KU LEUVEN

FACULTY OF BIOSCIENCE ENGINEERING

Socio-economic valuation of public goods provided through agriculture: a case study of traditional orchards in Haspengouw

Socio-economische valuatie van publieke goederen voorzien door landbouw: een casestudy over hoogstamboomgaarden in Haspengouw

Promotors:
Prof. Liesbet Vranken
Dr. Francis Turkelboom
Department of Earth and Environmental Sciences
Division of Bioeconomics

Dissertation presented in
Fulfillment of the requirements
for the degree of Master of Science in
Agro- and Ecosystems Engineering

Robin Vaes

September 2017

Abstract

The presence of traditional orchards in Haspengouw is a remainder of its rich history in fruit cultivation. Since 1950, there has been a shift from traditional orchards towards more productive, large-scale modern orchards. Although only a few hundred hectares are left in Haspengouw, the number of traditional orchards is still diminishing. The majority of these remaining orchards are privately owned and are usually not profitable for their owners. In contrast, society as a whole benefits from the presence of these orchards, mainly through its ecological, bequest and scenic values. In this respect, public goods are provided through traditional orchards and thus, a case can be made for public interventions to guarantee their conservation. However, to create a socially desirable outcome for these landscape elements, conservation efforts should be based on societal preferences. As such, this thesis focuses on the attitude of people residing in Haspengouw towards traditional orchards by means of a choice experiment.

To obtain meaningful and relevant results, the composition of the choice experiment was based on interviews with policy makers and targeted respondents. After the experimental design, an online survey was used to collect data from 252 individuals living in Haspengouw. Subsequently, a multinomial logit and a mixed logit model, both commonly used models to analyse choice experiments, were estimated. Because the latter model indicated preference heterogeneity across respondents, also a latent class analysis was performed.

Resulting from the descriptive and econometric analysis of this choice experiment, the main conclusion is that there is a social demand for improving the situation of traditional orchards in Haspengouw. Our findings also suggest that there is a substantial willingness to financially contribute for the conservation of these orchards. Additionally, the characteristics of traditional orchards in Haspengouw valued most by people living in the region are discussed. Furthermore, also the arguments for their conservation are summarized. Overall, this societal information can provide valuable insights for policy makers that strive for a socially desired outcome.

Abbreviations

ASC	Alternative Specific Constant
BIC	Bayesian Information Criterion
CAIC	Consistent Akaike Information Criterion
CAP	Common Agricultural Policy
DCE	Discrete Choice Experiment
DOE	Design Of Experiments
ESS	Ecosystem Services
IEEP	Institute for European Environmental Policy
IIA	Independence from irrelevant alternatives
INBO	Research Institute for Nature and Forest
IPBES	Intergovernmental Platform on Biodiversity and Ecosystem Services
LC	Latent Class
MEA	Millennium Ecosystem Assessment
MNL	Multinomial Logit
MWTP	Marginal willingness to pay
MXL	Mixed Logit
OECD	Organisation for Economic Co-operation and Development
PES	Payment for Ecosystem Services
RP	Revealed Preference
RU	Random Utility
SES	Social-Ecological Systems
SP	Stated Preference
WTP	Willingness to pay

List of tables

List of figures

Table of contents

1. Introduction

Haspengouw, which is the geophysical region in the southern part of the province Limburg in Belgium, has a rich history in fruit cultivation. Until the first half of the nineteenth century, fruit cultivation was limited to castle domains and small orchards used for own consumption by farmers. The realisation of a rail network around 1850 lead to an increase in export possibilities, and consequently to the start of commercial fruit cultivation in the region. Traditional orchards and its associated fruit industry have led to an unique and diverse landscape in Haspengouw. However, since the Second World War, there has been a shift from traditional orchards towards more productive, less labour-intensive modern orchards (Diriken, 2013). Due to this shift in production methods, the total area of traditional orchards has significantly decreased over the last 60 years, to the point where there are only a few hundred hectares left.

Resulting from this significant reduction, the public appreciation for traditional orchards, especially for its ecological, bequest and scenic values, has increased in the last three decades (NBS, 2015). Although several organisations, including *Nationale Boomgaardenstichting* and *Regionaal Landschap Haspengouw en Voeren*, strive for the conservation of traditional orchards in Haspengouw, the number of traditional orchards is still diminishing. Recently, the Flemish agency for Immovable Heritage (known as *agentschap Onroerend Erfgoed*) started a participative project to create a shared vision which should lead to sustainable measures in order to guarantee the conservation of traditional orchards.

The majority of the remaining traditional orchards in Haspengouw are privately owned. As keeping a traditional orchard in Haspengouw is not profitable anymore, the cost and benefits are not evenly distributed. While the owners of these orchards bear the cost associated with them, they only get limited benefits from its harvest. In contrast, society as a whole benefits from the presence of traditional orchards, primarily through landscape aesthetics. Furthermore, traditional orchards are considered cultural heritage in Haspengouw and inherently connected with the identity of the region.

In this respect, public goods are provided through traditional orchards in Haspengouw. As such, the literature review in this thesis starts with an overview of the theory of public goods provided through agriculture in general. Subsequently, the closely related concept of ecosystem services is elaborated. The decline in the number of traditional orchards in Haspengouw can be seen as the result of trade-offs between cultural and other ecosystem services. After describing both concepts, the newly-emerging, overarching framework of Social-Ecological System is introduced.

To create a socially desirable outcome for traditional orchards in Haspengouw, policy measures should be based on societal preferences. In this thesis, the preferences of people residing in Haspengouw are investigated by means of a choice experiment.

2. Objective

The general objective of this thesis is to describe the attitude of people living in Haspengouw towards traditional orchards. This societal information can provide valuable insights for policy makers that strive for a socially desired outcome.

To make the general objective more specific, two research questions are specified. The first research question is whether inhabitants of Haspengouw care about traditional orchards in their region. Do people think it is essential that traditional orchards in Haspengouw are conserved? Do they wish for an improvement in the situation of traditional orchards and move away from the business as usual scenario? In other words, is there a demand for public interventions? The second research questions is which characteristics of traditional orchards are valued most by people residing in Haspengouw. On which aspects should conservation efforts focus to reflect societal preferences? Additionally, the willingness to pay and the arguments for the conservation of traditional orchards are also investigated.

3. Literature review

3.1 Public goods

The public goods concept is well established in neoclassical economic theory and is developed by Samuelson (1954) and Musgrave (1959). Public goods are defined as goods which are non-rival and non-excludable (Buckley and Croson, 2006). Non-rivalry connotes with the situation in which one person's consumption of the good does not reduce the amount available to others. Non-excludability means that when a good is available to one person, others cannot be excluded from using it as well. In contrast to public goods, private goods are goods of which the consumption is both rival and excludable.

Whether a specific good is a public good, depends on its biophysical character. In reality, both the characteristics of non-rivalry and non-excludability are not entirely 'present' or 'not present' but can vary between these two extremes (IEEP, 2009). As such, goods can be classified along a 'continuum of publicness' as represented in Table 1. Regarding non-rivalry, it is important to consider congestion, which indicates that the benefit gained by a single user of a good is depleted when the number of users exceeds a certain threshold (Fisher and Turnovsky, 1998). A straightforward example is a highway between two cities. In normal conditions a highway is a non-rival good, however, if many people use the highway at the same time, it will result in a traffic congestion. Regarding non-excludability, it is often theoretically possible to establish exclusion mechanisms, but these are usually impractical and too costly.

Table 1: Classification of goods according to their degree of publicness (adapted from IEEP, 2009)

Degree of Publicness			
Low	***Medium***		***High***
Private Good	**Club Goods**	**Impure Public Good**	**Pure Public Good**
Rival and excludable.	Excludable and non-rival for a small user group. Subject to congestion as the number of users increases.	Excludable only at high costs and non-rival, but certain risk of congestion.	Non-rival and non-excludable.
Examples: Timber, Bread	Examples: Golf course, Cinema	Examples: Landscapes, Hiking trail	Examples: Biodiversity, Lighthouse

Classic economic theory predicts that, under free market conditions, private goods are supplied at an efficient level as a result of the interplay between supply and demand. However, these market mechanisms do not function for the provision of goods with a high degree of publicness (Bergstorm *et al*., 1986). This results from the defining characteristics of public goods, non-excludability and non-rivalry in consumption, which imply that consumers have no incentive to pay for public goods because they cannot be excluded from using it. These circumstances are likely to result in 'free-rider' behaviour (Moore, 1995). On the supply side, economic actors who are in a position to provide the public good have no incentives to provide them because there is no compensation for their efforts. This leads to a market failure; the supply of the public good is lower than the societal demand. In some cases, certain quantities of a public good are provided as an unintended side-effect of economically viable activities, which is known in economic theory as a positive externality (Willinger and Ziegelmeyer, 1999). However, unless the societal demand is satisfied by incidental delivery, public interventions are required to move provision of public goods closer to a social optimum. Three kinds of policy actions are usually suggested to augment the supply of public goods in line with social demand: direct provision of the goods by public intervention (e.g. management of a nature reserve by government); using market instruments to internalize benefits and costs (e.g. subsidies to increase supply of public goods by private actors); or establishing regulations in order to place obligate private actors to provide public goods (e.g. obligation of homeowners to take care of their facade) (PEGASUS, 2015).

