must be greater than 1 hectare.
ii. The trees' density must range from 30 to 200 trees per hectare.
iii. Trees species must be standard fruit trees or forest trees.

If the project complies with these criteria, it is eligible to subsidies (50% for an individual project, 60% for a collective project and 70% for a project located in a "water issue area"). The financial support includes the design, the purchase of related equipment and the initial trees maintenance.

A particular attention is paid to sensitive areas such as priority water catchment basins. Two water catchment areas were previously studied: Escrebieux and Cambrésis. The present study will focus on the **Water Catchment Area of Lille-South** which is managed by the Urban Community of Lille-Metropolis (LMCU).

1.4.2 Nord-Pas-de-Calais: an agricultural region, historically

With low reliefs and very fertile soils, at the crossroads of field crops areas (Belgium and Picardy) Nord-Pas-de-Calais region (**Figure 8**) has developed a **dynamic agricultural activity.**

[6] Agroof: research unit specialized in training and providing technical advices in agroforestry

Regional agriculture is often in the first national ranking for productivity and profitability for several crops (potatoes, beets, chicory, cereals…) and milk production. Moreover, agriculture has a strong urban character: **half of farms are located in an urban or suburban area** (DRDR 2009).

The rainfall lies between 600 mm and 1000 mm in the region and the atmospheric temperature range is between 20°C and 25°C. **This climate allows a high yielding agriculture** but is also favorable to the development of fungal diseases (INSEE 2009). Finally, the decreasing soil organic matter and calcium combined with heavy tillage can also worsen soil erosion due to increased instability of the upper soil layers.

a) Agricultural characteristics

The region is covered with a **homogeneous silty layer**, of aeolien origins, which is 10m depth, giving agricultural lands of excellent quality. Soils are fertile, loose and deep, with a good water reserve. Although they have a high agronomic value and good water retention capacity, they may, in some areas, suffer from intensive use, depleting organic matter (field crops) and locally sensitive to soil erosion and slaking crusts.

Agriculture represents 67% of the regional area. Among this agricultural area, arable lands account for 79% whereas permanent grass area account for 21% (DREAL 2013). During the last decades, agriculture has tended to concentrate, get bigger and specialize, with a **decline of livestock farming** (**Figure 9**).

Between 2000 and 2010, the number of field-crops farms has risen by 9% (it represents 44% in total) to the detriment of livestock farms which have decreased by 13%, from 61% to 52% of total farms (Agreste 2010). The most important crops grown in the region are **wheat, potato, beetroot and fresh vegetables.** Animal production is dominated by cattle and swine. In contrast, sheep and goat farms are very marginal. As a result, the region has focused on dairy cow milk. **Figure 10** describes the main agricultural orientations in the region. In 2010, NPDC region had 13 500 farms and their average size was 61 hectares (INSEE). Like elsewhere, the number of farms keeps on declining (-23% between 2000 and 2010) and consequently farms are getting bigger.

b) An increasing urban pressure…

The Nord-Pas-de-Calais region is one of the most urbanized regions in France. Urban zones represent 17% of the total area whereas natural, agricultural and forest areas represent 83% of the area. The population is 324 inhabitants per km², which is three times higher than the national mean. The population lives in very dense conurbation areas. Detailed characteristics of the region are summarized in **Table 2.**

Due to this increasing urban pressure, the Utilized Agricultural Area has decreased by **2500 ha per year** (Agreste 2010). As we can see in the **Figure 11 and 12**, agriculture is the activity most impacted by urbanization. On the other hand, in Lille area, 1 ha of urban extension is correlated to the creation of 34 households and new jobs (SCOT[7]). Hence there is a real tension regarding land property in the region. In this context, the price of lands has constantly increased, reaching 10,325 €/ha in 2012 which is twice the national mean (SAFER[8] Flandres-Artois).

c) …and some environmental issues

The region suffers from several environmental issues. First, the **soil erosion** is high, due to topographic and climatic conditions, combined with intensive farming and silty soil texture (Le Bissonnais et al. 2001). The region is also classified as **vulnerable** in terms of **nitrates** (Ministry of Ecology, Sustainable Development and Energy 2013). In addition, the underground water quality was assessed as "passable" to "very bad" (AEAP 2009). Finally the regional afforestation rate is the lowest in France (8% compared to the national mean of 27% - *Appendix 4*).

The **Regional Council**, which is led by the Socialist political party together with "Europe Ecology" party, has initiated several development projects, notably the Regional Forest Plan, in order to tackle these environmental issues. However, this "green" policy is facing a strong reaction of the regional agricultural chamber. The conference held on 20th February, with the regional council and the agricultural chamber had been subject of intense debate. Overall, **the agricultural profession** has taken a stand **against the development of agroforestry systems in the region**. The chamber cited a number of arguments for this opposition: (i) the tenant-farming is too high in the region; (ii) agroforestry systems are hardly compatible with key cultures of the

[7] SCOT : Territorial Coherence Program
[8] SAFER: Society for land tenure management and rural settlement

region (potato, beets and industry vegetables); (iii) agriculture is losing almost 2000 ha of arable lands per year and (iv) there is no local reference of modern agroforestry systems.

1.4.3 The specific context of Lille-South area

All the characteristics of the Nord-Pas-de-Calais region we have seen previously are exacerbated in the context of Lille-South area.

a) Water quality

The territory of the water catchment area of Lille-South covers the place of extraction of nearly **40% of the drinking water resource** within the LMCU. Every year, the 49 exploited wells draw more than 42 million m^3 of water from the aquifer of the chalk layer. The *Appendix 5* presents the available data on extracted water quality. Three types of substances have been identified during the measurement campaigns: the Nickel (Ni), Nitrates (NO_3) and organic molecules from agriculture. 19 catchments are likely to exceed the threshold of drinkable water for Nitrates (50mg/L) and for Nickel (20 mg/L). Regarding the organic molecules from agriculture, only traces were detected.

b) A peri-urban agriculture

Established in 1968, LMCU remains today one of the largest Metropolis in France with 1,106,885 inhabitants and a population density of 1,785 inhabitants per km^2. At the same time, it inherits the reference to “the most agricultural metropolis of France”. Experiencing a strong urban pressure, the territory is occupied LMCU for nearly half (44%) in agriculture. Agricultural activity also appears as the third pillar of the metropolitan economy.

Between May 2010 and February 2011, and agricultural diagnosis was carried out by the study bureau Studeis. This work allows us to have a general picture of the local agricultural context. The majority of **soils** are deep silt soils (chalky or not). The **farming systems** are mainly polyculture farm (wheat, potato and sugar beet) with few livestock farms (meat and dairy products). The average **farm size** is 66 ha, with an average plot size of 3.7 ha.

The land-use is given in **Figure 13;** there is a clear dominance of wheat, potato and sugar beets. The silage maize and prairies are used by breeders. The crop rotation is complemented with corn, chicory and industry vegetables (peas and beans).

However this study, done by studies, does not provide precise information, on farmers' decisions making scheme neither on their technical practices, which are needed when we need to develop action plans.

c) Farmers solicited and hesitant

Behind this global picture of the agricultural context, this metropolitan agriculture remains subject to many tensions, the LMCU has to do strategic choices regarding land use planning. In economic matters, the LMCU desires "to support the agricultural sector, including high added value productions (market garden, horticulture, organic farming) and support the development of short food channels". They also signed a charter with the Chamber of Agriculture to value agricultural lands and reduce the consumption of agricultural lands in the planning.

Generally speaking, there is a historical conflict between the agricultural profession and public authorities. Farmers feel that they are stigmatized as the single source of water pollution and are reluctant to endure new regulatory constraints. This aspect makes territorial actions even more challenging.

Finally…

All the territorial stakeholders must combine their actions with divergent objectives: the **economic development** (urban expansion), the increase of **wooded areas,** the improvement of **water quality** and the conservation of **arable lands**. Agroforestry appears to be a suitable compromise in order to meet each stakeholder's needs in the best possible way. However agroforestry systems are poorly developed in the area at the moment. It is then essential to carry out a prospective study which would assess the concrete development potential of agroforestry systems (**Figure 14**).

What are farmer's perceptions towards new farming practices?

What would determine the adoption of agricultural innovations such as agroforestry?

Chapter 2. Material and methods

2.1 Problematic, objectives and research questions.

2.1.1 Problematic

All the territorial stakeholders must combine their actions with divergent objectives: the **economic development** (urban expansion), the increase of **wooded areas,** the improvement of **water quality** and the conservation of **arable lands**. Agroforestry appears to be a suitable compromise in order to meet each stakeholder's needs in the best possible way. However agroforestry systems are poorly developed in the area at the moment, indeed very few farmers are engaged and the agricultural circle clearly disapproves this type of land use.

In previous feasibility studies (SAFE), it was shown that, in opposition with the common posture from mainstream agricultural circle, farmers are prompt to imagine agroforestry on their fields. To initiate the development of agroforestry in the present water catchment area, it is then essential to analyze local farming practices and their stakes, to identify local motivations and brakes toward agroforestry and finally to identify pioneer farmers willing to implement agroforestry.

2.1.2 Objectives and research questions

The overall objective of the present study is to:

Study the feasibility of agroforestry systems in Lille-South water catchment area.

This main objective is supplemented with four sub-objectives, which consist of:

i. Describe the local farming systems and practices

Research questions: What are the farms' main characteristics in the study area? What are the main farming systems? What sort of development trajectories did farms follow and plan to follow?

ii. Study the acceptability of agroforestry systems among local farmers

Research questions: What would be farmers' behavior towards new farming systems and particularly toward agroforestry? What are the constraints and the opportunities for the development of agroforestry practices according to farmers? Which factors determine agroforestry adoption among farmers? According to their current practices, which local stakes could be addressed by agroforestry?

iii. **Understand the local stakeholders and agricultural technicians' perception of agroforestry practices.**

Research questions: Do other local stakeholders have the same representation of agroforestry than farmers? What can agroforestry bring to their territorial actions? What are the legal levers and land-tenure levers that could favor the development of agroforestry?

iv. **Define the strategic issues to target for the territory animation, in order to promote agroforestry practices.**

Research questions: How to lift the constraints against the development of agroforestry? How to improve communication activities and facilitation plans regarding agroforestry?

2.1.3 Hypotheses

As it was shown in the state of art on feasibility study, there are actually numerous reasons influencing farmers' choice to adopt agroforestry (*§1.3*). However, the local context as described in the previous part raises particular questions and uncertainties on agroforestry feasibility. These questions are formulated below on the form of hypotheses that have to be tested (statistically). These hypotheses form a non-restrictive base for the methodological construction of our study, others questions can also emerge throughout the study and the associated analysis.

Hypothesis 1: Some farms' properties can influence the adoption of agroforestry systems (size, production type, presence of livestock, financial health, land property, etc.)

Example: *Bigger farms could easily afford investments linked to agroforestry implementation and then adopt it to a bigger extent.*

Hypothesis 2: Some farmers' characteristics (age, complementary activity, social involvement, labor management, presence of a successor, etc.) can also explain their behavior towards agroforestry.

Example: *Younger farmers would tend to be more open toward innovative systems such as agroforestry.*

Hypothesis 3: Farmers complying with books of specifications for vegetables grown for industrial processing would have more difficulties to consider agroforestry systems. On the other hand, farmers engaged in environmental initiatives would be more open to the advantages of agroforestry.

Hypothesis 4: The territorial constraints and erosion issues may influence farmer's choice to adopt agroforestry systems. The perception of territorial issues (urbanization, presence of restriction due to the water issue) can also influence its acceptability.

Hypothesis 5: Farmers having preliminary knowledge on agroforestry systems would adopt it more easily.

Hypothesis 6: Farmers would prefer the traditional agroforestry systems (hedgerows and orchard-meadow systems) than intra-plot agroforestry and alley cropping.

Hypothesis 7: Farmers linked to the agricultural chamber would be less willing to step in agroforestry.

Hypothesis 8: Innovative farmers would tend to be more open to agroforestry systems.

2.2 Study area and sampling

2.2.1 The study area: Water Catchment Area of Lille-South

The Lille-South water catchments area is located in the south of Lille Metropolis. The scope of the WCA intersects the territory of 13 municipalities on 2 250 ha: Allennes-les-Marais, Annoeulin, Don, Emmerin, Haubourdin, Houplin-Ancoisne, Gondecourt, Herrin, Noyelles-lez-Seclin, Sainghin-en-Weppes, Seclin, Wattignies and Wavrin *(Appendix 6).*

2.2.2 Sampling

A list of the 185 present farmers on the study area has been provided by the LMCU. A launch meeting has been organized on February 27th in Sainghin-en-Weppes. The meeting was meant to have a first contact with local farmers, to provide technical information about agroforestry systems and to inform farmers about development actions carried out in the region

According to the available time and means, the sample size was set to 40 farmers. The sampling was done, as far as possible, in order to represent farms diversity in the area. This task has been laborious because farmers' database included only names and addresses. This implied numerous overlapping contacts and unobtainable phone numbers. Farmers were solicited through the telephone directory.

2.3 Methodological approach

The methodological approach follows five main steps (**Figure 15**). First the interviews allowed us to carry out a descriptive analysis of the main farms' characteristics and to understand the perception of trees and agroforestry by farmers. Then a typology of farmers was made according to their level of acceptance of agroforestry systems. Finally a factorial analysis of agroforestry acceptance was carried out. In order to complement the factorial analysis with more qualitative data, the Q-method was used.

2.3.1 The choice of a survey method

There is a large literature exploring factors that lead to a producer's adoption of environmental friendly practices (e.g. organic agriculture, no-tillage, agroforestry…). An individual's decision to change behavior is a complex function, but one important part of this function is related to the **perception of the new practice (**Cf. supra §1.3). In the present study area, very few local references of agroforestry are available to farmers, so it is assumed that farmers' perception of agroforestry is an important factor toward its adoption. This has been explored through the **survey** and the **Q-Method** which are detailed below.