3.1.1 Public goods provided through agriculture

Agriculture is still the most dominant land use in Europe, accounting for approximately half of its territory (EEA, 2006). In the last two centuries, many low intensity farming systems have been transformed into more productive farming systems which are characterised by intensification and increased efficiency. This is a result of technological advances which are driven by the increasing demand for food and other materials and which are stimulated by market forces and policy drivers. However, these gains in productivity have not been without environmental and social costs (IEEP, 2009). Agriculture has a major impact on the environment, especially on land use, water availability, soils, landscapes and biodiversity. As such, it is generally recognised that there is a need to reduce the harmful and enhance the beneficial impacts of agriculture on the environment.

A wide range of public goods are associated with agriculture, many of which society highly values. Public goods provided through agriculture can take the form of physical entities as well as the form of services. All these public goods arise from the interplay between farming activities, the natural world, biophysical conditions and socio-cultural processes (Cooper *et al*., 2009). Examples of public goods associated with agriculture include resilience to flooding and fire, agricultural landscapes and farmland biodiversity. Additional to the inherent value of public goods provided through agriculture to society, a range of second order economic and social benefits, such as rural tourism, recreation, employment opportunities, sustaining social capital and cultural identity in rural areas, rely on the existence of these public goods (IEEP, 2009). A number of studies have investigated the economic benefits from attractive agricultural landscapes, historical features, the presence of farmland biodiversity, or a combination of these (Mills *et al*., 2000; Viladomiu and Rosell, 2004; Courtney *et al*., 2006). These studies conclude that the provision of public goods, such as the maintenance of attractive farmland features, can provide economic benefits for the local community by providing opportunities for employment, rural tourism and specialty products and foods.

The provision of public goods through agricultural activities is limited by a combination of the need to deliver private goods (food, fibre, industrial materials) to the public on a large scale and the fact that land is a finite resource (Havlik *et al*., 2005). A such, a balance needs to be found between the relative levels of supply of different private and public goods in line with society's interest.

Historically, many of the public goods associated with agriculture have been supplied incidentally, as unintended side-effects of economically viable activities, or as a result of farmer altruism or self-interest (Gliessman, 2010). If a certain public good is provided incidentally and in quantities which correspond with the societal demand, it is not necessary to intervene to secure the provision of the respective public good. However, the future provision of these public goods is not always guaranteed. For example, technological innovation and increased competition due to globalisation drive traditional agricultural systems (e.g. traditional orchards), which are often associated with a wide range of public goods, to more profitable forms of land use (e.g. modern orchards). In such cases, the opportunity costs linked with the continuation of traditional land management increase, resulting in a threat for the further provision its associated public goods. If there is an undersupply of certain public goods compared to the societal demand, it is the role of the relevant governing body to steer allocation of production factors to stimulate supply in order to satisfy society's needs (Shepsle and Weingast, 1984).

3.1.2 Bearing the costs: farmer versus tax-payer

As argued in the previous section, when there is an undersupply of certain public goods associated with agriculture, some form of public intervention is needed to scale up their supply in accordance with societal demand. In practice, farmers will be steered to allocate their private resources in order to deliver a socially desired outcome (Chang, 2009). This socially desired outcome is likely to differ from the situation in which farmers only follow market signals. For example, an economically rational farmer will replace his traditional orchards for more profitable uses of land, even though these traditional orchards are highly valued by society. As there are often significant costs associated with changing allocation of production factors towards the provision of public goods, there is an important consideration to be made. Who should bear the costs: the farmer or the tax-payer?

In order to distinguish between those cases where the cost of reaching certain environmental outcomes fall onto the farmers, and those cases where farmers are remunerated for providing public goods, the Organisation for Economic Co-operation and Development (OECD) developed the concept of the 'reference level' (OECD, 1998; OECD, 2001). This reference level defines the dividing line between the environmental responsibility farmers are expected to assume at their own expense, and those actions that deliver environmental quality beyond this level (see Figure 1). By establishing regulation and setting mandatory standards, enforced by means of some penalty on those farmers who fail to comply, it is possible to ensure that the environmental quality does not drop beneath the reference level. In different societies, reference levels may be set at different levels. Furthermore, these levels can change over time in response to changes in what is considered as fair (Chang, 2009). Nonetheless, according to Hodge (2008), there are certain generally agreed rules about responsibilities in EU's agricultural context, which allow appropriate reference levels to be determined.

To encourage farmers to take actions that provide environmental quality beyond mandatory standards and to satisfy societal demand, an economic incentive is required. To illustrate this, assume that a certain farmer owns a plot of land that provides a habitat for rare species, and that he has the right to convert the plot of land to a more profitable land use. However, if the farmer is offered a payment sufficient to cover his income forgone, he may be willing to maintain the habitat in line with society's biodiversity interests. In order to stimulate voluntary supply of public goods associated with agriculture, a range of mechanisms exist, including incentive payments and market based instruments (Jack *et al.*, 2008).

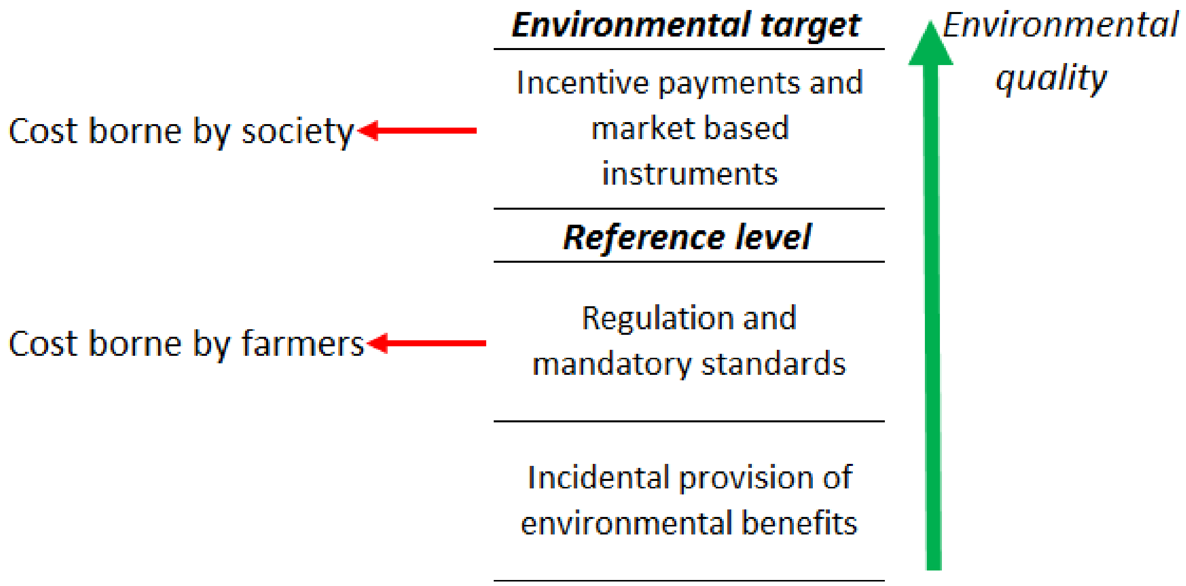


Figure 1: Reference level and environmental targets (adapted from IEEP (2009), based on OECD (2001))

3.1.3 Agricultural landscapes

Over the last several thousand years, agriculture has transformed Europe's wooded climax vegetation to open, agricultural landscapes. In Europe, agricultural landscapes are highly diverse and locally distinctive. Over time, society began to cherish many of these man-made landscapes in terms of its ecological, aesthetic and socio-cultural character (Déjeant-Pons, 2006). Agricultural landscapes are composite entities, which reflect the physical environment and local topography, and which comprise socio-cultural and natural heritage as well as an ecological infrastructure. These landscapes have evolved over time as a result of a complex, and often regionally specific, interactions between natural and cultural factors driven by environmental and socio-economic forces (Wascher, 2004). The development of more competitive agricultural systems has led to the disappearance of farming activities that generated some of these characteristic landscapes. A clear example hereof are traditional orchards in Haspengouw; while these orchards contribute to the region-specific and appreciated landscape, the traditional orchards are no longer competitive in the present economic climate. The Common Agricultural Policy (CAP), the agricultural policy of the European Union, stresses out the importance of preserving traditional agricultural landscapes because these landscapes form part of the natural and cultural heritage and because of the ecological integrity and scenic value of these landscapes (Gray, 2000).

Agricultural landscapes display a high degree of publicness. It is almost impossible, or at least not practically feasible, to exclude anyone from experiencing the benefits of an attractive landscape. Also rivalry in consumption is usually limited, albeit congestion can occur in popular areas, when a single person's benefits from experiencing the landscape declines because of large number of other visitors (IEEP, 2009). Certain traditional agricultural landscapes are also associated with significant existence values; although individuals might not experience the specific landscape directly, they may obtain satisfaction from knowing it exists (Swanwick *et al.*, 2007).