In order to maintain the overall coherence of the project, this interview grid was adapted from previous questionnaires used by Agroof and ISA[9] within other catchment basins: Escrebieux and Cambrésis. The aim is to keep some consistency for the entire project as well as being able to analyze together or compare results from different areas. It is indeed interesting to have a common approach on feasibility studies in order to compare study results in different region and agricultural contexts.

a) Objectives

The questionnaire *(Appendix 7)* is a combination of open and closed-ended questions. The closed-ended questions allow to obtain specific information whereas open-ended questions enrich the collection of information by the understanding of decision processes. Both kinds of questions are used.

The questionnaire was created on the assumption that agroforestry's adoption is related to the structure of the farm itself, but also the functioning of the farm, the agricultural practices, the degree of innovation and finally the mental representation of agroforestry systems among

[9] ISA: Higher Institute of Agriculture - Lille

farmers. The last part of the questionnaires (Q-Method) was added to initial survey to study more deeply farmers' representation of agroforestry systems while using interactive and playful tool.

b) Description of the survey

The survey was made to last between 2 and 4 hours. After a first "test" interview, the questionnaire was amended in order to make it more coherent and more fluent.

The interview grid is divided into 5 parts:

- **Part 1: Global description of the farm.**
    - The aim is to describe the main characteristics of the farm; its structure, its legal status, its main activities and its production systems. It is necessary to understand well farming systems in the region to propose suitable AF system.
- **Part 2: Analysis of the functioning of the farm and agricultural practices.**
    - This part aims to understand the technical management of the farm (technical operations, crop rotations, treatments, etc.). The issue that farmers address can be potential entry points for agroforestry.
- **Part 3: Degree of innovation of the farm and sensitivity to agro-environmental issues.**
    - This part is about the farmer's approach toward agro-environmental issues. It aims to understand the motivations and brakes toward changes of practices in relation with environmental issues (resource preservation, water quality, soil erosion, etc.) and can also be an entry point to agroforestry.
- **Part 4: Farmer's approach regarding trees and agroforestry.**
    - This part aims to know what is the level of awareness of farmers about agroforestry, what is their viewpoint regarding agroforestry. After a short presentation of agroforestry systems farmers were asked about the constraints and opportunities for the implementation of agroforestry systems. This part often constituted the first approach for farmers about agroforestry.
- **Part 5: Q-Method**
    - The Q-Method is described in the § 2.3.3 below. It is a method used for the subjectivity analysis.

2.3.2 Data management

a) A descriptive analysis

The descriptive analysis was made to understand **the functioning of agricultural holdings** and their main characteristics in the study area. Different strengths and weaknesses, either inherent to the farm or part the natural and socioeconomic environment, guide the choices of production systems as well as their evolution. This preliminary step allows a deeper understanding of local farming stakes and priorities. Further in the analysis, agroforestry acceptance could be regarded according to these structural elements.

b) Perception of agroforestry systems

In the second phase, we characterized behaviors of farmers towards innovative practices and in particular agroforestry systems. The objective is to assess the level of knowledge of agroforestry system among farmers, and to understand what are the opportunities and constraints farmers perceive regarding agroforestry systems.

c) Typology of farmers according to the level of acceptance of AFS

The level of acceptance of agroforestry systems was assessed in order to group farmers that have the same level of acceptation. Thanks to contingency tables, this classification was crossed with key variables, in order to draw up a typology of farmers according to their level of acceptation of agroforestry. This typology should allow us to highlight some general patterns that are important to address when putting in place animation programs on the territory. This also aims to observe tendencies about the factors influencing the adoption of agroforestry systems.

The **"favorable"** farmers gather farmers that are favorable toward at least one type of agroforestry **(AF^+ H^+; AF^0 H^+; AF^- H^+; AF^+ H^0 and AF^+ H^-).** The **"undecided"** farmers gather those who are undecided toward one or two types of agroforestry **(AF^0 H^0; AF^0 H^-; AF^- H^0).** The **"opposed"** farmers form a category of farmers that are opposed to any type of agroforestry **(AF^- H^-)** (**Table 3**).

AF (intra-plot agroforestry), H (hedges), "+" (interested), " ° " (undecided), " - " (opposed) *d) Factor analysis of acceptation*

In order to facilitate the analysis, seven main themes were synthetized, including the characteristic variables (**Figure 16**).

For each variable, a statistical test was carried out with a statistical tool (XLSTAT 2014) in order to observe the potential link with the acceptation of agroforestry.

For **quantitative** data, an **Analysis of Variance** (ANOVA) was carried out. The test used here is the Fisher's F test. If the *p*-value is less than 5% (α=0.05) this test allows to reject the null hypothesis "H_0" meaning "the variables are independent".

For **qualitative** data, the **Chi-square** (χ^2) test of independence was carried out. If the calculated *p*-value is less than 5% (α=0.05) this test allows to reject the null hypothesis "H_0" meaning "the variables are independent".

Given the fact that the population (*n*) is 36 farmers, the tests often reveal relations that are not statistically significant ($p > \alpha$) but trends were enlighten which are interesting to take into account in further territory animation activities.

2.3.3 Contextualize factors: the Q-Method

This approach is a complementary method based on the analysis of perception and representations of farmers on agroforestry. It is supposed that farmers' representation of their farming environmental and territorial issues can influence their choices. The **"contextualizing elements"** represent a source of information that can better explain the influencing factors by finding **causal links** and **mechanisms** behind the **decision process**.

Q-methodology provides a tool to study subjectivity, for revealing shared viewpoints that exist on an issue or topic. The Q-method aims to study deeply the subjectivity and obtain structural and statistically analyzable results (Risdon et al. 2003). The results of a Q methodological study can be useful to evaluate and clarify the different views of various stakeholders about the topic. In this way, it can be very helpful in exploring tastes, preferences, sentiments, motivations and goals, the part of personality that is of great influence on behavior but that often remains largely unexplored. Another characteristic of Q-method is that Q does not need large numbers of subjects. Using few respondents still allows to cover a large diversity of views covering the topic (Addams at al. 2000; Smith 2001 cited in Van Exel et al., 2005).

Typically, in a Q-method study, people are presented with a **sample of statements** about a topic (called **Q-set**). The **respondents** (called **P-set**) are asked to rank the statements according to their own point of view. This ranking allows us to study subjective viewpoint of the population. Performing a Q-method study involves the following steps:

a) Definition of the concourse (collection of statements)

The concourse is a collection of all the possible statements the respondents can make about the topic (in this case agroforestry). The concourse contains **all the relevant aspects** of the topic. It is up to the researcher to draw a representative sample (interviewing people, participant observation, popular and scientific literature). The gathered material represents **all existing opinions and arguments about the topic**. In the present study, the concourse has been developed through the existing literature on agroforestry adoption, the first meetings with farmers and experts' consultation.

b) Development of the Q-set

Next, the **Q-set** is drawn from the concourse. It consists of **56 statements** structured within a framework. The aim is to arrive at a Q-set that is representative of the wide range of existing opinions about the topic. Another researcher would probably not have the same Q-set, but if the statements are representative of the whole range of opinions, the results of the study would be the same, independently of the researcher (Brown 1993 cited in Addams et al. 2000).

The 56 statements are in the *Appendix 8*, they are organized by theme. For instance, statement from A1 to A16 deal with farmer's vision of agriculture, statements from C1 to C9 deal with farmer's agronomic vision of agroforestry.

c) Selection of the P-set

A Q-method study requires only a limited number of respondents. The P-set is not random, it is a structured sample of respondents who are theoretically relevant to the problem. On our case, the P-set represents the farmers who answered the survey as well as agricultural technicians.

d) Q-sorting

The respondents are asked to rank the statements according to their point of view regarding the issue. The sorting instruction asks the person to sort the statements based on how well each statement describes the actual situation. The ranking is done from "most disagree" to "most agree" (example: from -3 to +3). Q-sorting is associated with additional remarks in order to elaborate on the most salient statements (those placed a both extreme of the score sheet). The information is helpful for the interpretation of factors later on.

Least Agree						Most Agree
			(Statement Scores)			
-3	-2	-1	0	1	2	3

It is important to let the respondent know about the aim of the study because Q-sorting is complex and unfamiliar to the general public.

e) Analysis and interpretation

First, the correlation matrix of all Q-sorts is calculated. This represents the level of (dis)agreement between the individual sorts, that is, the degree of (dis)similarity in points of view between the individual Q sorters. Next, this correlation matrix is subject to factor analysis (PCA), with the objective to identify the number of natural groupings of Q sorts by virtue of being similar or dissimilar to one another (Brown 1980; 1993, cited in Van Exel et al., 2005).

Finally, the explanations Q sorters gave during the follow-up interview can be helpful in interpretation of the factors, in ex-post verification of the interpretation, and as illustration material (sometimes a single quotation says it all).

The results of the Q-Method were analyzed with the PQMethod software (version 2.33) and exported to XLSTAT 2014 for additional analyses. They are presented as given in **Table 4.**

For the three farmers' groups, the Mean (**M**), the standard error (**SE**) and the number of zeroes (**0**) have been calculated. The P-set represents the total population. The Kruskal-Wallis test (**KW**) was used to determine if the samples come from a single population or if at least one sample comes from a different population than the others. When the *p*-value is such that the H_0 hypothesis has to be rejected (p<0.05) then at least one group is different from the others. Finally the Sparkline chart of means was drew to have a clear picture of the groups' position. It represents the mean of each statement from left to right: favorable, undecided and opposed farmers.

2.3.4 Further work

Seven agricultural technicians specialized in the main crops grown in the region were interviewed. The objective was to understand what the role of their institution in the agricultural field is, their perception of agroforestry systems, and their vision of the development of such systems in the region. The interview grid for non-farmers stakeholders is available at the *Appendix 9.* These stakeholders were also provided a lighten Q-Method in order to compare their vision of agroforestry to the vision of farmers.

Chapter 3. Results

3.1 Sample presentation

3.1.1 Farmers solicitation

A list of 184 present farmers in the study area was provided by the LMCU. Among the 184 farmers, 42 farmers had no contact information and 51 farmers were unreachable. The large amount of unreachable farmers is explained by the fact that the survey has been carried out during spring, when farmers are busy with important field work (beetroot sowing, potato sowing, etc.). It was challenging to obtain appointments and then the survey was delayed. The withdrawals were mainly due to urgent agricultural works mentioned above.

Finally, 91 farmers were contacted. Even if solicited farmers were initially skeptical toward the approach, they answered positively (40%) to the interview request (**Table 5**). The two main reasons given by farmers who refused to answer the survey were: (i) lack of time and (ii) lack of interest toward the project.

Table 5: Summary of the interview request

Response of farmers to interview solicitation	*Occurrence*
YES	**36**
No, not available	22
No, not interested	10
No because of farmer's retirement	23
TOTAL NO	**55**
TOTAL	**91**

Overall, the context of water catchment area and high land pressure are also favorable to the reluctance of farmers towards such kinds of studies.

3.1.2 Interviews and statements sorting

Among the 36 interviewed farmers, 26 answered the Q-Method. Since the method was placed at the end of the interview, some farmers did not have enough time to answer it. In addition, 6 agricultural technicians were met and answered the Q-Method.

The statements' sorting was always done in a positive atmosphere. Some stakeholders were initially intrigued and sometimes reluctant to assign a score to the statements. Generally, they gradually got caught up in the game and understood better the interest of such method.

The respondents (Q-sorter) were asked to comment their answers in order to have some additional qualitative information (complementary notes were taken). Although the methodology provides statistically analyzed results, comments are important to understand the views of stakeholders and the reasons for their position.

When the Q-sorter had finished his statements sorting, he was free to change and adjust positions if the discussion had clarified his point of view. Nevertheless, it was rare for them to reposition statements because they often reflected well before placing the statements.

3.1.3 Sample description

a) Location of surveyed farmers

The surveys of 36 farmers have covered 2 944 ha in total. It represent a greater surface than the actual water catchment area because farmers do not have all their lands included in the area, but only few plots. The **Figure 18** shows the distribution of farms in the study area. The farms households are homogeneously distributed within the study territory.

b) Farmers

The distribution of ages' classes (**Figure 19**) indicates that farmers are generally close to retirement, with **41%** of farmers that are **more than 50 years old**. Farmer's age can be a determining factor in the adoption of new agricultural practices. The adoption of agroforestry often involves successors. In the study population, only **one third of farmers** assured that they **had a successor** for the farm, the others (69%) did not have successor or did not know at the moment of the survey (**Figure 20**). In addition 4/5 of farmers interviewed during the survey were males.

In general, older farmers (>50 years old) have a clearer picture of the farm recovery, but in our sample only 35% of old farmers affirmed that they had a successor. This phenomenon added with high land pressure reinforces the declining farmers' population process.

c) Farms

The average Utilized Agricultural Area (UAA) is **84 ha**, of which 8% of farms are bigger than 200 ha, the median UAA is 70 ha (**Figure 21**). Apart from a few large farms, **most of the farms** are **between 40 and 90 ha**. Agricultural lands are quite fragmented; plots are ranging from 85 acres to 16 ha and the **average size of a plots-patch is 4.7 ha** (±2.2). Plots are relatively small and fragmented because there was no land consolidation[10] in the area.

d) Land-use and farming environment

The farming environment is important to take into account when designing agroforestry systems. Soil types, soil issues, irrigation, drainage, land-use or land-tenure are all points that need to be cleared up before designing suitable systems.

In the sample, half of the farmers have **drainage installations** on their fields. However, this represents only 17% of the total cultivated area. It is not advisable to set up agroforestry systems in drained fields because tree roots can block water circulation in the pipes.

Regarding soil types, farmers cultivate mainly on deep **silty** and **silt-clay soils**. These soils are favorable to agroforestry systems. However a lot of farmers (n=27/36) mentioned that their soils are subjects to **slaking crust** and to a lesser extent **runoff** and **drying** (**Figure 22**) which is predictable since there are very few slopes.