For agricultural landscapes and certain other public goods like habitats for particular species, their existence is inherently linked to certain types of agricultural activity (Gliessman, 2010). Furthermore, limited possibilities exists for these types of public goods to be provided through alternative land uses. The close interrelationship between these valued environmental public goods and certain characteristics of the agricultural system with which they are associated results from the co-evolution of the landscape and the adaptation of many species to agriculture over a significant time period (Havlik *et al*.,2005). In contrast, other public goods associated with agriculture, such as increased resilience to flooding, do not depend on agricultural activity *per se* for its provision and could be provided by alternative forms of land use.

3.2 Ecosystem services

An ecosystem is a dynamic complex of plant, animals, microorganism communities and the non-living environment interacting as a functional unit (Biggs *et al*., 2012). Ecosystems range from undisturbed landscapes, such as natural forests, to systems intensively managed and modified by humans, such as agricultural land and urban areas.

Ecosystem services (ESS) are the direct and indirect contributions of ecosystem services to human well-being. The Millennium Ecosystem Assessment (MEA, 2005) classifies ESS into four broad types of services to society: provisioning services, regulating services, cultural services and supporting services. Provisioning services are the products obtained from ecosystems, including food, fibres, biomass fuels and fresh water. Regulating services are the benefits obtained from the regulation of ecosystem processes, examples include carbon sequestration, water purification and waste decomposition. Cultural services are the nonmaterial benefits people obtain from ecosystems through spiritual enrichment, recreation, aesthetic experiences and cognitive development. The importance of cultural services, such as cultural heritage, recreation and ecotourism, is often underestimated. Although it is usually difficult to quantify the value of these cultural services, they are nevertheless important for society (Norton et al., 2012). For many local communities, both in industrial countries (e.g. urban parks) and developing countries (e.g. sacred trees in India), cultural values are as meaningful as other services provided by ecosystems. Supporting services are services that are necessary for the production of all other ecosystem services. Examples of supporting services include soil formation, photosynthesis and nutrient recycling (MEA,2005).

Humanity puts effort in engineering ecosystems to produce cheap and reliable desired ecosystem provisioning services. However, these efforts often overlook the fact that ecosystems simultaneously produce multiple ecosystem services (Rodriguez *et al*., 2006; Brauman *et al*., 2007). Ecosystem management that attempts to maximize the production of one ecosystem service often results in substantial declines in the provision of other ecosystem services. This trade-off is often most significant for provisioning services versus regulating and cultural services (Bennett *et al*., 2009). For example, by converting traditional orchards into modern orchards, provisioning services (fruit production) will increase. At the same time, however, cultural services (aesthetic beauty of the landscape) will decline. Lele *et al*. (2013) state that policy makers are increasingly demanding economic valuations of how ESS loss may impact human well-being. Payment for ecosystem services (PES) is a method to translate values of non-marketed ESS into financial incentives for local actors to provide these services to society (Rowcroft *et al*., 2011). PES are financial incentives offered to farmers or landowners in exchange for managing their land to provide ecosystem services desired by society.

3.3 Social-Ecological Systems

While the public goods approach emphasizes the phenomenon of market failure and focuses on private benefits versus public benefits, the ESS concept focuses on the environmental processes by which natural and human elements of ecosystems interact. Both concepts can help to analyse issues and propose solutions to promote a greater provision of environmental and social benefits from agricultural activities. Furthermore, analyses of agricultural issues which use public goods or ESS as conceptual starting points show considerable overlap in coverage and concerns (Dwyer *et al*., 2015). Insights from both concepts can be embraced within the newly-emerging, overarching framework of Social-Ecological Systems (SES).

For a better understanding of the world around us, social scientist and ecologists have worked within their academic disciplines to develop a range of methods and models to examine how humans interact with the environment (Raufflet, 2000). However, most researchers looked for answers within the boundaries of their discipline and neglected the interrelationship between social and ecological systems. As humans are an integral part of practically all ecosystems, it is no longer reasonable to study social and ecological systems in isolation from one another (Redman *et al*., 2004). As such, the overarching SES concept is gaining popularity. SES are linked systems of people and nature, emphasizing the close interdependencies between natural and man-made factors and processes which function in an integrated way (Raufflet, 2000). Berkes *et al*. (2002) state that social and ecological systems are in fact linked and that the delineation between them is artificial and arbitrary.

The ability of the SES approach is to embrace different disciplines (ecology, economics, cultural and socio-political knowledge) within a coherent framework is perhaps its most valuable characteristic. However, the approach is still under active development and thus far, its policy application has been limited (Dwyer *et al*., 2015). Recently, a number of SES frameworks have been developed (Redman *et al*., 2004; Biggs *et al*., 2012; Anderies *et al*., 2014). The SES framework proposed by Redman *et al*. (2004) is the most straightforward one (see Figure 2).

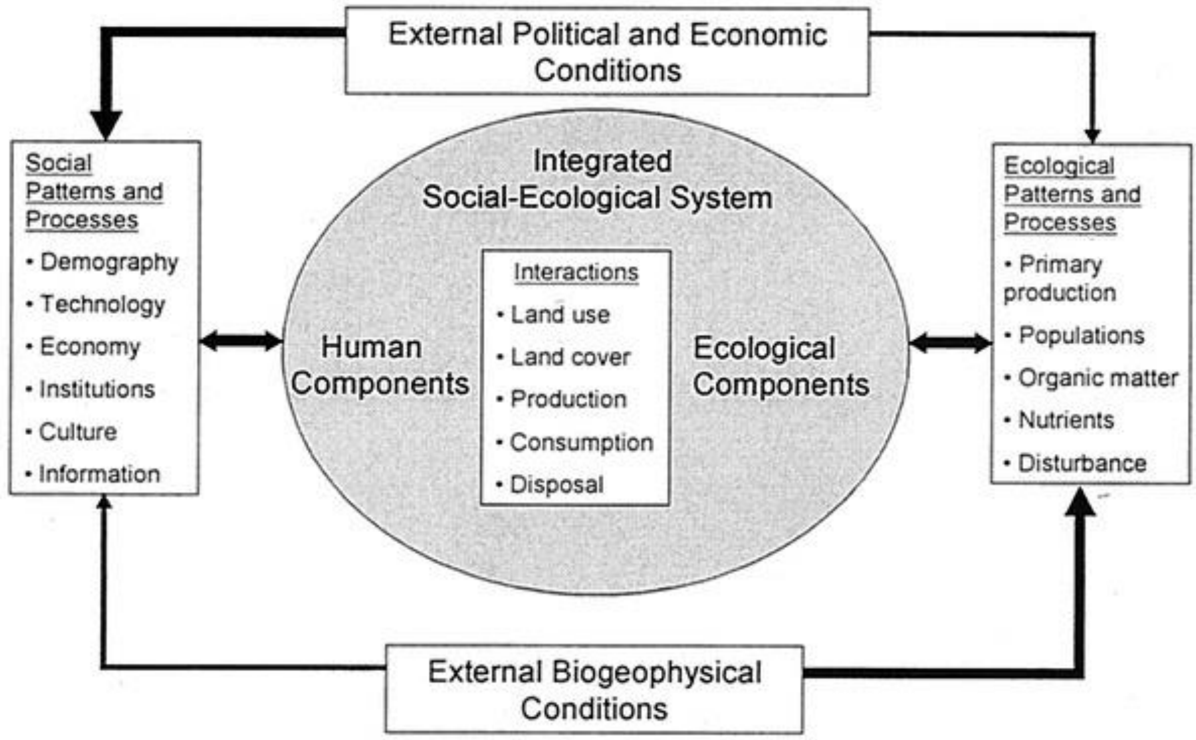


Figure 2: Conceptual SES framework from Redman, Grove and Kuby (2004)

3.4 Valuing ecosystem services and public goods

To create successful and supported environmental policies, it is rational to incorporate local stakeholders' preferences for environmental goods and services into decision-making (Kainer *et al*, 2009). The challenge is that the value society places on the provision of public goods and ecosystem services, such as clean air and attractive landscapes, is often impossible to directly observe from the market. Several economic techniques exist to quantify people's preferences and these techniques can be divided into two major groups: Revealed Preference (RP) techniques and Stated Preference (SP) techniques (Adamowicz *et al*., 1994).

3.4.1 Stated Preference versus Revealed Preference techniques

RP methods use observations on actual choices made in the real world. These methods exploit data on observed behaviour in a market in order to assess preferences of people for a certain programme, service or product (Perman *et al*., 2011). Well-known examples of RP techniques are the travel cost method and the hedonic price method. The travel cost method is used to value recreational benefits of environmental resources, such as a national park or a forest, by considering the number of visitors and the travel cost incurred by visiting such a site (Willis and Garrod, 1991). The hedonic price method is usually applied to the housing market within which many environmental goods, like air quality and noise nuisance, are implicitly traded. The basic idea is that households reveal their preferences for these environmental goods through their decision about where to locate (Garrod and Willis, 1992). As RP techniques completely rely on observable behaviour, research possibilities are limited to scenarios which already exist. As such, the desirability for an innovative product or the willingness to adopt a new policy measure cannot be assessed by using RP techniques. At the same time, however, the reliability of RP techniques on actual choices made in the market is also an important advantage, as its prevents biases associated with hypothetical responses such as failure to correctly consider budget constraints or strategic responses (Perman *et al*., 2011).