The plain territory is favorable to various productions and the land-use in the region is relatively varied. The agricultural landscape is dominated by **wheat, potatoes and beet** cultivation (**Figure 23**). To a lesser extent, prairies, maize (Corn and Silage), fresh vegetables (Pea, Endive, Beans) are also part of the agricultural landscape. The graph shows a real dominance of wheat over the other crops, but potatoes, beets and industry vegetables are also of economic interest. They are intensive cultures that require a lot of field works but have a high gross margin per hectare.

In farmers' land-use, the cash crops (potatoes, beets and industry vegetables) are cultivated in rotation with wheat and the average rotation duration is 4 years.

[10]Land consolidation is a land reform carried out in order to restructure the land properties by amalgamating different fields under the same property that were formerly geographically dispersed, thus reducing labor costs of cultivating those fields.

Compared with others rather intensive territory of NPDC (Cambrésis and Escrebieux, ISA, Agroof, 2014), the territory of study is even more intensive. Generally wheat represents at least half of the sole in order to alternate winter and spring crops and so to break weeds development. Furthermore, in LMCU, potatoes' cultivation is very important whereas this culture is known to be as environmentally impacting as decisive for farm economy. This high proportion of spring crops also question agroforestry agronomic feasibility since it is supposed competition for resources is high between trees and spring crops. It is further developed in another study done currently by Agroof.

e) Land-tenure

The **tenant-farming represents 83%** of agricultural fields among studied farms (**Figure 24**). However 10% of lands are under family land-tenure, so the actual tenant farming rate outside family circle drops to 73%.

Farmers are obviously mainly renting most of their lands. One farmer also reported having *"more than 75 different landowners".* However, they are subjected to different lease types (**Figure 25**). The **rural lease** (9 years) is largely **dominant** (83%) and the long-term lease (25 years) is used by 39% of farmers. **Communal** and **precarious leases** are also used respectively by **23**% and **40%** of farmers. This is an important point that will be addressed in the discussion *(§ 4.2*). In addition, 17% of farmers used oral leases (Tenancy at Will).

Regarding land management, 77% of farmers argued that they have a **high land pressure**. The **Figure 26** shows that this land pressure is related to **(i) urbanization**; **(ii) infrastructures** (roads, railways, industrial zone); **(iii) environmental issues** (water quality, afforestation, expropriation); **(iv) others** (land speculation).

f) Economic and technical orientation (ETO)

Half of the farms are in the form of **individual holdings**. The remaining farms are in associated form (mainly GAEC[11] and EARL[12]). In accordance to the general patterns, farms have mainly specialized into **polyculture** and **mixed farming** is becoming increasingly abandoned (**Figure 27**).

Farmers were asked to indicate their general farming practices. **Two third** of the farmers practiced the form of agriculture called "**Sustainable farming**" (**Figure 28**). **Sustainable farming** is derived from **conventional farming**, aims to reduce the environmental impact of agriculture (fertilizer use, soil protection, diffuse pollution, landscape preservation, etc.). It is a voluntary process that does not require any certification. On the other hand, i**ntegrated farming** is a more holistic approach based on nutrients' cycle, natural mechanisms and reduced amount of inputs, we consider these farmers to be the most advanced in terms of environmental practices. Eventually, if the so called "conventional" farmers clearly express their difference in practices, it was hard to catch the difference of meanings farmers attribute to either "sustainable" or "integrated" and this classification was not used further in the analyze. **No organic farmer** was met during the field work; they are very few and represent only 1.6% of farms in the region (2010 Agriculture Census).

g) Turnover and financial health

Farms' turnover is homogeneous in the sample. We can observe the same proportion of turnover < 100 000 € than the others turnover classes (**Figure 29**). Farmers are optimistic regarding the financial health of their farms. Indeed, three quarter of the farmers assess their financial health as "good" and "very good" whereas one quarter assess it as "average". The bigger farms do not tend to consider their financial health better than the others. This can be due to the fact that farmers have specialized into high added-value crops that do not require a large agricultural area.

[11] GAEC: Collective farming grouping
[12] EARL: Private limited farming company

h) Social involvement and sources of information

Farmers' group can be a good vector of communication and information for the adoption of innovative practices. In the sample, half of the famers are involved in a farmers' group. The main reasons **for groups involvement** is for the **access to technical information** and **exchanges with farmers** and technicians (**Figure 30**). Some farmers also mentioned political commitment and collective shops.

Apart from farmers' groups, different sources of technical information have been identified (**Figure 31**). **Media** (specialized press and internet), **Chamber of agriculture** and **trading companies** are the most cited sources. Though, informal exchange between farmers, technical institutes and cooperatives' technicians are also a significant source of information. Overall, farmers like to have several sources of information.

3.1.4 Territorial approach and agro-environmental issues

During the questionnaires, the part dealing with agro-environmental issue has raised a lot of reactions. Farmers argue that they are often solicited on the topic. Some of them were expropriated due to the water quality: their fields close to the water source were afforested. This is a delicate issue.

a) Environmental issues

Among study farmers, **two thirds** of them were aware that they were located in an environmental issue area, meaning that one third remained not aware of that fact. In addition, farmers have negative image of this environmental categorization (**Figure 32**), they have got the feeling to be "tracked". More than a feeling, the environmental rules is said to put at stake their activity, one farmer mentioned *"it is difficult to have projects in this area".*

However, when farmers were asked whether the environmental classification impact them on a daily basis, **81% of them** said that is has **no impact on their practices**, 19% said that this represents heavy constraints and 5% adapted voluntarily their practices. It seems that the atmosphere is more a general skepticism on future development opportunities rather than actual regulatory constraints.

b) Water quality

Overall, farmers do not question the fact that they play a role in preserving water quality. 86% of them judged that their activity have an influence on water quality. That influence is mainly due to **crop protection products** and **fertilizers**. As such, 27% of farmers subscribed to an environmental contract related to the water issue (PEA, PVE, CTE or MAE)[13].

However, farmers often reported that farming practices are pointed out whereas some **other human activities** (urbanization, shopping areas, highways and infrastructures) have a greater impact on water quality. Half of the farmers also mentioned that they have **no information on water quality**.

3.1.5 Degree of innovation

When studying the adoption of agroforestry systems, it is interesting to study beforehand the degree of innovation of farmers. It is assumed that in a farmers' population, innovative farmers would be more likely to adopt new practices.

a) Behavior toward innovative practices

In the sample, the main motivations for the adoption of agricultural innovations are: (i) the improvement of working conditions; (ii) the maintenance of a technological state of the art and (iii) the reduction of working time (**Figure 33**). The improvement of farming practices and the diversification of income have been cited only once, while it could be a major advantage for the adoption of agroforestry.

On the other hand, the major brakes to the adoption of agricultural innovations are (i) the economical investment and (ii) the mistrust regarding new practices (**Figure 34**). These are interesting points to deal with when presenting agroforestry systems to farmers.

Among the agricultural innovations that farmers already putted in place, we could observe very broad innovations. For instance: buildings and machinery improvement (tractors, GPS

[13] PEA: Program Water and Agriculture
PVE: Plant and Environment Program
CTE: Farming Territorial Contract
MAE: Agri-Environmental Measure
Description of these measures available at: <http://www.agriculture-npdc.fr/contrats-environnementaux.html> accessed on 01-09-2014.

technology, low volume sprayers…), farming practices and systems changes (organic agriculture, false seedbed, low density sowing…).

b) Farms' internal changes

After analyzing farmers' vision of innovative practices, we classified farms according to their dynamics, which allows us to assess the farm trajectory. Farm's dynamic and farm's stage (recent creation, future retirement…) play an important role in the launch of an innovation and related investments. We made a subjective classification[14] of farmers in order to characterize farms trajectory:

- **Conservatives** (7 farms): Farmers who keep the same farming system over years. Almost no innovations.
- **Simplifiers** (14 farms): Farmers have tended to specialize, reducing the number of productions and the complexity of the farming system.
- **Diversifiers** (10 farms): This strategy is contrary to the simplifiers, farmers have adopted new productions, new practices and try to diversify the farming system.
- **Triers** (3 farms): Curious farmers, who try new practices, new productions but on the same time leaving other productions.

We will further on cross this classification with the level of acceptation of agroforestry systems, in order to assess the influence of farms' trajectories on the adoption of AFS.

3.1.6 Farms types

To conclude, we can distinguish **three farms types** in our sample which are well distributed. They are summarized in **Figure 35**.

First, the **"Polyculture"** type is composed of farms practicing a simple rotation based on **wheat, potation** and **beetroots**. This rotation can be sometimes complemented with corn, winter barley or rape seed. Farmers' age ranges from 40 to 67 years. They have the smallest average UAA (60 ha) and then the lowest average workload (34 ha/HWU). Their land rent ratio is among the smallest (between 33% and 90%). They also have the lowest number of plots (14) but one fifth has drainage installations. Most of these farms have simplified their farming systems (often the livestock was removed) in order to concentrate only on arable crops. Regarding farms

[14] Classification based on the following factors: farm's history, past and future changes, objectives and motivations regarding innovations.

economy, they have and “average” to “good” financial health and farms are managed in a “cruising” and “short-term” view. However, the farm durability is not endangered because they have successors. These farmers are mostly not involved in farmers’ groups (n=7).

Second, the **“polyculture and industry vegetables”** type is composed of farms practicing a more complex rotation, based on the regional crops (wheat, potation and beetroots) in association with **industry vegetables**. The industry vegetables production is made in contract with food industry, respecting a strict book of specifications. In the study area, farmers grew mainly **peas** and **beans** for industry. Regarding farms characteristics, they have the highest UAA (100 ha in average) and the highest land rent ratio (from 50 to 96%). Drainage is also present on one fifth of the lands. These farmers have a “good” financial health and cruising to long-term farm management. This system was adopted by simplifiers (from livestock) and diversifiers (from polyculture). The farm succession is not yet ensured, and farmers of moderately involved in farmers’ groups (n=5).

Finally, the **“mixed farms”** are the relics from the traditional farming systems in the area. They are farms that have kept a **livestock keeping activity** in association with **arable crops.** This system is transmitted from father to son and farmers’ age ranges from 24 to 82 years old. Farmers have an average workload (47 ha/HWU). They have a high land rent ratio (35-100%), a high plot number (21 in average) but the lowest drainage rate (8%). Farm’s economy is “good” to “very good” and the management is done at cruising and long-term scale. These farmers are deeply involved in farmers’ groups (n=8).

We can observe within this highly intensive agricultural area different farm types which distinguish themselves on their productions and farm trajectories. Different visions of innovative practices, awareness on crust phenomena, generally good financial results let us think there is room for agricultural innovations. On the other hand, cropping systems are intensive, farms have small and fragmented land surface where can be installed drainage systems and farmers express their fear of new environmental constraints and urban pressure.

In this context, what is the perception of trees and agroforestry practices among farmers ? Will they be willing to set up agroforestry?

3.2 Farmers' perception of trees and agroforestry systems

3.2.1 Tree's place within the farm

A large majority of farmers (**88%**) have already woody elements on their farm, **mainly in the form of hedges (78%).** Farmers have also isolated trees and forest (**Figure 36**). One example of agroforestry systems has been encountered during the survey, it was an ancient orchard-meadow system. The present trees are very often relics from previous generations. However, some farmers have planted new hedges in order to comply with new cross-compliance CAP regulations. They do not make benefits of these new trees since it is mainly seen as a constraint for farming.

In addition, **63% of farmers** have cultivated fields on **grove edges (woodland edges)**. In average, each farmer has **833 linear meters** of plots edges cultivated next to hedges or woodlands. This is an important point because farmers often raised the fact that crops do not perform well on grove edges due to the competition with light and nutrients. This issue was often taken has a disadvantage of agroforestry systems.

3.2.2 Knowledge about agroforestry

More than half of farmers are aware of agroforestry and give a good definition of the system despite a slight confusion with afforestation. (**Figure 37**). Farmers who have a clear picture of agroforestry systems have heard of agroforestry mainly through media and information meeting. However, only **2 farmers** in the sample had already visited an agroforestry field (the experimental plot of LaSalle Beauvais). They saw this system as well integrated in the given agricultural context, they both said *"why not, if you have enough space"*.

The knowledge about agroforestry systems was tested according to farmers' age, but no relation was found between the two variables. New generations of farmers are not better informed about agroforestry in our sample.

3.2.3 Motivations and limitations regarding agroforestry projects

After reviewing the woody elements present on the farm, farmers were presented Agroforestry Systems (AFS) through a short presentation (*Appendix 10*). At the end of the presentation, they were asked to freely express themselves through the question: **"What would be the advantages and the disadvantages of the implementation of agroforestry systems in your farm?"**

Overall, twice more constraints (107 occurrences) than advantages (53 occurrences) were mentioned. This tendency can be partly explained by the fact that innovative farming practices lead to a feeling of apprehension. Farmers tend to be *prima facie* more skeptical toward new practices and seriously weigh the pros and cons (Baumgart-Getz et al. 2012).

a) Motivations for the implementation agroforestry systems

The main motivation for farmers to implement an agroforestry system is the increasing **biodiversity and beneficial organisms.** Farmers are convinced that the presence of trees on their fields will increase the amount of beneficial organisms, such as ladybugs or syrphid flies. They also recognize the role of trees regarding animal welfare, soil erosion and the windbreak effect. Some of them (n=6) argue that trees improve their living environment (**Figure 38**).

b) Brakes for the implementation of agroforestry systems

On the other hand, farmers perceive numerous constraints to the implementation of agroforestry systems (**Figure 39**). The first constraints are linked with the **increasing labor** that AF requires and the fact that farmers have **fragmented plots** (n=18). The **mechanization** issue is also perceived as a major constraint (n=17), trees would represent obstacles to the machinery. The **tree-crops competition** for light and nutrients remains as well a significant constraint for farmers (n=16).

The brakes and motivations as perceived by farmers have been classified into 4 categories. The categories have been developed according to farmer's answers (*Appendix 11*).

(i) **Agronomic** aspects: related to the main production factors, light, nutrients, weeds, pests and diseases, soil, etc.