SP methods have primarily emerged from a desire to understand consumer demand for goods and services where it was not possible to use RP data. In environmental economics, SP techniques involve asking individuals, directly or indirectly, about their willingness to pay or willingness to accept a compensation for a hypothetical change in the provision of an environmental good (Mangham *et al*., 2008). An important advantage of SP techniques compared to RP techniques is the high flexibility, but the drawback is the need to obtain reliable answers to hypothetical questions. Another difference between RP methods and SP methods is that RP methods only estimate use values, while SP methods estimate use as well as non-use values (Morrison, 2000). Non-use values are the benefits a person derives from a resource without ever physically interacting with it. For example, the survival of polar bears can be valuable for some people, even though they will probably never encounter a polar bear in real life. For environmental goods in general, non-use values are often likely to be significant and as a consequence, it is advisable to opt for SP techniques in case of valuing an environmental good (Hanley *et al.,* 2003).

Historically, the most used SP method is contingent valuation. Contingent valuation directly asks people how much money they would be willing to pay for a specified, hypothetical product or service (Venkatachalam, 2004). Monetary terms are thus rather explicit than implicit, which may increase the tendency of respondents to refuse to participate. Furthermore, contingent valuation is subject to a large number of potential biases, including a compliance bias, an insensitivity to scope and protest bids. A more recently introduced SP method are choice experiments. Compared to the contingent valuation method, choice experiments allow a larger range of alternatives to be analysed, is more robust with respect to some potential biases and is able to estimate marginal effects (Bennett and Blamey, 2001).

3.4.2 Choice experiments

A discrete choice experiment (DCE) is a survey-based valuation method. This method allows researchers to uncover how individuals value selected characteristics of a programme, product of service by asking them to state their choice over various hypothetical alternatives (Mangham *et al*., 2008). By doing this, it creates a hypothetical market in which individuals make a decision similar to a real-world scenario. DCEs are common in marketing and transport literature and have also become popular in environmental economics to value a wide variety of environmental goods (Morrison, 2000).

Conceptually, choice experiments are based on Lancaster's consumer theory which states that, rather than goods are the direct objects of utility, it are the properties or characteristics of goods from which utility is derived (Lancaster, 1966). Choice experiments require respondents to state their preference over a set of hypothetical alternatives. Each alternative is described by several, predefined characteristics, known as attributes, and responses are used to derive the value placed on each attribute (Hanley *et al*., 2002).

Each respondent answers a number of discrete choice questions, known as choice sets, and this results in multiple observations for each individual. Two important considerations for researchers working on discrete choice experiments are the number of alternatives in each choice set and the number of choice sets in each questionnaire (Chung *et al*., 2011). While more alternatives per choice set is making the choice task more complex for respondents, it also increases the statistical information from each choice made by a respondent. As the objective is to collect as much data as possible from each respondent, a large number of choice sets per questionnaire is preferable. However, if the questionnaire is too long, corresponding with many choice sets per respondent, individuals can get bored or fatigued and their answers will be of limited value.

In stating a preference, the respondent is assumed to choose the alternative from which the utility exceeds the utility associated with the other alternatives. The utility yielded by a particular alternative is assumed to be a function of its attributes and attribute levels. DCE has its theoretical foundation in the random utility (RU) theory and relies on the assumption of economic rationality, which implies the assumption of utility maximisation (Hall *et al*., 2004).

RU models have been developed to describe choice among mutually exclusive discrete alternatives and are well-established methods for describing discrete choice behaviour (Baltas and Doyle, 2001). As mentioned, RU models assume that respondents consistently select those alternatives matching with the highest level of utility. More specifically, if individual *i* chooses alternative *g* out of *j=1,…,J* alternatives it must be the case that the utility associated with choice *g* (u_{ig}) is higher than the utility of the other alternatives (Kjaer, 2001). This can be depicted with the following equation:

$$u_{ig} \geq u_{ij} \; \forall j \neq g \in J \tag{3.1}$$

RU models further assume that utility *u* has a deterministic component *v* and a stochastic component ε. The purpose of including the stochastic component ε is to account for unobserved variations in taste (or heterogeneity in preferences), measurement errors and imperfect information (Kjaer, 2001). Equation (3.1) can thus be rewritten as follows:

$$v_{ig} + \varepsilon_{ig} \geq v_{ij} + \varepsilon_{ij} \; \forall j \neq g \in J \tag{3.2}$$

In choice experiments, it is standard practice to assume a linear additive utility function (Hoyos, 2010). This corresponds with saying that the utility of an alternative is equal to the sum of utilities of its attributes. As such, the deterministic component of utility for alternative j (v_j) can be written as follows:

$$v_j = \beta x_j \tag{3.3}$$

Where $x_j = (x_{1j}, x_{2j},\ldots,x_{pj})$ is the vector of the attributes for alternative *j* and β is the associated vector with the parameters of the attributes. Combining equations (3.2) and (3.3) result in:

$$\beta x_{ig} + \varepsilon_{ig} \geq \beta x_{ij} + \varepsilon_{ij} \;\; \forall j \neq g \in J \tag{3.4}$$

Choice experiments are used to determine the significance of the selected attributes and the extent individuals are willing to trade one attribute for another. The relative importance of attributes can be useful for policy decision making and setting resource allocation priorities (Blamey *et al*., 2000). By including a cost attribute in a DCE, it is possible to indirectly obtain the respondent's willingness to pay (WTP) for either an alternative in its entirety or the respondent's marginal WTP for a specific attribute (Mangham *et al*., 2008). Conditional on the context of the choice task, the cost attribute can take many different forms in a DCE. The form in which cost are specified in the survey is termed 'payment vehicle' (Kjaer, 2005). This detailed information on WTP may be useful, though some evidence suggest that the levels of the cost attribute can affect the estimates. A clear example hereof is a bias known as temporal embedding. Temporal embedding refers to a situation in which the WTP does only vary limited with respect to the frequency of payment; in some cases the maximum WTP as a one-off payment of a respondent is remarkably similar to his WTP as an annual or even monthly payment (Drummond *et al*, 2005).

3.4.3 Attributes and attribute levels within a choice experiment

The first stages of a choice experiment are the identification of relevant attributes and subsequently, the assignation of attribute levels to these identified attributes. Attributes can be quantitative or qualitative and should be based on knowledge gathered from literature reviews, interviews, group discussions and expert opinions (Coast and Horrocks, 2007). Secondary data can be useful, however, primary research is usually essential to guarantee a sound and appropriate set of attributes. The context and objective of choice experiments can be very diverse and there is no universal standard for the definition of attributes (Kløjgaard *et al*., 2012). However, two issues in particular are important to consider when deciding which attributes to include in a DCE. First, the attributes need to be relevant for the needs of the policy makers. Second, the attributes should be meaningful and important for respondents (Bennet and Blamey, 2001). Some literature directly points to qualitative work as a basis for ensuring that attributes are formulated in a clear and understandable manner for respondents (Mays and Pope, 2000).

Regarding design restrictions, there is no limitation on the number of attributes included in a DCE. However, the more attributes are considered, the more difficult the choice task for a respondent becomes. With too many attributes, the respondents will have an incentive to neglect certain attributes and to apply simple decision rules based on a subset of attributes (DeShazo and Fermo, 2002). In practice, this link between the number of attributes and the complexity of choices for respondents results in most DCEs containing fewer than ten attributes. According to Green and Srinivasan (1978), respondents can only accurate process up to about six attributes at once. A method for dealing with large numbers of attributes is using partial profile designs. In a partial profile experiment, the choice task is simplified by holding levels of some of the attributes constant and in subsequent choices, holding a different subset of attributes constant. Consequently, the cognitive burden imposed on the respondents is relieved. In case of a dominant attribute, partial profiles can also be useful to obtain information about trade-offs made between the other, non-dominant attributes (Kessels *et al*., 2011).

Choice experiments can rarely include all relevant attributes but it is crucial that the most important attributes relevant to the majority of respondents are included. If this is not the case, respondents will make assumptions about the excluded attributes and this can negatively affect the validity of the study (Hensher, 2006). In establishing attributes, it is also important to avoid inter-attribute correlation, which is the conceptual overlap between two or more attributes which are included in experiment. In specifying attributes, an effort should be made to ensure that definitions are not ambiguous, clear and appropriate for the setting (Hall *et al*., 2004).

Once the attributes are established, suitable attribute levels need to be assigned. There are three key success factors when determining the levels of each attribute (Ryan, 1999; Kjaer, 2005). First, the attribute levels should be plausible to the respondents. Second, the levels should be actionable to the respondents. This corresponds with saying that respondents should believe it is possible to achieve all specified attribute levels. Third, the levels should be constructed in such a way that the respondents are willing to make trade-offs between combinations of the attributes. Improper level ranges can be a reason for respondents to be unwilling to make these trade-offs. If the distance between levels is too wide or too narrow, the respondent will consider the difference between levels significant or insignificant, respectively. In turn, this will result in seemingly dominant or dominated attributes.