(ii) **Socio-economic** aspects: related to farm's economy, land tenure, labor management, outlets, agricultural policies, etc.

(iii) **Technical** aspects: related to mechanization, irrigation, drainage, plots' size and shape, industry book of specifications, etc.

(iv) **Environmental** aspects: related to the biodiversity, animal welfare, soil erosion, farmer's living environment, etc.

The graph (**Figure 40**) outlines two general tendencies in the perception of agroforestry systems by farmers. First, the **motivations** are clearly oriented toward **environmental** and **agronomic** characteristics of such systems; farmers identify easily the agronomic and environmental interests of AFs systems. On the other hand, the **brakes** are oriented toward **socio-economic** and **technical** characteristics. Many farmers do not perceive the technical feasibility of AF systems on their farm, they argue that AFS *"are not adapted to their farming systems"* or simply not adapted to the region.

c) Farmers' acceptation of agroforestry systems

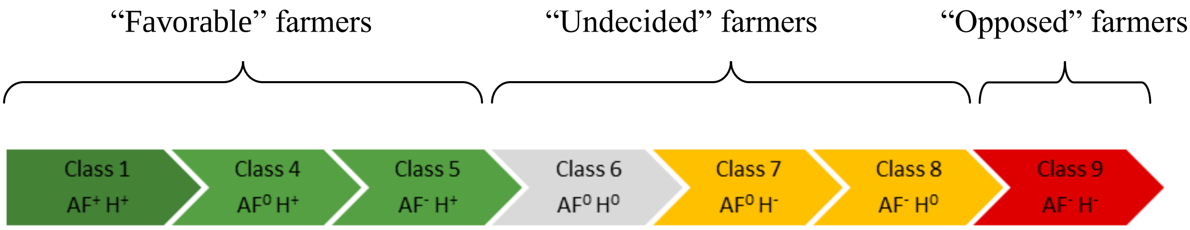
Finally, farmers were asked about the prospect of implementing agroforestry systems on their fields. Overall, **41% were favorable to agroforestry** (**Figure 41**). On the other hand, farmers were globally more favorable towards hedges (14 occurrences) than towards intra-plot agroforestry (2 occurrences) – (**Figure 42**). The main reason farmers gave to this differences is that hedges do not question their actual farming systems, whereas alley cropping requires a lot of preliminary works in order to fit with mechanization and technical constraints.

The results on the acceptance of agroforestry systems are summarized in the **Table 6 (previous page)**. From this table, we can describe **three level of acceptance** of agroforestry

Table 6: The level of acceptance of agroforestry systems. H: Hedge; AF: intra-plot agroforestry (Adapted from Grandgirard et al 2012).

Combination (occurrence) Class Number		**AGROFORESTRY (AF)**			
		Favorable	**Undecided**	**Opposed**	**Total**
HEDGES (H)	**Favorable**	$AF^{+} H^{+}$ (2) Class 1	$AF^{0} H^{+}$ (7) Class 4	$AF^{-} H^{+}$ (5) Class 5	**14 (41%)**
	Undecided	$AF^{+} H^{0}$ (0) Class 2	$AF^{0} H^{0}$ (4) Class 6	$AF^{-} H^{0}$ (4) Class 8	**8 (24%)**
	Opposed	$AF^{+} H^{-}$ (0) Class 3	$AF^{0} H^{-}$ (2) Class 7	$AF^{-} H^{-}$ (10) Class 9	**12 (35%)**
	Total	**2 (6%)**	**13 (38%)**	**19 (56%)**	**34**

systems. The **"favorable"** farmers gather farmers that are favorable toward at least one type of agroforestry (AF^{+} H^{+}; AF^{0} H^{+}; AF^{-} H^{+}; AF^{+} H^{0} and AF^{+} H^{-}). The **"undecided"** farmers gather those who are undecided toward one or two types of agroforestry (AF^{0} H^{0}; AF^{0} H^{-}; AF^{-} H^{0}). The **"opposed"** farmers form a category of farmers that are opposed to any type of agroforestry (AF^{-} H^{-}).



3.3 Farmers' typology according to the level of acceptance of AFS

In order to characterize each of the three groups, we will **cross the data** with farms' indicators previously determined *(§ 2.3.2.d* – **Figure 43**).

a) Opposed farmers

The "opposed" farmers are the oldest farmers (51 years old in average). They also have the largest Utilized Agricultural Area (106 ha). New practices are not subject to a special enthusiasm because this group gathers most of the conventional and conservative farmers. This point reflects the **traditional nature** of farmers in this group.

They have a high workload (59ha/HWU) and probably no time to spend on tree cares. Overall, they do not plan to make changes on their production system during the coming years. They have a short-term management and their agronomic practices were assessed as "average" and "low". Most of them argued that they have no information on water quality and consequently made no practices adaptation according to water quality.

Farmers rent 83% of their lands outside family circle and they feel, as a general pattern, a **high land pressure**. Some farmers mentioned to have "more than 50 different owners". Trees on agricultural lands are mainly **perceived as constraints** and are sources of many problems: pests and diseases, competition for light and nutrients, wildlife, low branches, inconvenience for mechanization…. Globally, they think that agroforestry would **endanger their production**

system. Farmers often mentioned that the **fragmented plots of a suburban area** are a major constraint to the implementation of AFS.

They are against any type of agroforestry systems but they consider few advantages of agroforestry systems, such as biodiversity and beneficial organisms, the added value for poor soils, the windbreak effect or the possibility for hunting.

b) Undecided farmers

"Undecided" farmers gather farmers that do not take sides for agroforestry. They expressed many **doubts and questions**, but also **a need for information** about agroforestry. Formed by polyculture and mixed farms, they do **sustainable farming** and they had a **conservative trajectory.** They have a relatively low land-leasing ratio (63%) but have scattered plots.

Overall, they have a low workload (37 ha/HWU) and their agronomic practices were assessed "average" and "low". They are not closed to agri-environmental practices, but for the case of agroforestry they mentioned a great **lack of local references.**

Farmers in this group perceive the advantages of agroforestry systems through income diversification, the improvement of the living environment and the increase of biodiversity and beneficial organisms. However, they do not see clearly the **application of such systems into their production systems**, they often mentioned practical disadvantages related to labor, land-tenure or fragmented plots.

c) Favorable farmers

The "favorable" farmers are slightly younger (46 years old), they have the **smallest UAA** (72 ha). They practice legumes and mixed farming, mainly in the form of sustainable agriculture. They have a relatively **low land-leasing ratio** (73%) and have **grouped plots.**

In term of labor management, farmers have a relatively low workload (40ha/HWU) and have no other activity. Concerning their farm management, they showed **"good" agronomic practices** and most of them are engaged in **quality product certification.** The farm management is viewed as a **mid-term process** and most of the farmers (n=10) have planned **changes** in the next future (n=13).

Farmers also argued that they have proper information on **water quality** and they have adapted their practices accordingly.

Concerning agroforestry systems, the **main advantages** perceived by those farmers are the environmental advantages: the increasing animal welfare, the increased biodiversity and beneficial organisms and the role of AF against erosion.

However, they also perceived numerous **disadvantages** that are common with other groups of farmers: mechanization, fragmented plots and increasing labor.

To conclude, twice more constraints were expressed on agroforestry which clearly indicates a general skepticism, this phenomena is further underlined with the only two farmers interested by intra plot agroforestry.

The expressed disadvantages were more or less the same between the groups of acceptance and were focused on general aspects such as mechanization, land tenure and increasing labor. It shows that farmers rarely imagine themselves implementing agroforestry. In this case we supposed they would have think of more agronomic aspects. Still, further studies and explanations might be put in place to answer these issues.

On the other hand, we see differences and variety of perceived advantages: economic diversification, functional biodiversity, hunting, wind-break effects… It might imply farmers have a certain awareness of agroforestry.

To put in perspectives these visions of agroforestry, it might be interesting to compare it to their stakeholder views but in a first time the main factors of acceptance will be studied in order to understand more deeply the main levers or causes of reject, the agroforestry extension service might take into account.

3.4 Factor analysis of acceptation

After studying each level of acceptance of agroforestry systems, we will further investigate the factors explaining it. To do so, conducting a Chi-squared test (for qualitative data) and an ANOVA[15] (for quantitative data) should allow to **link the levels of acceptance with variables** corresponding to our hypotheses *(Cf. supra §2.2.3).* Due to the sample size, **tests often reveal trends**, although some factors are statistically significant. The results of these tests are presented in *Appendix 12.*

Each factor analysis is complemented with the Q-Method, in order to have a better picture of farmer's opinion. For each group of farmers and for each statement, the mean (**M**) was calculated. These means are represented on Sparkline's graphics to be more easily observable. The standard error (**SE**) was also calculated. It allows to observe the dispersion of data among each group. The number of zeroes (**0**) indicates, in some cases, the ignorance toward the topic, or in other cases that farmer refuses to take a position on the topic. Finally the Kruskal-Wallis test (**KW**) was carried out to observe the difference between groups. If the test indicates a significant results, this means that at least one group is different from the others (*Appendix 13).*

3.4.1 Farms characteristics

➔ UAA and agroforestry? [Hypothesis 1][16]

The **Utilized Agricultural Area** showed no statistical relation with the level of acceptation of agroforestry systems (F=1.02; p=0.373)[17]. However, we can observe that the average UAA of favorable farmers is 34 ha less than opposed farmers, two factors could explain it. First, bigger farms might rather develop an extension strategy in terms of cultivated lands in this case they enlarge the machineries' working size and agroforestry could impede it. They are also more into specialized and simplifier strategies. Otherwise, it is probable that farmers with a lower UAA have also more time available to consider such systems (**Figure 44**). This trend is confirmed by the analysis of the **workload** (UAA/HWU). Farmers with lower work load would be more likely to adopt agroforestry (F=1.733; p=0.193).

[15] ANOVA = Analysis of Variance
[16] A reminder of the hypotheses in provided in Table 5 (next page)
[17] ANOVA results. F = F-value; p = probability to observe the F-value.

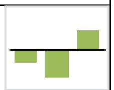
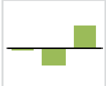
Statements		Group 1 "Favorable"			Group 2 "Undecided"			Group 3 "Opposed"			P-set			KW (p)	Sparkline
		M	SE	0	M	SE	0	M	SE	0	M	SE	0		
D3	Small farms will perhaps go into agroforestry, but not the large ones, they won't waste time	**-1.8**	0.9	0	**-1.1**	1.7	1	**-1.8**	1.1	1	**-1.5**	1.3	2	0.56	

However when we analyze farmers' speech **[Statement D3]** they all disagree on the fact that small farms are more suitable with agroforestry systems. Farmers argue that *"big farms can afford to test agroforestry, because it does not represent a large part of their UAA"*. Smaller farms would be more dependent of the valorization of every hectare. Regarding the workload, farmers do not have a clear picture of the amount of work that agroforestry represents, they often gave a neutral answer.

➔ Technical orientation and AF? [Hypothesis 1]

The **technical orientation** or farms do not influence farmers' choice in our sample (χ^2=0.028; *p*=0.986)[18]. Indeed, we can observe the same proportion of polyculture and mixed farmers in all the acceptation classes. However no "legume" producer is found in the opposed group and 5 of them said to be quite interested. It is a surprising result since they often have to comply with restrictive book of specifications which impede trees plantations. In the work of Bastien Danneels[19] (not published), such legume producers express their interest in the windbreak effect so to get a more homogenous production. It might be interesting to investigate further what are the concrete advantages they see to their legume production and what kind of agroforestry they imagine: intra ploty or hedges.

Regarding the **type of agriculture**, we can observe that integrated and sustainable are more likely to consider an agroforestry project, although there is no statistical significance (χ^2=1.678; *p*=0.795). No organic farms were met during the survey.

Statements		Group 1 "Favorable"			Group 2 "Undecided"			Group 3 "Opposed"			P-set			KW (p)	Sparkline
		M	SE	0	M	SE	0	M	SE	0	M	SE	0		
B6	Agroforestry is for organic farmers, or those who have stopped tilling	**-0.9**	1.2	2	**-1.9**	1.3	0	**1.2**	1.1	1	**-0.9**	1.6	3	0.00	
B7	Agroforestry is just for livestock farmers on grasslands	**-0.2**	1.7	1	**-1.1**	1.7	0	**1.2**	1.9	0	**-0.3**	1.9	1	0.09	

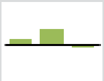
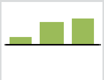
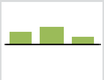
[18] Chi² results. χ^2= χ^2 value; *p* = probability to observe the χ^2 value.
[19] Bastien Danneels was carrying another MSc Thesis at Agroof, focusing on technical integration of AFS into the farming systems of NPDC.

On this topic, the vision of the “opposed” group distinguishes itself from the others **[Statement B6; B7].** For them, AFS are seen as alternative systems as for organic or no-tillage agriculture whereas the “favorable” and “undecided” can see the application to conventional agricultural systems. This tendency is the same for the type of agroforestry; “opposed” farmers consider AF feasible only as the traditional *“orchard-meadow system”*, whereas other farmers’ groups see AFS *“adapted to the modern agriculture”*. Eventually, even the undecided farmers disagree with certain sectarianism, they suppose every kind of system could implement agroforestry.

In economic matters, the **turnover** (χ^2=1.964; p=0.923) and the **financial health** (χ^2=1.657; p=0.798) of farms did not show significant effects on the adoption of agroforestry. However we can notice that farms judging their financial health as “good” tended to be more favorable to agroforestry (n=9/18), whereas farms with an “average” financial health tend to be more undecided and opposed (n=6/8) (**Figure 45**). This trend is not surprising since on one hand agroforestry requires investments and on the other hand it by nature excludes a surface from cultivation. A complementary indicator for the assessment of farms economy is the Operating Cash Flow (OCF); it assesses the surplus of cash generated by farm activity. This indicator could be useful in assessing the capacity of a farm to invest in projects such as agroforestry plantation.

➔ Age and agroforestry? [Hypothesis 2]

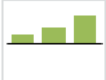
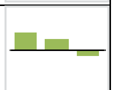
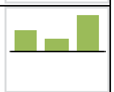
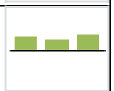
No statistical link was found between farmer’s age and the acceptability of AFS (χ^2=2.222; p=0.695). Even when farmers already know the **successor of the farm**, they would tend to be more opposed (n=5/11) to the prospect of agroforestry (χ^2=3.252; p=0.517), it was not directly asked but we supposed planting trees would be seen as a way of blocking possibility (machinery enlargement) to the successor.

Statements		Group 1 "Favorable"			Group 2 "Undecided"			Group 3 "Opposed"			P-set			KW (p)	Sparkline
		M	SE	0	**M**	SE	0	**M**	SE	0	**M**	SE	0		
D1	At 50 years old, we are more reluctant to put trees than if we were 30	**0.4**	1.7	2	**1.0**	1.7	1	**-0.2**	2.2	0	**0.5**	1.8	3	0.50	
D2	Agroforestry is a mindset, it's not about farm size or farmer's age	**0.5**	1.5	3	**1.4**	1.3	1	**1.6**	1.7	0	**1.0**	1.5	4	0.23	
C12	Planting trees will benefit my children	**0.8**	1.7	4	**1.1**	1.3	2	**0.4**	1.1	2	**0.8**	1.4	8	0.59	

We can observe that the farm durability (farmer's age and presence of a successor) does not come into play in the decision-making process of farmers. Even if they agree that planting trees would benefit their children, they see agroforestry more as "mindset" where age does not matter **[Statement D1; D2; C12]**. Still, on **Statement D2**, it is interesting that the most interested farmers are thinking to a less extent agroforestry is about mindset, agroforestry might be seen as a rational farm project. We can assume that the high lease ratio combined with the high land pressure does not favor the serenity and the hindsight of farmers regarding their own situation and the future of their farm

➔ Farmers relation to the tree

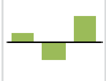
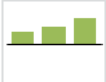
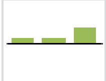
In our sample, the **fact to have planted trees** does not influence farmers' choices. (χ^2=0.221; p=0.895). Most farmers who planted trees did it by necessity, not by choice. According to them, planting trees is not part of their culture: *"It [the open-field landscape] is like this since the World War II, we are used to it"*.

Statements		Group 1 "Favorable"			Group 2 "Undecided"			Group 3 "Opposed"			P-set			KW (p)	Sparkline
		M	SE	0	M	SE	0	M	SE	0	M	SE	0		
B1	Woods, hedgerows, woodland edges, all this is still a constraint for farmers	**0.5**	1.4	1	**1.0**	1.6	0	**1.8**	0.8	0	**1.0**	1.4	1	0.23	
B4	I'm trying to get rid of trees rather than replanting them	**-0.8**	1.7	2	**-0.6**	1.4	2	**-0.6**	1.7	1	**-0.7**	1.5	5	0.92	
B5	Today, in productive areas, we've been too far, there are no trees anymore, it's time to rectify it	**1.1**	1.8	1	**0.7**	1.9	3	**-0.4**	2.2	1	**0.6**	1.9	5	0.41	
C8	Trees shade crops too much	**1.3**	1.2	1	**0.8**	1.5	3	**2.4**	0.5	0	**1.3**	1.3	4	0.08	
C9	Open-field vegetables are incompatible with trees	**0.9**	1.6	0	**0.7**	1.1	3	**1.0**	1.2	2	**0.8**	1.3	5	0.73	

The experience of farmers regarding the interaction between trees and crops was often mentioned. Trees are mainly seen as a constraint for agriculture **[Statement B1; C8]** farmers mentioned: *"on wood edges I have a ridiculously low yield"* or *"all the hedges are refuges for wildlife"*. Some farmers also talked about the discomfort that trees represent for mechanization. But even if farmers have a bad experience with trees, they do not tend to get rid of them **[Statement B4; B5]**: *"they are part of our landscape"*. Based on their experience of industry vegetables production, farmers, and favorable ones significantly, globally tend to think that trees are not adapted to this production: *"we have very strict book of specifications, we cannot take the risk of losing everything"*.

3.4.2 Farm's dynamic and vision of agricultural innovations

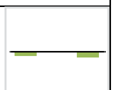
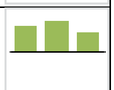
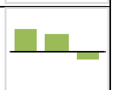
a) Vision of the current system

Statements		Group 1 "Favorable"			Group 2 "Undecided"			Group 3 "Opposed"			P-set			KW (p)	Sparkline
		M	SE	0	M	SE	0	M	SE	0	M	SE	0		
A1	Farmers could not produce without chemical fertilizers and plant-protection products	**0.5**	1.6	0	**-1.2**	1.8	1	**1.6**	0.9	0	**0.1**	1.9	1	0.01	
A2	I am satisfied with the way I currently farm	**0.8**	1.1	1	**1.1**	0.9	0	**1.6**	1.7	0	**1.1**	1.1	1	0.39	
A3	Our soils are absolutely not being depleted	**0.4**	1.4	0	**0.3**	1.2	3	**1.0**	1.2	0	**0.5**	1.3	3	0.57	

All groups agree with **Statements A2 and A3.** Indeed, the most "opposed" are farmers who are generally the most satisfied with their current farming system. This group also disagrees with the fact that soils are depleting. The other groups are less satisfied with their farming system and showed no clear opinion on the soil depleting issue. Farmers have divergent opinions on systems without pesticides and chemical fertilizers **[Statement A1]**; group 1 and 3 do not question this type of systems whereas group 2 expresses a doubt about such systems.

Globally, farmers do not question their current agricultural system; they are quite satisfied with their current systems, but on the other hand they are not completely close to alternative systems as we saw in the previous part.

b) The evolution of farming systems

Statements		Group 1 "Favorable"			Group 2 "Undecided"			Group 3 "Opposed"			P-set			KW (p)	Sparkline
		M	SE	0	M	SE	0	M	SE	0	M	SE	0		
A4	Agriculture is at a turning point and current farming systems cannot continue	**-0.4**	1.4	3	**0.0**	0.9	2	**-0.4**	1.1	2	**-0.2**	1.2	7	0.77	
A5	Farmers will have to take more care of their soil's life	**1.6**	1.6	1	**2.0**	1.2	0	**1.2**	2.0	0	**1.7**	1.5	1	0.72	
A6	We have tremendously neglected the interesting inputs that nature can bring	**1.5**	1.0	0	**1.1**	1.7	0	**-0.6**	1.8	1	**0.9**	1.6	1	0.07	

Linked to the preceding point, the **Statement A4** shows that farmers do not perceive the sustainability issue raised by some farming systems. Due to the large number of zeroes this statement made farmers skeptical about the need for new systems in agriculture. However, all farmers agree with the fact that they will have to take more care of their soils **[Statement A5].** Indeed a lot of them have stopped the livestock activity and are wondering about the future of their soil fertility. The **Statement A6** divides more the opinion: "favorable" and "undecided" farmers think that agriculture has gotten too far from natural balances, in biological control for instance. *"We've lost ancestral knowledge on which was based all of our agriculture".*

c) Innovation and system changes

➔ Farm trajectory [Hypothesis 2]

It appears that the **farm trajectory** plays a role in their posture toward agroforestry. Indeed, a statistical significance was found (χ^2=13.475; p=0.036). Most of the "diversifiers" and "simplifiers" are favorable to agroforestry, whereas "conservative" are mostly undecided and opposed to agroforestry. The diversifiers tend to adopt new practices and new productions, then the result is not surprising for this class of farmers. On the other hand, the simplifiers are globally favorable to agroforestry (n=9/14). We can assume that they have simplified their production system and may have more time available to consider AFS.

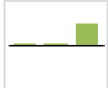
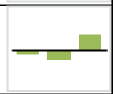
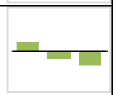
➔ Changes projects, recent investments and current innovation [Hypothesis 2]

Farmers who have **changes projects** during the next future (χ^2=8.478; p=0.014) and, to a lesser extent, farmers who made **recent investments** (χ^2=3.855; p=0.146) are more inclined to accept agroforestry. This is consistent with the logic of farm dynamics: a farmer making investments and planning change is more open to new opportunities. In addition, farmers who have a stable **farm management**, called "cruising management", tend to be more open to AFS.

However, farmers **working on an innovation** (at the time of the survey) are not more favorable to the prospect of agroforestry projects (χ^2=0.334; p=0.846) This might be explained by the fact that there are busy with changing systems or adopting a new practice, hence they cannot devote time to such project at this time.

➔ Degree of innovation and agroforestry? [Hypothesis 8]

When assessing the adoption new practices, it is interesting to assess the **degree of innovation** of farmers through the existing practices. To do so, we created a subjective indicator based on farmer's agricultural practices (*Appendix 14*). This indicator was made to assess the degree of innovation of farmers through the settlement of certain practices (crop rotation, biological control, varietal blends, etc.). We can observe that farmers opposed to AFS have the lowest score (21), and favorable farmers have the highest score (27), with undecided in-between (23), although it is just a trend (F=1.827; p=0.178).

Statements		Group 1 "Favorable"			Group 2 "Undecided"			Group 3 "Opposed"			P-set			KW (p)	Sparkline
		M	SE	0	M	SE	0	M	SE	0	M	SE	0		
A7	I prefer to observe how it goes with my neighbors before testing agroforestry	**0.1**	2.3	0	**0.1**	1.2	3	**1.4**	1.5	2	**0.3**	1.8	5	0.43	
A8	It's hard not to do like your neighbors, it requires courage	**-0.3**	1.6	3	**-0.7**	1.9	1	**1.0**	1.4	3	**-0.2**	1.8	7	0.28	
A9	To get things moving with farmers, you need to talk about money, subsidies and profitability	**0.5**	1.8	0	**-0.5**	1.6	0	**-1.0**	2.8	0	**-0.2**	2.0	0	0.25	

When we analyze the statements, this tendency is also visible. The "opposed" farmers affirm that rather prefer to observe innovations on neighbors fields **[Statement A7]** and also assure that doing differently from his neighbor requires courage **[Statement A8].** This is a good example of the conservative behavior of "opposed" farmers.

➔ Farmer's group involvement

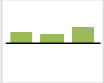
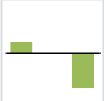
No statistical link was found between farmer's group involvement and the acceptability of AFS (χ^2=0.283; p=0.868). This could be explained by the fact that AFS are poorly developed in the area, farmers' groups have no local references to deal with.

3.4.3 The farm in its environment

Besides the farm's characteristic, some external factors can influence farmers' choices regarding new practices. Some territorial issues or specific characteristics of the "small agricultural region" are important to take into account.

➔ Land-property and agroforestry? [Hypothesis 1]

The **land tenure** is one of the most significant factors influencing farmers' adoption in our sample (F=4.657; *p*=0.017). Indeed farmers who have the highest land-leasing ratio are the most opposed farmers (83% of land leases).

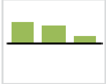
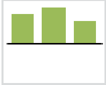
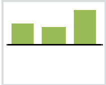
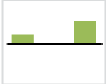
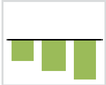
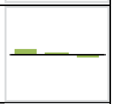
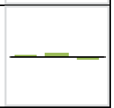
Statements		Group 1 "Favorable"			Group 2 "Undecided"			Group 3 "Opposed"			P-set			KW (p)	Sparkline
		M	SE	0	**M**	SE	0	**M**	SE	0	**M**	SE	0		
D4	You must own your lands to do agroforestry	**0.6**	2.0	4	**0.5**	1.8	1	**1.0**	1.9	0	**0.7**	1.8	5	0.82	
D5	I don't want to plant trees for my owner's grandchildren	**0.5**	1.8	5	**0.6**	2.2	2	**0.6**	1.8	1	**0.6**	1.9	8	0.93	
D6	Long-term leases or a lower land rent could convince me doing agroforestry	**0.1**	1.6	3	**-0.2**	2.0	1	**-2.2**	1.1	0	**-0.5**	1.9	4	0.06	
D7	I am ready to discuss about agroforestry with my owners in a win-win approach	**0.5**	1.1	4	**-0.1**	1.4	4	**-1.8**	1.6	0	**-0.2**	1.5	8	0.05	

All the farmers agree on the fact that owning their lands is an essential condition for agroforestry **[Statement D4; D5]**, although their opinion is not deep-rooted on this topic. *"I don't want to plant trees for my owner's grandchildren"* is a sentence expressed by the vice president of the Agricultural Chamber and wins unanimous support from farmers. However, some farmers from the "favorable" group would be more open to plant trees on rented lands if they had something in return **[Statement D6; D7].** This could be, for example, a lower rent or the guarantee to have a long-term lease on precarious lands. Such lever was identified by Agroof to solve the land tenure issue, it does not seem to receive a clearly positive reception from farmers. After further work and with concrete propositions, this solution could be proposed again.

a) Agriculture and water resource

➔ Water quality [Hypothesis 4]

The **water quality** is a strong territorial issue in the area, source of many reactions. Although most of the farmers agree with the fact that agriculture has an impact on water quality, we can observe that favorable farmers admit it more easily than opposed farmers, who claim that **other human activities** have a greater impact on the water than agriculture. In the same way, farmers who have **proper information on water quality** tend to be more favorable to AFS (χ^2=1.385; p=0.500) compared to undecided and opposed farmers who mentioned a *“lack of transparency”* regarding water quality.