Another complication when assigning levels to attributes is known as the attribute-effect and refers to the situation in which an increase in the number of levels for an attribute causes the attribute to become relatively more significant, even if the upper and lower level are not altered (Kjaer, 2005). One way to minimize this problem is to assign the same number of levels to every attribute (Curry, 1997). In most cases, however, assigning the same number of levels will be neither desirable nor practical. As usually more levels are assigned to the cost attribute than to the other attributes, this is particularly true for the cost attribute.

3.4.4 Stages of a choice experiment

After the objective of a research is established, a number of stages have to be subsequently fulfilled in order to complete a choice experiment. Kjaer (2005) advocates a five stage approach, as illustrated in Figure 3.

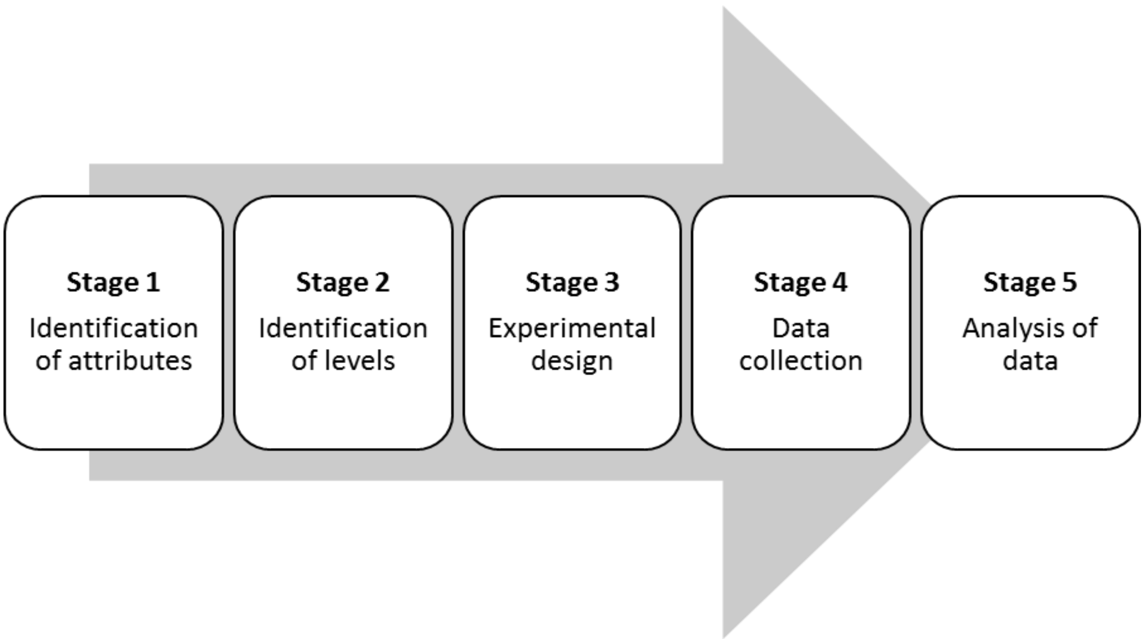


Figure 3: Stages of a DCE

4. Materials and methods

4.1 Identification attributes

As a first step to identify the relevant attributes concerning traditional orchards in Haspengouw, all potential relevant attributes were listed. This list of attributes was put together based on an interim report of the Research Institute for Nature and Forest (INBO) about traditional orchards in Haspengouw and further developed in multiple discussions. Subsequently, in order to guarantee that all possible attributes were considered, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) valuation framework was screened.

The IPBES valuation framework is a conceptual framework which encompass three broad categories of values concerning biodiversity and ecosystem services issues: '*nature*', '*nature's benefits to people*' and '*good quality of life'*. This division supports diverse worldviews and captures an array of different interests (Pascual *et al*., 2017). The IPBES conceptual framework is widely applicable to initiatives at the knowledge-policy interface, which inherently requires a pluralistic approach to the multiple values of the natural world and its contribution to human societies (Diaz *et al*., 2015). The values of the category 'nature' refer to the intrinsic values of natural entities, and include moral values including the rights of living organisms to exist as well as their functional ecological value. In contrast to the other categories, 'nature' is non-anthropocentric. The second category, 'nature's benefits to people', is associated with the contributions from nature or ecosystem functions to society. The values of this category are instrumental values, which are values attributed to something as a mean to achieve a particular end, including material contributions (e.g. water, food) and non-material ones (e.g. recreation). The category 'good quality of life' concerns the contribution of nature and ecosystem processes to human well-being and its associated values are relational values (Chan *et al*., 2016). Table 2 gives an overview of the categories proposed by IPBES.

Table 2: IPBES valuation framework

Categories of values	Types of values	Key targets of valuation
NATURE	Non-antropocentric, intrinsic values	*Individual organisms*
		Biophysical assemblages
		Biophysical processes
		Biodiversity
NATURE'S BENEFITS FOR PEOPLE	Antropocentric, instrumental values	*Biosphere's ability to enable human endeavour*
		Nature's ability to supply benefits (basis of benefits)
		Nature's gifts, goods and services (actual services enjoyed)
GOOD QUALITY OF LIFE	Antropocentric, relational values	*Security and livelihoods*
		Sustainability and resilience
		Diversity and options
		Living well in harmony with nature and Mother Earth
		Health and wellbeing
		Education and knowledge
		Identity and autonomy
		Good social relations
		Art and cultural heritage
		Spirituality and religions
		Governance and justice

Reviewing INBO's interim report, having multiple discussions and screening the IPBES valuation framework resulted in twelve attributes which were initially considered (Table 3). From this range of potential attributes, the objective was to select the most relevant ones and to end up with six or seven attributes, including a cost attribute. As previously mentioned, in order to conduct a meaningful choice experiment, the selected attributes need to be relevant for the needs of policy makers and meaningful for the targeted respondents.

Table 3: Twelve initial considered attributes

Attributes	***Meaning***
Yield	*Amount of yield from traditional orchards*
Fruit tree diversity	*Diversity of fruit trees (apple, pear, cherry, plum) in traditional orchards*
Health of fruit trees	*Whether fruit trees in traditional orchards are 'healthy' and 'lively'*
Social employment	*Whether initiatives to preserve traditional orchards should also focus on social employment*
Citizens involvement	*Citizens involvement in management and harvesting of traditional orchards*
Ecological value	*Value of traditional orchards in the perspective of nature conservation*
Accessibility	*Whether traditional orchards are (freely) accessible for the public*
Type of fencing	*How the traditional orchard is fenced (hedgerow, barbed wire, etc.)*
Grazing	*Whether the grass between fruit trees is grazed (either by cattle or sheep)*
Total area	*Total area of traditional orchards in Haspengouw*
Distance to village center	*Distance traditional orchards to nearest village center*
Distribution over landscape	*Whether traditional orchards are concentrated or more evenly distributed in Haspengouw*

As mentioned in the introduction, the Flemish agency for Immovable Heritage (known as *Agentschap Onroerend Erfgoed*) recently started a participative project in order to guarantee the conservation of traditional orchards in Haspengouw. For this participative project, meetings are regularly organised with two different steering groups: a regional group and a Flemish group. While the former mainly consists of delegates from the different municipalities of Haspengouw, the latter consists of delegates from several relevant organisations, including INBO, *Agentschap voor Natuur en Bos*, *Departement Landbouw en Visserij*, *Nationale boomgaardenstichting* and *Toerisme Vlaanderen*. In order to assess which attributes are most relevant for policy makers, there was a possibility to join these meetings of both steering groups. Moreover, this opportunity was also used to conduct a short survey in each group. Subsequently, in order to assess which attributes are most important for the targeted respondents, a similar survey was conducted with fourteen people who live in Haspengouw and who do not have any specific knowledge about traditional orchards.

4.1.1 Survey steering groups

At the end of the start-up meeting of the regional steering group, a questionnaire was handed out to all twenty attendees. After a short introduction and explanation of what was exactly meant by each of the attributes, the attendees were asked which of the described attributes they considered important aspects to take into account for initiatives to preserve traditional orchards in Haspengouw. For each of the twelve initial attributes (Table 3), the attendees had to score whether they believed the considered attributes are important on a seven-point Likert scale, ranging from totally disagree (-3) to totally agree (+3). The respondents had also the option to indicate that they had no opinion about certain attributes. Furthermore, they had the possibility to give suggestions and comments. Figure 4 gives an overview of the results by giving the average score for each attribute and its associated mean deviation.

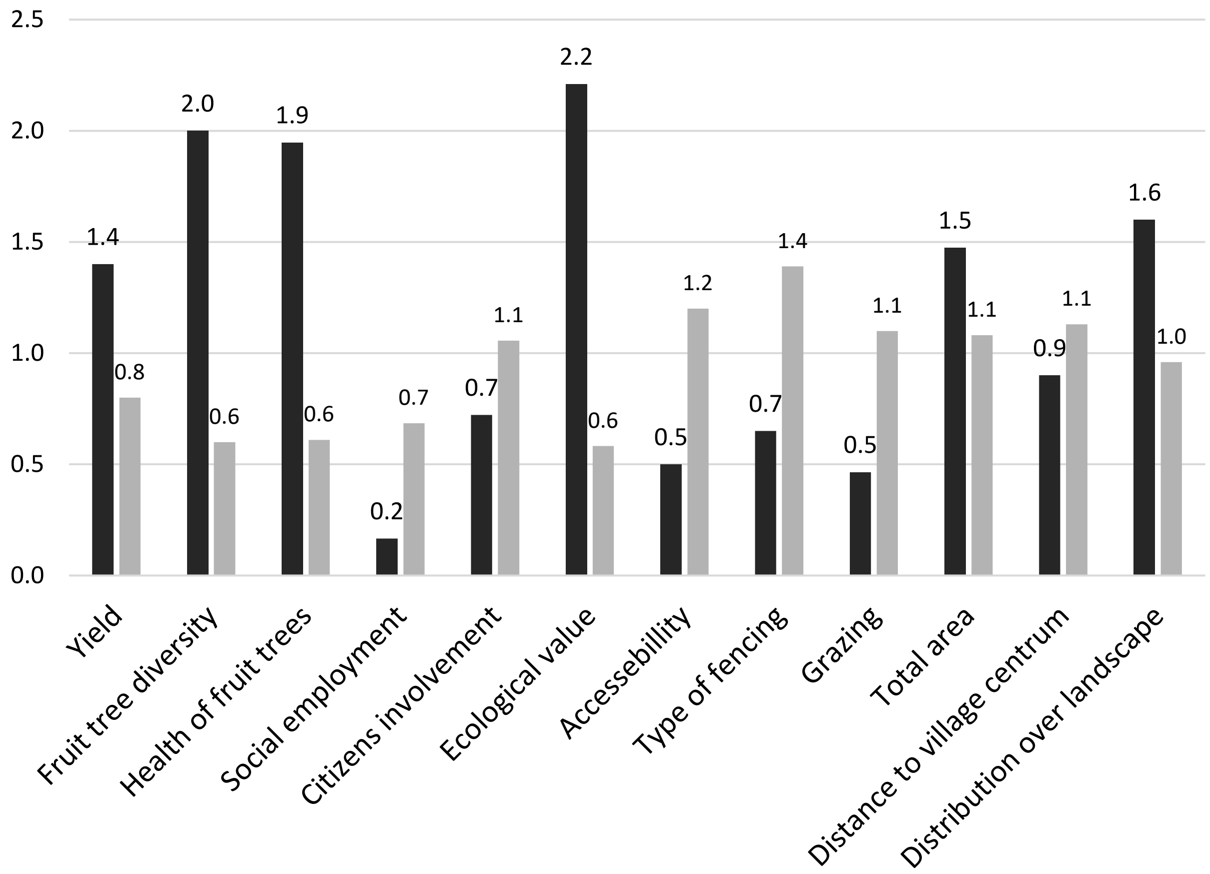


Figure 4: Results survey regional steering group (n=20): average score of attributes on seven-point Likert scale (dark) and associated mean deviations (light)

The five aspects of traditional orchards in Haspengouw considered most crucial according to the regional steering group are *ecological value*, *fruit tree diversity*, *health of fruit trees*, *distribution over landscape* and *total area*. Although some respondents believed initiatives should primarily focus on the quality of traditional orchards, most respondents found it necessary that a sufficient area remained in order to maintain the typical landscape image. Some of the respondents indicated that the aspect *health of fruit trees* was difficult to interpret and that the maintenance of fruit trees, especially pruning, was also particularly important to take into account. As such, in the following two surveys the aspect *health of fruit trees* was replaced by a broader concept, namely *(physical) condition of fruit trees*. One respondent also noted that the educational values of traditional orchards (e.g. for primary schools or through information boards) can also be important. Therefore, the aspect *educational value* was included in the subsequent surveys.

After making the described adjustments, the survey was also conducted during a meeting of the Flemish steering group. Again, after a short introduction and explanation of the different attributes, the attendees had to score whether they believed the considered attributes are important to take into account for initiatives to preserve traditional orchards in Haspengouw. Figure 5 gives an overview of the results from the Flemish steering group.

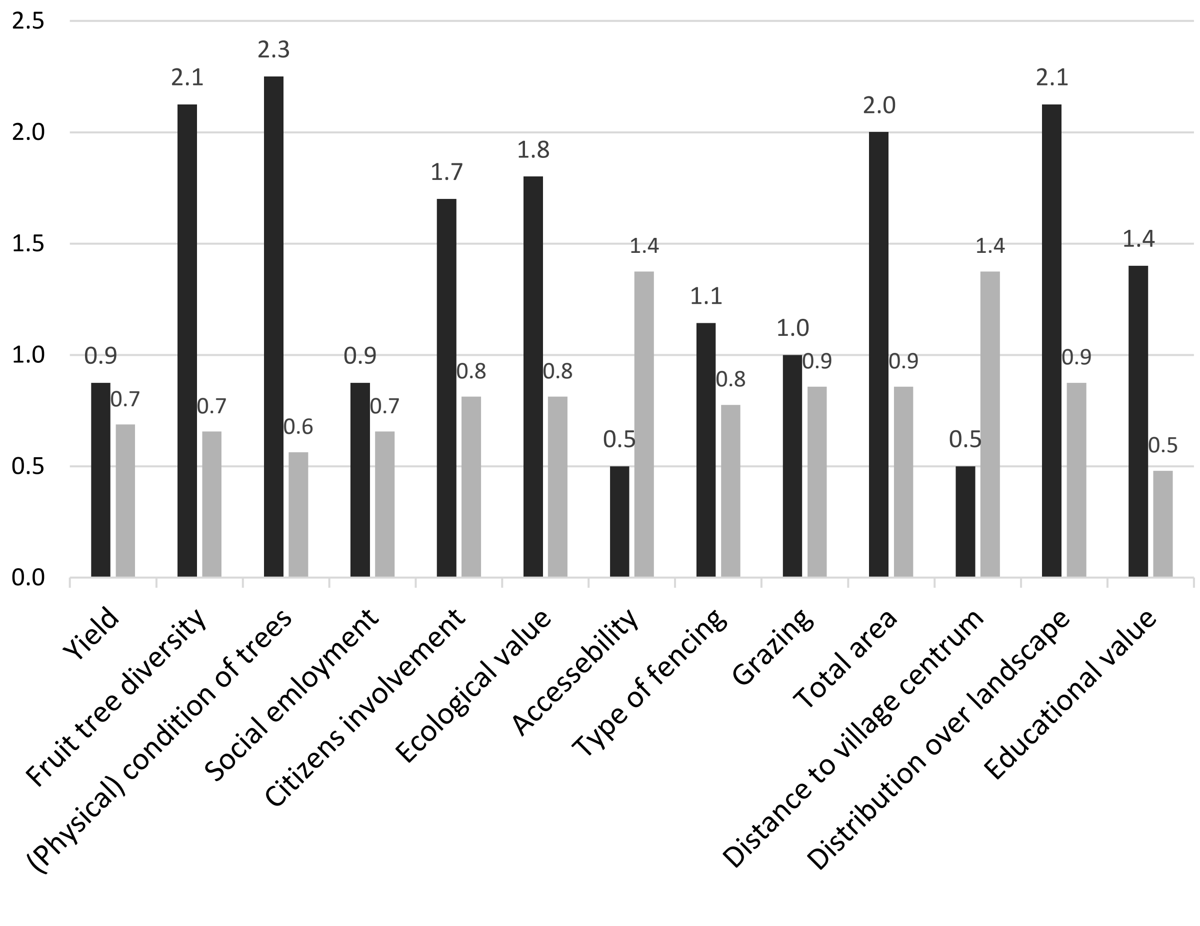


Figure 5: Results survey Flemish steering group (n=9): average score of attributes on seven-point Likert scale (dark) and associated mean deviations (light)

Although only nine respondents completed this second survey, it is notable that the five attributes considered most important (*condition of trees*, *distribution over landscape*, *fruit tree diversity*, *total area* and *ecological value*) match with the ones from the regional steering group. In addition to whether respondents thought certain attributes are important to take into account, respondents were also asked to give the reasons why they consider certain attributes to be important. According to the respondents, the (physical) condition of trees is vital for the recognisability and continuity of traditional orchards. Furthermore, a uniform distribution of traditional orchards over the landscape is crucial to maintain the regional identity. If traditional orchards would be too concentrated, it would resemble an open-air museum. Reasons stated for focussing on diversity of fruit trees were to preserve old cultivars and to prevent genetic erosion. Furthermore, the total area of traditional orchards should be higher than a certain threshold in order to sustain the landscape image it creates in Haspengouw. And lastly, the respondents argued that concentrating on the ecological value of traditional orchards is important to conserve local biodiversity.

One respondent also commented that, from a touristic point of view, it could be interesting to have some traditional orchards with picnic possibilities or with playground equipment. As such, the aspect *recreational value* was included in the subsequent survey with the residents of Haspengouw.