Statements		Group 1 "Favorable"			Group 2 "Undecided"			Group 3 "Opposed"			P-set			KW (p)	Sparkline
		M	SE	0	M	SE	0	M	SE	0	M	SE	0		
A10	Agroforestry can play a filtering role, especially in water catchment areas	**1.3**	1.3	1	**1.1**	1.5	1	**0.4**	1.8	2	**1.0**	1.5	4	0.50	
A11	Farmers have an image of polluters with society	**1.9**	0.9	1	**2.3**	0.9	0	**1.4**	1.5	0	**2.0**	1.1	1	0.38	
A12	I am aware of the water issue in the watershed and I think about techniques to improve water quality	**1.4**	1.0	0	**1.1**	1.5	3	**2.2**	1.1	0	**1.4**	1.3	3	0.33	
A13	There are much more interesting techniques than agroforestry to protect water	**0.5**	0.8	4	**0.0**	0.9	7	**1.4**	1.3	2	**0.5**	1.0	**13**	0.07	
A14	It would be better to impose agroforestry	**-1.5**	1.6	2	**-2.2**	0.9	0	**-2.8**	0.4	0	**-2.0**	1.3	2	0.16	
A15	Agroforestry is good alternative to other input reduction measures	**0.3**	0.8	4	**0.1**	1.5	4	**-0.2**	2.0	2	**0.1**	1.3	**10**	0.66	
A16	I would be ready to do agroforestry within the close perimeter of protection	**0.1**	1.1	6	**0.2**	1.5	7	**-0.2**	2.0	2	**0.1**	1.4	**15**	0.77	

On the water issue, farmers often reached a consensus. Within a water catchment area, the tension is palpable **[Statement A11]** and farmers are often accused of contamination water: *“I am regularly insulted of polluter by locals”*. The urban context intensifies as well this phenomenon. However, farmers mostly argue that they are aware of the water issue, and some of them actually made changes in their farming systems according to that problem **[Statement A12]**. The main practices actually adopted in relation to the water issue are grass strips and agri-environmental measures (PEA).

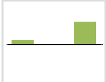
Regarding the role of agroforestry in a WCA, farmers have mixed feelings. On the one side they admit that agroforestry is an interesting practices regarding water issue **[Statement A10]**, but on the other side they seem to be extremely prudent toward the application on their farms **[Statement A13; A15; A16].** They also strongly agree on the fact that agroforestry should not be imposed **[Statement A14].**

➔ Agri-Environmental Measures [Hypothesis 3]

Half of the farmers involved in an **agri-environmental measure** are favorable to agroforestry; whereas the repartition of non-involved farmers is homogeneous among the acceptation classes. This tendency is though not statically significant (χ^2=0.696; *p*=0.706).

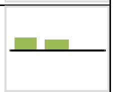
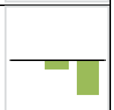
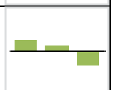
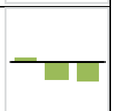
➔ Land pressure [Hypothesis 4]

The **land pressure** is felt by the majority of farmers (n=27/36) in the area and hence does not show a particular influence on farmers' adoption classes of agroforestry systems (χ^2=0.336; *p*=0.845).

Statements		Group 1 "Favorable"			Group 2 "Undecided"			Group 3 "Opposed"			P-set			KW (p)	Sparkline
		M	SE	0	M	SE	0	M	SE	0	M	SE	0		
E1	Soon, the whole region will be a protected area, Natura 2000 or whatever	**0.3**	0.8	7	**0.0**	0.9	5	**1.4**	1.5	2	**0.4**	1.1	14	0.19	

➔ Technical advice & Lack of references [Hypothesis 5]

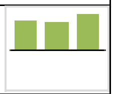
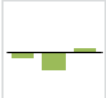
In our sample, the previous **knowledge of agroforestry systems** does not influence statistically farmers' choice. However, when we analyze the statements, we can observe interesting tendencies.

Statements		Group 1 "Favorable"			Group 2 "Undecided"			Group 3 "Opposed"			P-set			KW (p)	Sparkline
		M	SE	0	M	SE	0	M	SE	0	M	SE	0		
E4	If I had technical-economical references in agroforestry I would probably take the plunge	**0.5**	1.3	2	**0.0**	1.1	3	**-1.2**	1.1	2	**0.0**	1.3	7	0.04	
E5	If I see agroforestry plots in the Nord region, I will have a better idea of system	**0.8**	1.3	3	**0.7**	1.2	4	**0.0**	1.2	2	**0.6**	1.2	9	0.49	
E6	I would do agroforestry if Chambers or Agriculture or other professional organizations advise me	**0.0**	1.0	4	**-0.5**	1.4	3	**-1.8**	1.6	2	**-0.5**	1.4	9	0.15	
E7	Industry should support us on Agroforestry	**0.6**	0.9	6	**0.3**	2.1	1	**-1.0**	1.0	2	**0.2**	1.5	9	0.09	
E8	In Nord-Pas-de-Calais, in terms of technical information for farmers, there is not much	**0.2**	1.5	2	**-0.9**	0.6	2	**-1.0**	2.0	0	**-0.5**	1.4	4	0.20	

Indeed, favorable and opposed farmers often disagree on this topic. For favorable farmers, there is a real need for **local references** of agroforestry systems **[Statement E4; E5]** whereas opposed farmers do not perceive the need for local references. The **technical advises** and support raised the same reactions **[Statements E6; E7; E8]**, favorable farmers are not fully satisfied with the technical advice in the region, whereas opposed farmers claim to have proper agricultural advices.

➔ Agricultural policy

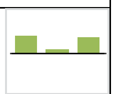
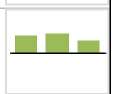
All the farmers strongly agree that the agricultural policies do not fit agriculture's need **[Statement E2]**. On the other hand, they have a mixed opinion on subsidies for agroforestry projects: *"of course [subsidies] can help but you have to be convinced before planning such a project"* mentioned a farmer on **[Statement E3].**

Statements		Group 1 "Favorable"			Group 2 "Undecided"			Group 3 "Opposed"			P-set			KW (p)	Sparkline
		M	SE	0	M	SE	0	M	SE	0	M	SE	0		
E2	Bureaucrats deliver stuffs without setting foot in the fields	**1.8**	1.7	1	**1.8**	1.2	2	**2.8**	0.4	0	**2.0**	1.4	3	0.30	
E3	The only interest of agroforestry is SET (CAP subsidies)	**-0.4**	2.1	3	**-1.0**	1.8	2	**0.2**	1.1	3	**-0.5**	1.8	8	0.45	

3.4.4 Farmers' vision of agroforestry systems

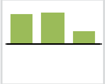
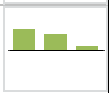
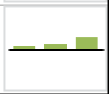
a) What type of project a priori? [Hypothesis 6]

As we have seen in the previous parts, farmers are more open to hedge than to intra-plot agroforestry systems (Cf. supra Table 5). This is confirmed by the Q-method **[Statement B2]**. Farmers can well distinguish between both systems **[Statement B3]** and they would give priority to hedges.

Statements		Group 1 "Favorable"			Group 2 "Undecided"			Group 3 "Opposed"			P-set			KW (p)	Sparkline
		M	SE	0	M	SE	0	M	SE	0	M	SE	0		
B2	I prefer hedges than agroforestry (alley cropping)	**1.1**	1.0	4	**0.2**	1.4	1	**1.0**	0.8	2	**0.7**	1.2	7	0.33	
B3	Hedges and agroforestry (alley cropping) meet very different objectives	**1.1**	1.4	4	**1.2**	1.1	1	**0.8**	1.3	3	**1.1**	1.2	8	0.76	

b) Agronomic vision

In general, farmers do not disagree on the agronomic vision of agroforestry systems. If the agri-environmental aspect of agroforestry on soil erosion, run-off, soil fertility and nutrient leaching are acknowledged **[Statement C1, C2, C5]**, farmer have more doubts on the role of tree for water infiltration **[Statement C3]**. The weed invasion due the grass strip between trees is often seen a constraint, in our sample it is moderate **[Statement C7]**.

Statements		Group 1 "Favorable"			Group 2 "Undecided"			Group 3 "Opposed"			P-set			KW (p)	Sparkline
		M	SE	0	**M**	SE	0	**M**	SE	0	**M**	SE	0		
C1	Agroforestry clearly plays a role against soil erosion and runoff	**1.8**	0.9	1	**2.0**	0.9	0	**0.8**	1.8	0	**1.7**	1.2	1	0.29	
C2	Agroforestry allows to regenerate soil fertility and improve their organic matter	**0.4**	1.6	0	**0.4**	1.5	2	**0.2**	1.3	1	**0.3**	1.5	3	0.92	
C3	Trees can replace agricultural drains	**-0.5**	1.8	2	**-0.7**	1.6	2	**-0.2**	1.1	3	**-0.5**	1.6	7	0.84	
C5	In Agroforestry, tree roots grow under the crops and collect the fertilizer left over by crops	**1.4**	1.0	0	**1.0**	1.3	3	**0.2**	1.6	0	**1.0**	1.3	3	0.33	
C7	One great concern with agroforestry is weed invasion	**0.3**	1.8	3	**0.3**	1.7	2	**0.8**	0.4	1	**0.4**	1.6	6	0.67	

c) Economic vision

The economic aspect of agroforestry systems was probably the most questioned issue during the Q-method. In general, farmers expressed skepticism about the economic performance of AFS **[Statement C6; C11].** It can be explained by the lack of local references, one farmer said *"we believe only what we see"*. This lack must be answered. Farmers (to a greater extent the opposed farmers) agreed that agroforestry would be adapted to less productive lands: *"it would be an enormous waste to plant trees in such fertile lands"* **[Statement C4]**.

Farmers also have reservations about the role of trees in reducing fertilizers and plant protection products **[Statement C13; C14]**.

Statements		Group 1 "Favorable"			Group 2 "Undecided"			Group 3 "Opposed"			P-set			KW (p)	Sparkline
		M	SE	0	M	SE	0	M	SE	0	M	SE	0		
C4	Agroforestry is adapted to less productive lands than we have	**0.4**	1.6	2	**0.7**	1.6	1	**1.6**	1.7	0	**0.7**	1.6	3	0.32	
C6	If the region is fertile for crops, it is also fertile for trees and we will get an amazing production	**0.1**	1.4	1	**-0.2**	1.7	1	**-0.4**	2.1	1	**-0.1**	1.6	3	0.72	
C11	In the balance sheet of agroforestry plots, trees income is the icing on the cake	**-0.2**	1.2	8	**0.3**	1.1	5	**-0.4**	0.5	3	**0.0**	1.0	16	0.38	
C13	The tree will allow me to significantly reduce the use of fertilizer and plant-protection products	**-0.6**	1.3	1	**-0.4**	1.6	1	**-0.8**	1.6	2	**-0.6**	1.4	4	0.93	
C14	Trees can replace animal manure in areas without livestock	**-0.6**	1.4	5	**-0.6**	2.0	0	**-1.0**	1.2	0	**-0.7**	1.6	5	0.88	

d) Mechanization and labor

Regarding mechanization and labor, farmers tend to be more positive towards agroforestry. Even if farmers think that sprayers will tend to widen in the future **[Statement C16]**, the adaptation to equipment does not seem to be a problem **[Statement C15]**.

Finally concerning the workload, farmers do not see the additional work as a constraint **[Statement C17]**: *"I have no idea what it represents in terms of workload but I guess it is feasible during winter"*.

Statements		Group 1 "Favorable"			Group 2 "Undecided"			Group 3 "Opposed"			P-set			KW (p)	Sparkline
		M	SE	0	M	SE	0	M	SE	0	M	SE	0		
C15	In agroforestry, one must change all the equipment	**-1.4**	0.9	2	**-1.3**	1.6	1	**-1.0**	1.4	3	**-1.3**	1.3	6	0.83	
C16	Sprayers will tend to widen	**1.1**	1.6	1	**-0.8**	1.6	3	**0.4**	1.5	3	**0.3**	1.7	7	0.06	
C17	I have no free time at all to take care of a plantation	**0.0**	1.3	5	**0.0**	1.6	2	**0.0**	2.2	1	**0.0**	1.5	8	1.00	

To conclude, the main influencing factors (showing significant results) are (i) the land property, (ii) the farm trajectory and (iii) changes projects. However, the tests also showed trends. The Q-method allowed to better explain and to illustrate those trends.

Some farms properties such as farm size, the type of agriculture, financial health or recent investments seem to be key factors in our sample. However, the production type, farmer's age, the presence of a successor or the social involvement of farmers does not seem to influence farmers' choices.

Farmers have different perceptions of agricultural innovations. They clearly perceive the environmental benefits of agroforestry systems but they are still uncertain on technical aspects. If some farmers would be ready to take the plunge with proper local references and technical advices, some other famers seem to be completely close to that farming system.

Overall, farmers are well aware of the environmental issues (soil and water quality) and the possible solutions agroforestry could provide, but they have difficulties to question their current systems. They would rather do minor adaptations than a complete change of farming system.

A synthesis of the influencing factors is presented in the next part.

3.5 Synthesis on the hypotheses

The **Table 8** presents a synthesis of the variables tested for each hypothesis formulated in the previous parts (Cf. supra §2.1.3). The hypotheses are confirmed or disproved according the statistical tests **and** the subjective opinion of the researcher, based on qualitative information and the Q-method.

Table 8: Synthesis of the hypotheses.

*** = statistically significant (p<0.05); ++ = strong influence; + = moderate influence; Ø = no relation**

Hypothesis	Variable	Result
Hypothesis 1: *"Some farms' properties can influence the adoption of agroforestry systems"*	Land property	*
	Farm's trajectory	*
	Size	+
	Type of agriculture	+
	Financial health	+
	Recent investment	+
	Production type	Ø
	Turnover	Ø
Hypothesis 2: *"Some farmers' characteristics can explain their behavior towards agroforestry"*	Change projects	*
	Workload	+ +
	Age	Ø
	Presence of a successor	Ø
	Social involvement (farmers' group)	Ø
	Current innovation	Ø
Hypothesis 3: *"Farmers complying with books of specifications for vegetables grown for industrial processing would have more difficulties to consider agroforestry systems. On the other hand, farmers engaged in environmental initiatives would be more open to the advantages of agroforestry"*	Agri-environmental measure	+
	Industry vegetables production	Ø
Hypothesis 4: *"The territorial constraints and erosion issues may influence farmer's choice to adopt agroforestry systems. The perception of territorial issues (urbanization, presence of restriction due to the water issue) can also influence its acceptability"*	Fragmented plots	+ +
	Urbanization	+ +
	Perception of the water issue	+

	Agricultural policies	+
Hypothesis 5: **“***Farmers having preliminary knowledge on agroforestry systems would adopt it more easily”*	Knowledge of AFS	+ +
Hypothesis 6: *“Farmers would prefer the traditional agroforestry systems (hedgerows and orchard-meadow systems) than intra-plot agroforestry and alley cropping”*	Hedges rather than intra-plot AF	+ +
Hypothesis 7: **“***Farmers linked to the agricultural chamber would be less willing to step in agroforestry”*	Farmers’ group	Ø
Hypothesis 8: **“***Innovative farmers would tend to be more open to agroforestry systems”*	Synthetic indicator on farming practices	+

3.6 What do agricultural technicians think about agroforestry?

If the development of an agricultural innovation mainly depends on its acceptation, what is the perception of other stakeholders about agroforestry?