4.1.2 Survey residents of Haspengouw

The objective of the surveys conducted with the regional and Flemish steering group was to check which attributes are relevant for policy makers that want to take societal needs into account. However, for a choice experiment to be meaningful, the selected attributes also need to be important according to the targeted respondents. In this case, people residing in Haspengouw who do not have any specific knowledge about traditional orchards are targeted. To determine which attributes are important for these individuals, fourteen people residing at various locations in Haspengouw (Sint-Truiden, Alken, Borgloon, Wellen, Heers and Tongeren) were interviewed. Once again, the respondents were asked to score on a seven-point Likert scale whether they personally believed that the specified attributes are important or not. Figure 6 gives the average scores and the associated mean deviations for each attribute.

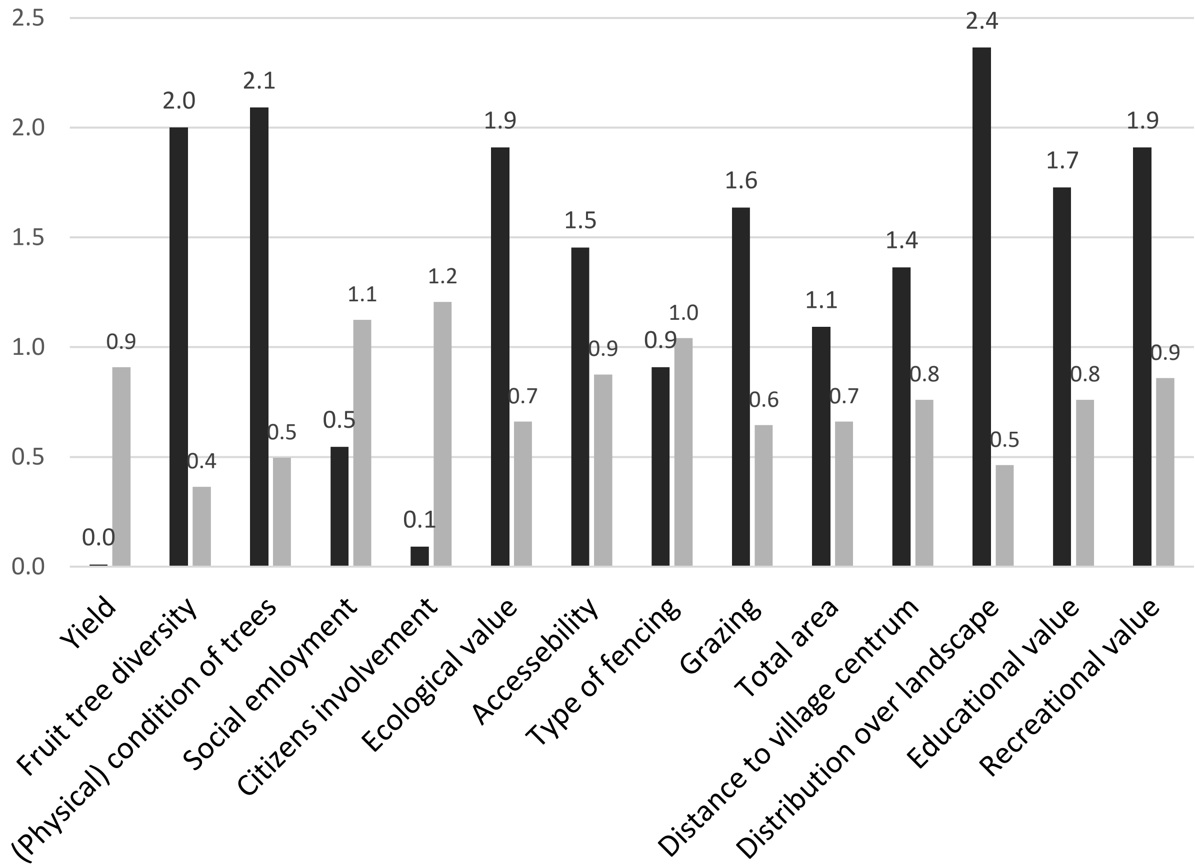


Figure 6: Results survey residents of Haspengouw (n=14): average score of attributes on seven-point Likert scale (dark) and associated mean deviations (light)

Four of the attributes considered most important for people living in Haspengouw were also considered crucial by both steering groups. As such, the attributes *fruit tree diversity, condition of trees, ecological value* and *distribution over landscape* seemed to be good options to include in the choice experiment. Furthermore, also *recreational value*, which was not included in the first two surveys, turned out to be of considerable importance for residents of Haspengouw. The most notable difference between the targeted respondents and the policy makers is that the former group focusses less on the quantity (*total area*) of traditional orchards in Haspengouw.

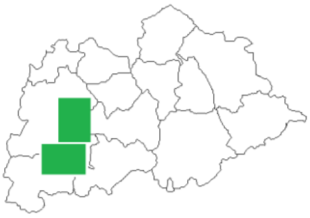
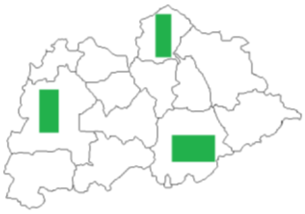
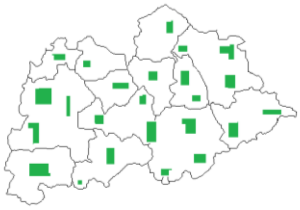
4.1.3 Final attributes and attribute levels

Based on the three conducted surveys, six attributes were selected to be included in the choice experiment: *distribution over landscape*, *total area*, *fruit tree diversity*, *ecological value*, *condition* and *recreational value*. Furthermore, also a cost attribute was included to enable the calculation of willingness to pay measures for different outcomes. To minimize the attribute-effect, which refers to the positive correlation between the significance of an attribute and its number of levels, three levels were assigned to all non-cost attributes. An overview of the final attributes and associated attribute levels is given in Table 4. In the remaining part of this section, the seven attributes will be elaborated in more detail.

First, *distribution over landscape* is the distribution of traditional orchards over the landscape of Haspengouw. This distribution can be either concentrated, clustered or evenly distributed. Second, the attribute *total area* is the total area of traditional orchards in Haspengouw and is a combination of the number of traditional orchards and the size of these orchards. The third attribute is *fruit tree diversity*. Traditional orchards can contain different cultivars of apple trees, pear trees, plum trees and cherry trees. A high diversity of fruit tree cultivars can be helpful to preserve old cultivars and can create a larger variation in the landscape (e.g. varying flowering times). Next, *ecological value* is the value from a nature conservation point of view. Traditional orchards can be a suitable habitat for numerous species, including a variety of plants, butterflies, birds and mammals. Well-known species occurring in traditional orchards in Haspengouw are the garden dormouse (*Eliomys quercinus)* and the little owl (*Athene noctua*). Measures to increase the ecological value of a traditional orchard include building a pond, placing hedgerows around the orchard and hanging birdhouses. Fifth, *condition* is the (physical) condition of trees in the traditional orchard and can range from 'degraded' to 'good/healthy'. This characteristic can be influenced by pruning regularly, replacing fallen trees and other maintenance measures. Next, *recreational value* is the value a traditional orchard can offer for recreation. Picnic possibilities and playground equipment are options to increase this value. Lastly, *monthly donation* is the cost attribute and defined as a voluntarily, monthly donation to a hypothetical fund. Furthermore, it is assumed that the hypothetical donation is effectively used to improve the situation of traditional orchards in Haspengouw and is not tax-deductible. Six attribute levels, ranging from €0 to €50 per month, are used for the cost attribute in the choice experiment.

Table 4: Final attributes and attribute levels

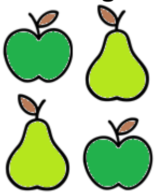
Distribution over landscape

Concentrated	Clustered	Evenly distributed
		

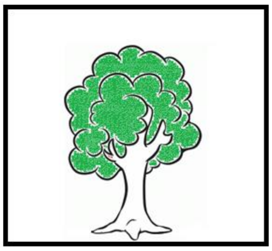
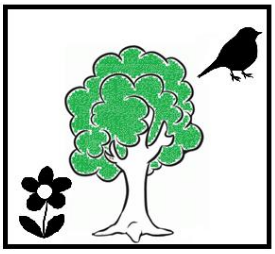
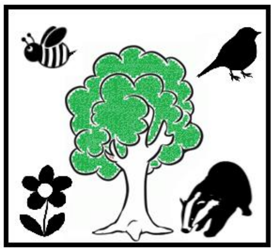
Total area

Decrease	Constant	Increase
↘↘ (-50%)	≈	↗↗ (+50%)

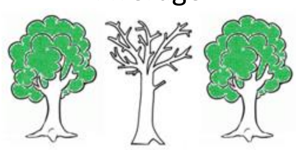
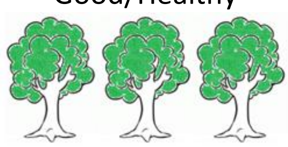
Fruit tree diversity

Low	Average	High
		

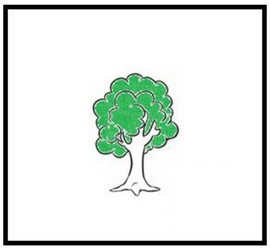
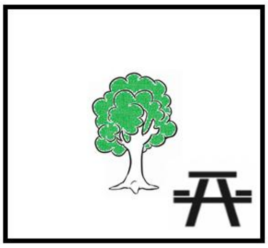
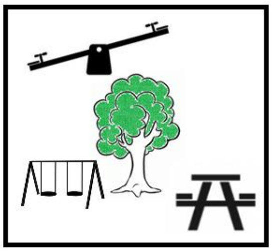
Ecological value

Low	Average	High
		

Condition

Degraded	Average	Good/Healthy
		

Recreational value

Low	Average	High
		

Monthly donation

€0	**€5**	**€10**	**€15**	**€25**	**€50**

4.2 Experimental design

To secure a valid interpretation of results, all choice sets in a choice experiment should include a realistic business as usual or opt-out alternative (Bonnichsen and Ladenburg, 2015). In our case, without a base case scenario, respondents would be forced to choose between different intervention outcomes for traditional orchards in Haspengouw, although they might prefer the situation without any intervention. To create a realistic business as usual scenario, the Flemish steering group was consulted. There was a general agreement among its members that, without any further intervention, the situation of traditional orchards in Haspengouw would deteriorate rapidly. As such, we described the business as usual scenario as the situation in which respondents do not have to contribute financially, but within ten years all traditional orchards will disappear in Haspengouw.