Seven technicians were met, representing the main crops grown in the region. A list of these persons and their function is presented in **Table 9.** The aim was to understand what would be the constraints and the opportunities perceived by technicians for each production. They were also provided a lighten Q-Method in order to assess their perception of AFS.

Among the seven actors, almost all (6/7) knew correctly agroforestry systems. However, none of them had already seen an agroforestry plot. They had little information and little hindsight on this practice. All the stakeholders recognized the environmental characteristics of AFS, but they have mitigated opinions on its feasibility.

Most of them were **open** and **interested** to discuss about agroforestry because they see these systems as a **credible alternative** at the long-term scale. On the other hand, there were curious and ask lots of questions. Most of them deplored the **lack of hindsight** on such system in the area, but *a priori* they do not perceive AFS as unfeasible.

The advantages perceived by technicians differ according to their specialized production. Some advantages such as the **windbreak effect**, the increasing **beneficial organisms'** population or the **organic matter** input are often mentioned. On the other hand, the main disadvantages are related to the **light competition** and the need for **quality products** especially in industry vegetables production (book of specifications).

The lighten Q-method provided in *Appendix 15* does not show fundamental differences with farmers' answers. Indeed, they agree with farmers on the majority of statements (n=22/28).

From a technical point of view, **all the productions except spinach** were feasible in agroforestry systems, according to the technicians. Indeed, spinach is a leaf that requires no foreign body (tree leaves, branches, etc.) during the harvest process. But expect from spinach, all the cultures were assessed suitable to agroforestry systems. That is an important to take into account for further development projects.

Chapter 4. Discussion

4.1 Discussion about the method

4.1.1 Inherent limits of the study

As in every project, there are constraints such as time, financial and technical resources that are inherent. In the present study, working with farmers implies working according to the farming environment (climate, animals and urgent agricultural tasks). Meteorological conditions were too favorable for farming and so it was difficult to reach farmers when we wanted. The survey took longer than expected and the results were delayed.

In addition, the Chamber of Agriculture has clearly taken a stand against the development of agroforestry systems in the region. It was then even harder to reach farmers without the support of the Chamber and the access to updated farmers' contacts.

4.1.2 Reflections on the methodology

a) The limits of the approach

The aim of the survey was to obtain both quantitative and qualitative information on the influencing factors on the adoption of agroforestry. To do so, the questionnaire and the Q-method were combined in order to be complementary. However, this approach was heavy for farmers and some of them showed signs of tiredness at the end of the interview.

In some territories, farmers are highly solicited and the farms structures as well as farming systems are well known. In that case, the single Q-method can be a good solution to deal with agroforestry adoption in a more direct way, saving the researcher and farmers time.

For further development projects, a **two-step approach** could be interesting. First, the **questionnaire** can be carried out with the entire sample of farmers, in order to characterize farms, farming systems and territorial issues. Second, the **collective Q-method** can be carried out with the **most relevant[20] farmers** in order to develop further the agroforestry feasibility. This approach would be less demanding for farmers and more relevant for researchers. The collective Q-method was tested and it is described below in the §4.1.3.b.

[20] "Relevant" here means the "quality of the information" given by the farmer. This should be independent of farmer's acceptability of agroforestry systems. An opposed farmer could provide very interesting arguments.

b) Reliability and validity of the research

Reliability and validity are issues that are often raised in quantitative researches. The validity and the rigor norms applied in quantitative researches are not entirely applicable to qualitative researches but are still important. Reliability and validity in qualitative research means the extent to which the data is **credible** and **trustworthy** (Bashir et al. 2008).

The sampling was done as random as possible, but due to the high refusal rate, the LMCU sometimes guided us towards the more "open" or "interesting" farmers. Darré et al. (2004) recommend to avoid bias linked to the social position of farmers and then to take into account the largest possible number of actors, including those *"ignored by the common sense"* (in our case farmers not much "open" or "interesting"). Thus, our subjective sampling might have biased the **validity** of the results. On the other hand, being "open" to surveys does not mean being "open" to agroforestry systems, on due to the lack of references on AFS and the confusion this term could engender, the word "agroforestry" was not mentioned during the interview request.

Golafshani (2003) described qualitative research as a multi-method involving an interpretive, naturalistic approach to its subject matters. This means that qualitative research study things on their natural settings, attempting to make sense of it, or to interpret phenomena regarding the meaning people bring to them. The available time and means allowed us to carry out 43 interviews (36 farmers and 7 technicians). Due to the sample size, the **reliability** of the results is moderated: the statistical analysis showed mostly trends and few significant variables. Stenbacka (2001) viewed reliability as "generating understanding" in qualitative approach to research. Since the small sample size often reveals trends, the Q-method was carried out in order to understand better those decision mechanisms and explain better the trends. This brought more reliability to the results.

These levels of **validity** and **reliability** can be enough to develop an action plan in the study area. Nevertheless, the data collected through the survey was designed to be compatible with similar surveys carried out in other territories. The present data will be enriched by other studies in order to have more statistically significant results and to publish a scientific article.

4.1.3 Q method

a) Limits

The Q-method is often criticized because it is based on a statement sorting. The detractors of the Q-method argue that the results are unreliable and cannot be applied generally. However it has been proved that the results are reproducible (Thomas et al. 1992). In the present study, this is not the objective of the Q-method, which is only relevant if the researcher digs deeper into the interviewee's opinion in order to understand how the person position himself regarding the problematic (Rajé 2007). However, some statements were confusing for farmers and needed to be rearranged early in the study.

In addition, we could observe a "Yes bias", similar to the "Hawthorne effect" (Bouletreau et al. 1999), when farmers tended more to acquiesce the statements. In our study, only 5 statements were formulated negatively. We should further pay attention to alternate positive and negative statements in order to avoid this bias.

b) Collective Q-method

During the survey, we could observe that the presence of relatives or close friends allowed a better exchange and better qualitative information. Then we decided to test the Q-method in small group (4 farmers). This was done to assess the relevance of a collective Q-method and the improvement of information's quality.

Although the results do not change substantially between the individual Q-Method and the collective Q-Method (Cf. Appendix 16), the collective method has created a participatory emulation and provides much more qualitative information. Farmers' group has to reach a consensus on each statement, and it helps to have rich and interesting discussions because opinions often diverge. Farmers must adduce their arguments in order to ultimately reach an agreement.

4.2 Discussion about the results

4.2.1 Synthesis and comparison of the results

The chart below presents the main factors influencing agroforestry adoption in our study territory. There are in some cases, statistically significant links, but on other cases, tendencies and subjective opinions of the researcher. In fact, the innovation's adoption process is a complex phenomenon in which numerous factors are involved. The **Figure 46** represents the synthesis of influencing factors for the adoption of agroforestry systems.

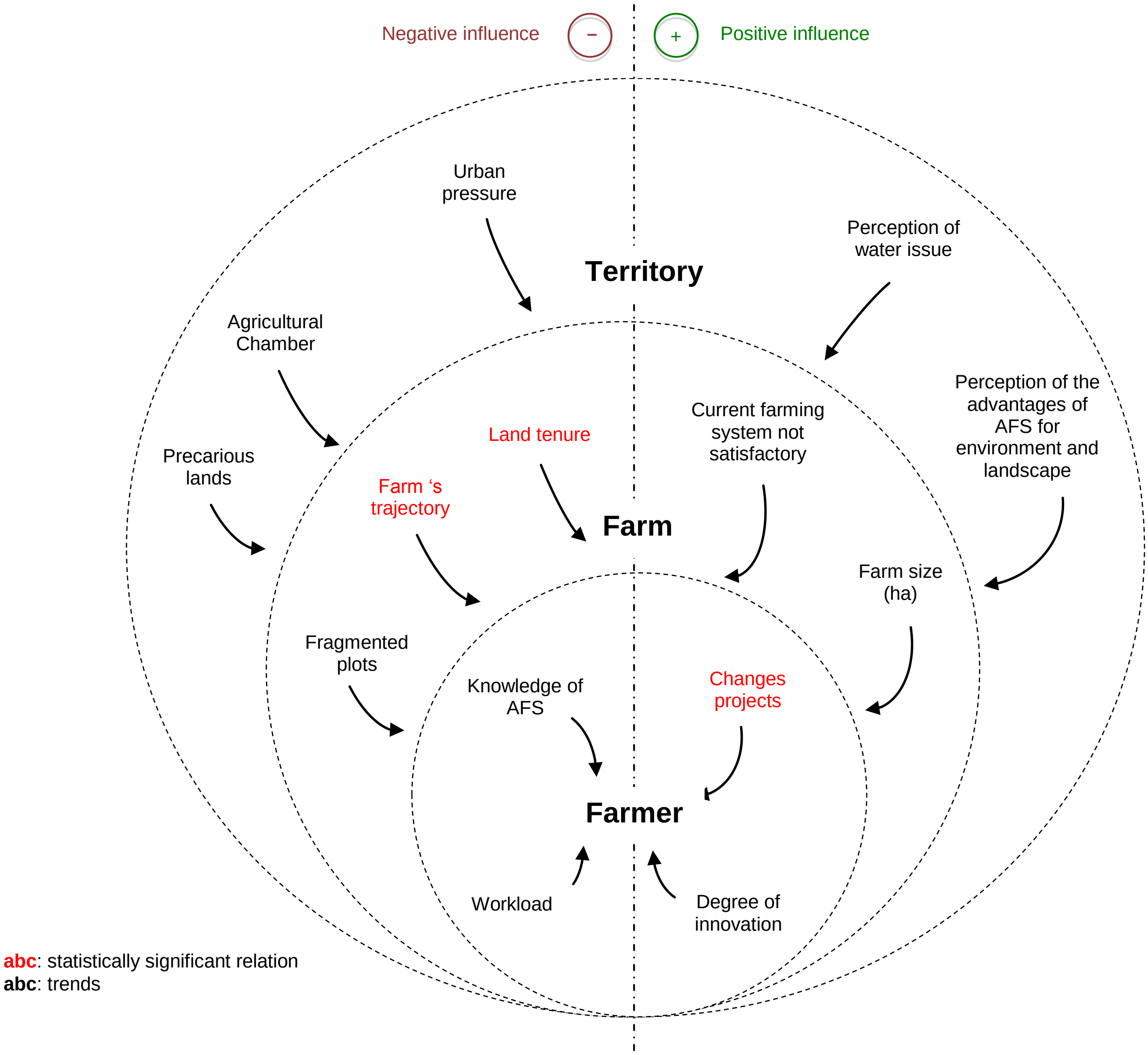


Figure 46: Synthesis of the factors influencing the acceptation of agroforestry systems in the study area, for each level of analysis

Although the agricultural context of Lille-South is different from other regions in France and in Europe, the behavior towards new practices and changes is quite similar. The increasing workload and financial investment represent the main brakes to the innovation in our sample and is common to several studies (Pottiez 2006; Hamon 2007). However some motivation towards innovation such as "reducing working time" are incompatible with agroforestry systems (Boisset 2005; Pottiez 2006). The diversification of income which appeared in numerous studies is not present in ours.

Table 10 summarizes the key results regarding agroforestry in our study and in the most relevant other studies. The Cambrésis and the Escrebieux are two areas where students from ISA (higher institute of agriculture) carried out complementary studies. The are also part of the Nord-Pas-de-Calais region. The SAFE study is the main reference for agroforestry's adoption studies in Europe.

First the knowledge of agroforestry systems is higher than the European mean, but lower that other NPDC areas. The result is surprising given that there are very few local references of agroforestry systems.

Regarding the main advantages of AFS, the **role against erosion** can be found within other territories, whereas the **increase biodiversity**, **beneficial organisms** and **animal welfare** was not mentioned in the other studies. These factors are characteristics to the study area.

Concerning the disadvantages of AFS, the **increased workload** and the **mechanization** were also mentioned in other studies, but the distinctive feature in our area is the **fragmented plots.** This seems to be a major constraint.

Overall, we found 42% of farmers were favorable to at least one type of agroforestry system, 29% were undecided and 30% were opposed to any type of agroforestry. However, regarding **intra-plot agroforestry,** only **6% of farmers were favorable**. This low rate could be explained by several factors that seem to be **inherent to the local context** (urbanization, land-tenure ratio, fragmented plots…) but some other factors can be addressed (tree-crop competition, lack of knowledge, lack of local references, perception of water issues…). We will deal with the different levers identified in order to cope with those potential constraints in the next part.

In addition, this very low rate can also be explained by the formulation of the question: *"Would you agree with the establishment of agroforestry plots on your farm?"*

This formulation is very straightforward; it asks the farmer about the prospect of a **concrete agroforestry project** on his farm. This might have a "repellent" effect for farmers who have little knowledge on agroforestry systems. In other words, a farmer could be "favorable" *in theory* towards AFS, but without the necessary perspective on his own situation, he could answer "no" to this question.

4.2.2 Technical levers

a) Support for the establishment of an agroforestry system

The technical constraints were the most cited by farmers. Among them we can find constraints related to the **functioning of agroforestry systems** (tree-crop competition, mechanization, labor). These constraints are related to the lack of local references and knowledge of farmers regarding agroforestry systems. They can be addressed through training, meetings and exchanges (Cf. action plan §4.3). However, other technical constraints related to the **farming environment** such as the small, fragmented plots and industry crop production are harder to deal with, because they are inherent to the agricultural landscape. We will have to design agroforestry systems that are suitable to the local farming systems. This work has been carried out within another master thesis work by Bastien Danneels and needs to be shared with farmers.

b) The problem of land property

As expected, the **land-rent ratio** is very high in the study area (73% outside family circle). This is a major brake to the adoption of AFS because farmers are not willing to invest on lands that they do not own. On the other hand, in this area lots of farmers work on **precarious lands** such as communal lands. Some of them argued that they would be **willing to invest on agroforestry** systems if they had, for example, a lower rent or the guarantee to have a long-term lease. A document called *"Make agroforestry a lever for land-use planning"* was made during the MSc thesis in order to cope with this issue. The document deals with the legal and technical means to introduce agroforestry systems in territorial consistency and orientation schemes, such as SCoT, PCET, TVB and PLU[21]. It could be good basis to get in contact with local land-use planners and bring concrete solutions to farmers.

[21] SCoT: Territorial Coherence Program
PCET: Territorial Climate and Energy Plan.
TVB: Green and Blue Corridors. Program to improve biodiversity corridors.
PLU: Local Town Planning.

4.2.3 Social levers

The first limiting factor for the establishment of agroforestry is that the majority of land users in the area have never heard of nor seen innovative agroforestry systems. As such they miss the knowledge and experience to form a realistic picture of agroforestry (influencing their aspirations, beliefs, etc.) and they may feel incapable to become an agroforester (perceived ability).

a) The lack of knowledge on AFS

Among the study farmers, only half of them did not know agroforestry systems, and only 2 farmers already visited an agroforestry field. The lack of knowledge is mainly due to the **lack of local references** but also to the fact that interested farmers have difficulties to access proper information. Indeed, since the agricultural chamber is against the development of agroforestry systems, the study bureau Agroof will have to build a **territorial legitimacy**. It is important for such a project to build legitimacy, this implies to make themselves known and recognized as the main reference regarding agroforestry in the region, with all stakeholders (Théret 2002).

The major source of information used by farmers is specialized press (paper press and internet). And interesting way to develop the knowledge on AF could be to use that information media to reach farmers, for instance during training sessions or information meetings.

In addition, there are 30 agricultural schools and training centers in NPDC[22]. Schools of agriculture play an important role in the diffusion of alternative farming systems (Daneau 2009), thus it could be relevant to integrate the agricultural program.

b) Farmers' groups: vectors of changes

A local farmer group is *"a group of farmers that works in similar conditions and have numerous occasion to meet each other, exchange and cooperate within professional actions"* (Darré 1996). The membership in such group is essential because farmers have access to information and knowledge that are discussed at a local scale; this requires dialogue within the network. This dynamic brings the possibility to evolve and improve the **social acceptability** of diverse farming systems, including alternative systems (Darré et al. 2004).

[22] Educational or training institutions. Available at <http://www.agriculture-npdc.fr/formation-initiale.html> accessed on 01-09-2014.

For the present study, we could identity farmers' group that could be reached in order to promote and discuss agroforestry systems.

Ansaloni et al. (2006) observed that, if farmers groups were associated with the modernization of agriculture in the 60's, they are now at the origin of farm hybridization leading to more sustainable farming systems. They showed that farmers' group are places for **exchanges and learning** about sustainable agriculture and innovative practices. For the current project, 43 farmers' groups were identified, they are mentioned in *Appendix 17.* Nevertheless, we should be aware that many farmers' groups are linked with the agricultural chamber. Since the dialogue with the agricultural chamber is not open for the moment, we could favor independent farmers groups or collective Q-method.

c) Preservation of natural resources: insist on positive externalities

We have seen that the main advantages of agroforestry perceived by farmers are related to the environment. Farmers do agree that agroforestry has positive externalities on soils, water, biodiversity and beneficial organisms. The collaboration with farmers' groups and organization dealing with environmental aspects of agriculture could be fruitful.

d) Limits of the individual logic facing the need for collective and concerted actions

In a territory were multiple sectors of activities are present, we can wonder if the objective of protecting water resources could be achieved without a concerted management, between farmers and other actors. However, this goal is difficult to achieve when each sector wants to protect its own interests. Agroforestry contracts are based on individual choices to engage on this system. It is a commitment on the "means" but not on the "results", thus we can wonder on its efficiency on water quality.

In some departments, by applying incentives programs or imposing obligatory measures, stakeholders managed to solve the problem of coordination. For instance, the Nièvre department reserves a "collective bonus" of 20% on Agri-Environmental Measures (AEM) for farmers groups that contractualize on the same AEM. Bretagne region also took an original initiative for water quality by imposing 3 compulsory measures[23] (Urbano and Vollet 2005). The assessment of the efficiency of such measures is then related to the subscription of farmers, but in those particular cases, environment and water quality became issues shared by all stakeholders. In our case, the study results could be a good entry point to initiate such a collective dynamic.

4.2.4 Economical levers

a) Ignorance of the economic and technical results of AFS

Linked with the lack of knowledge on agroforestry systems, it has been observed that farmers generally raise doubts about the performance of such systems. Do they really perform well? Do trees not shade too much the intercrop? Is it really profitable? All these questions should be addressed in the following development works either by providing scientific references or by providing example of agroforestry systems in similar land-use and climate conditions (from Picardy for instance). We can also suppose that the first experimental plots will provide interesting answers to these questions in the coming years.

b) Creation of an added-value channel for agroforestry products

Given that Nord-Pas-de-Calais region is the less wooded region in France, there is a need to develop the "wood" sector. Farmers often mentioned the uncertainty on wood market as a disadvantage of agroforestry. Indeed, as for agriculture, the market outlets must be secured before taking the plunge into agroforestry. A contract between Picardy and NPDC regions was signed in February 2010. This official document expresses the will to share all the economic and institutional means in order to develop a strong wood products channel. This collective approach is symbolized by the brand "Bois&Vous" (INSEE 2010).

c) Agricultural policies

Agricultural policies are often considered as a key element in practices changes process. Indeed, through the financial support of farmers, they determine the profitability of the farming

[23] The compulsory measures are related to the adaptation of fertilization according to the analyses, the diagnosis of sensitive plots and the implementation of cover crops during winter.

system and then the decision to adopt an innovative practice (Ansaloni et al. 2006). In the region, through the “measure 222” agroforestry projects can be financed (Cf. supra §1.4.1). However no farmers met during the survey were aware of that opportunity. Further communication actions by Agroof or the regional council could focus on that point.

4.3 Action plan

In the previous part, we analyzed the main factors influencing the adoption of agroforestry in our study area. These variables shape a land user’s perception, which in turn will result in certain decisions and actions. As such, these variables can be helpful in understanding what farmers do and not do at a given point in time and can give us some **entry points** for supporting land users in trying new practices and eventually to adopt agroforestry. Thus, we can set up and **action plan** summarized in **Table 11.**

Table 11: Objectives, tools and target population for the territorial animation of the project on Lille-South water catchment area

Objectives for the animation		Tools	Contacts / target population
Awareness and communication	Communicate about the role of AFS on **water quality** (diffuse pollution, input reduction)	• Information brochure • Scientific researches	All farmers Municipalities Water agencies
	Inform on **economic and technical results** of AF	• Information brochure • Training and workshop • Fields visits in Picardy region	All farmers
	Make agroforestry a lever for **land-use planning**	• Information brochure • Meetings	Farmers working on precarious lands Municipalities Community of communes Water agencies
	Improve the **image** of agriculture in a **peri-urban area**	• Communicate on the inputs of AF for landscape planning • Workshop with all stakeholders • Collective tree-planting	Undecided and opposed farmers
	Inform on **diversity of AF systems** and the **adaptability** according to farming systems and **objectives**	• Brochures • Audiovisual media • Visiting experimental plots • Farmer’s own words (testimony)	All farmers

	Inform on the advantages of AFS for **livestock**	• Brochures • Audiovisual media • Show different modalities (pollard trees, fruit trees) and traditional AFS	Livestock farmers
	Communicate on the possibility to **add value to** the potential of **poor soils**	• Favor the experience sharing between farmers	Undecided and opposed farmers
Development activities	Continue the individual support of agroforestry projects	• Farm's diagnosis	All interested farmers
	Collaborate with **farmers' groups** in order to favor exchanges and acceptability of AF	• Meetings • Fields visits	Farmers involved in farmers' groups
	Train farmers to **tree maintenance** in AFS.	• Brochure • Audiovisual media • Workshop	Favorable farmers
	Highlight **traditional** agroforestry systems and existing **trees**	• Valorization of orchard-meadow systems • Maintenance of hedges	All farmers
	Set-up **demonstration plots** in **favorable farmers'** fields	• Organize participatory tree plating • Visit plots with other farmers • Communicate on the design and the adaptation of the agroforestry system	All farmers
	Set-up new **collective Q-method**	• Collective meetings (4-5 farmers)	All farmers
Research	Valorize the **positive externalities** of AFS	• Participatory research	Farmers' groups Organizations dealing with environmental externalities of agriculture
	Set-up **experimental plots** in agricultural schools and training centers	• Show different AF modalities for farmers • Set-up local references	Agricultural schools and training centers All farmers

Chapter 5. Conclusion

The objective of the present study was to assess the feasibility of agroforestry systems in the water catchment area of Lille-South. The feasibility study was carried out in order to understand local farming systems and to evaluate the acceptability of this innovative practice among farmers.

The agricultural landscape of this plain is characterized by mixed farms and polyculture farms growing wheat and important cash crops (potatoes, beetroots, industry vegetables). Although farmers have to deal with an increasing urban pressure, the context of "water catchment area" and more broadly the agricultural crisis, they showed a particular attachment to their cultural farming systems.

Overall, farmers perceive intra-plots agroforestry system as a sustainable farming system providing numerous agri-environmental advantages, but the profitability and the adaptation of such systems in the local context are still questioned. Consequently, among the interested farmers, they largely prefer hedges.

The agroforestry's adoption process is a complex phenomenon in which numerous factors are involved. The present study analyzed the main factors influencing this process through a questionnaire and the Q-methodology. Some factors seem to be inherent to the local context (urbanization, land-tenure ratio, fragmented plots…) but some other factors can be addressed (tree-crop competition, lack of knowledge, lack of local references, perception of water issues…).

The typology of the different level of acceptance of agroforestry systems, the different behaviors regarding agricultural innovations and the diverse perceptions of agroforestry let us see the possibility to implement several strategies for further development projects.

Different levers identified in order to develop agroforestry systems are presented in the action plan. This would include to: (i) continue the individual support of agroforestry projects in the region; (ii) communicate on the different advantages of agroforestry systems, especially on economic and technical aspects; (iii) initiate a farmers' groups dynamic, through the collective Q-method, in order to better exchange on agroforestry systems.

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Topic category:

TITLE: FEASIBILITY STUDY OF AGROFORESTY SYSTEMS IN LILLE-SOUTH WATER CATCHMENT AREA

Etude de faisabilité de l'agroforesterie dans le bassin de captage Lille-Sud

Key-words: Agroforestry, adoption, survey, Q-methodology, farmers, water catchment area

Mots clés: Agroforesterie, adoption, enquêtes, méthodologie Q, agriculteurs, basin de captage

Résumé: Les systèmes modernes d'agroforesterie (ou agroforesterie en couloir) présentent de nombreux atouts économiques et agri-environementaux, ainsi qu'une alternative crédible aux systèmes de productions traditionnels. Cette pratique agroécologique a fait l'objet de nombreuses études scientifiques probantes au court des 20 dernières années, mais peine encore à se diffuser dans certaines régions. Cette étude a été réalisée dans le cadre du programme intitulé « Amorcer le développement de l'agroforesterie en région Nord-Pas de Calais ». L'étude se concentre sur l'aire d'alimentation de captage de Lille-Sud et a pour objectif d'évaluer les potentiels d'adoption l'agroforesterie ainsi que son acceptabilité auprès des agriculteurs locaux. Ce travail s'organise autour de : (i) la caractérisation des systèmes d'exploitation ; (ii) l'analyse des comportements vis-à-vis des pratiques innovantes ; (iii) l'études des facteurs d'acceptation l'agroforesterie et enfin ; (iv) une analyse détaillée de la perception de cette nouvelle pratiques auprès des agriculteurs et des acteurs locaux. A l'aide d'un questionnaire semi-directif et de la méthodologie Q, ce rapport a mis en avant des contraintes majeures au développement de l'agroforesterie : un taux de fermage très élevé (73%), un parcellaire morcelé, une forte pression foncière et un manque de références locales. Cependant des opportunités de développement de l'agroforesterie sur le territoire existent et ont permis d'élaborer un plan d'action qui servira de base pour l'animation du territoire.

Abstract: Modern agroforestry systems (or alley cropping) present numerous economic and agri-environmental advantages as well as a credible alternative for traditional farming systems. This agroecological practice has been the subject of many scientific studies over the past 20 years but is still struggling to be adopted in certain areas. The present study was carried out within a project called *"Initiating the development of agroforestry in the Nord-Pas-de-Calais region".* The study focuses on the water catchment area of Lille-South. The objective is to evaluate the potentials for the adoption of agroforestry systems and its acceptability by local farmers. This work is based on: (i) the characterization of farming systems; (ii) the analysis of behaviors regarding innovative practices; (iii) the study of the acceptance factors of agroforestry and finally; (iv) a detailed perception study of this innovative practice among farmers and local stakeholders. Through a semi-structure questionnaire and the Q-methodology, this report highlighted the main constraints for the development of agroforestry: a high land-rent ratio (73%), small and fragmented plots, a high land pressure and a lack of local references. However numerous opportunities for the development of agroforestry on the territory exist and allowed to elaborate an action plan that will serve as a basis for further territorial coordination.

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