Based on the number of attributes and associated attribute levels included in the choice experiment (see Table 4), a large number of hypothetical situations of traditional orchards in Haspengouw can be described. The full factorial design, which consists of all possible combinations of attribute levels, amounts to 4,374 unique combinations (3^6x6^1). For practical considerations, this number is too large to be feasible. Consequently, we rely on an efficient fractional factorial design, which consist of a selected fraction of the full factorial design.

In choice experiments with many attributes, respondents can have difficulties with the complexity of the choice task and in turn, this can impose a cognitive burden on the respondents (Kessels *et al*., 2011). Because we have relatively many attributes, we opted for a partial profile design of the choice experiment. In a partial profile experiment, the choice task is simplified by holding levels of some of the attributes constant and in subsequent choices, holding a different subset of attributes constant. In our choice experiment, at least two of the seven attributes are constant in each choice set.

Another decision to be made regarding the experimental design is how many choice questions each respondent will be asked to complete. Given that data collection can be costly and time consuming, a fair amount of choice questions per respondent is preferred. However, if there are too many choice questions, respondents can get fatigued or bored and their answers will be of limited value. Furthermore, each respondent can be given a subset of the full set of combinations by using a blocked design (Blamey *et al*., 2000). We opted for thirty choice sets divided over three blocks, resulting in ten choice questions per respondent.

To obtain an efficient experiment design, we used the statistical program JMP. Using the Design Of Experiments (DOE) platform in JMP, it is possible to design a choice experiment with a specified number of choice set per block and a specified number of blocks (blocked design) as well as with a specified number of attributes that can change within a choice set (partial profile design). However, in order to create an efficient design (D-optimal), prior information about the attributes is needed (JMP, 2016). Therefore, a pilot survey was conducted, resulting in the needed prior information to create a D-optimal design. Specifically, a choice experiment created by JMP without prior information was conducted on a set of fifteen individuals. The results of this pilot study were used to design an efficient choice experiment. Figure 7 gives an example of one of the thirty choice cards used in the choice experiment.

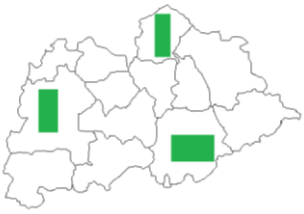
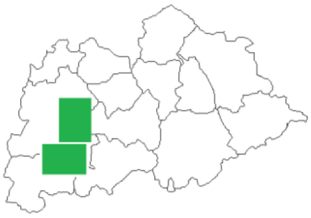
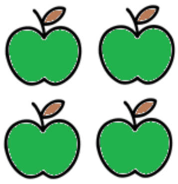
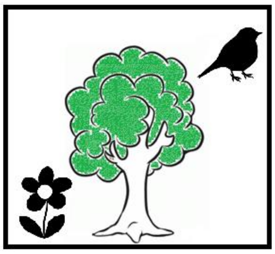
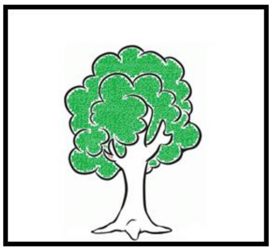
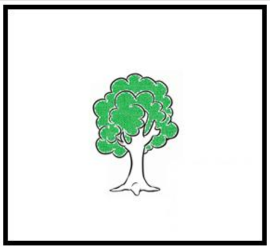
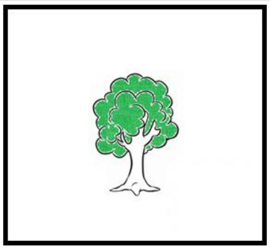
	Scenario A	Scenario B	Business As Usual
Distribution over landscape	Clustered 	Concentrated 	Neither scenario A nor scenario B (No monthly donation, but within ten years all traditional orchards will disappear in Haspengouw)
Total area	Constant ≈	Constant ≈	
Fruit tree diversity	High 	Low 	
Ecological value	Average 	Low 	
Condition	Average 	Good/Healthy 	
Recreational value	Low 	Low 	
Monthly donation	**50€**	**0€**	**0€**

Figure 7: Example of a choice card

4.3 Data collection

To collect data from people living in Haspengouw, we created and published an online survey with LimeSurvey. The questionnaire consisted of three modules. First, after an introduction about the topic and the intention of the questionnaire, respondents were asked to provide some background information. This information included their socio-economic characteristics, their vision on nature conservation and whether they believed it is important that traditional orchards in Haspengouw are conserved. Furthermore, respondents got the opportunity to share their vision regarding the conservation of traditional orchards. The second module consisted of the choice experiment itself. After an explanation about the attributes and the associated attribute levels, ten choice cards were presented to each respondent. These ten choice questions represented one of the three blocks of the experimental design and were randomly assigned to the respondents. Moreover, the choice questions within each block were also randomised per respondent in order to avoid systematic errors caused by weariness. The final module consisted of two control questions. First, we asked how difficult it was for respondents to choose between different scenarios. Second, respondents were asked how decisive each attribute was in their decision.

Our initial strategy to reach respondents was to distribute short letters with an invitation to complete the online questionnaire. These letters were delivered to mailboxes in thirteen municipalities located in Haspengouw (Figure 8) and the number of invitations per municipality was proportionate to its populations size. Although this stratified sampling method was theoretically a good option, the response rate was particularly low. Consequently, we also used two other sampling methods afterwards. First, we went to several outdoor markets in Haspengouw in order to convince people to fill in the survey online. Second, we also used social media to inform people about the survey. In total, the combination of these three sampling methods resulted in 252 respondents of whom 193 successfully completed the survey.

Figure 8: Data collection in thirteen municipalities (source: Provincie Limburg)

4.4 Econometric approach

Subsequent to the data collection, we analysed the data in the statistical software STATA. This occurred in several steps. The first step involved cleaning the collected data and preparing it for the analysis. Second, we estimated a multinomial logit model, which is the most used model to analyse discrete choice experiments. Third, in order to take into account preference heterogeneity across respondents, we also estimated a more advanced mixed logit model. For both models, we also calculated the corresponding willingness to pay values. Finally, we performed a latent class analysis to divide the sample into different segments of respondents with homogeneous preferences.

To be able to use the data obtained in the online questionnaire, two adjustments needed to be made. First, we included an Alternative Specific Constant (ASC) in our dataset, coded as 0 for the opt-out alternative and 1 for the two alternatives describing hypothetical situations of traditional orchards in Haspengouw. As such, a positive ASC means that respondents have a preference to move away from business as usual scenario. In other words, they prefer a situation in which action is undertaken to preserve traditional orchards, independent of what this action seeks to achieve. Second, dummy coding or effects coding is necessary for categorical attributes to decompose them into items that can be worked with. In our case, all attributes except the cost attribute are qualitative attributes. Both coding schemes are shown in Table 5. As dummy coding results in parameter estimations which are easier to interpret, we opted to proceed the analysis with dummy codes.

Table 5: Dummy and effects coding scheme for categorical variables

	Dummy coding		**Effects coding**	
Distribution over landscape	DIST1	DIST2	DIST1	DIST2
Concentrated	0	0	-1	-1
Clustered	1	0	1	0
Evenly distributed	0	1	0	1
Total area	AREA1	AREA2	AREA1	AREA2
Decrease	0	0	-1	-1
Constant	1	0	1	0
Increase	0	1	0	1
Fruit tree diversity	DIVE1	DIVE2	DIVE1	DIVE2
Low	0	0	-1	-1
Average	1	0	1	0
High	0	1	0	1
Ecological value	ECOV1	ECOV2	ECOV1	ECOV2
Low	0	0	-1	-1
Average	1	0	1	0
High	0	1	0	1
Condition	COND1	COND2	COND1	COND2
Low	0	0	-1	-1
Average	1	0	1	0
High	0	1	0	1
Recreational value	RECV1	RECV2	RECV1	RECV2
Low	0	0	-1	-1
Average	1	0	1	0
High	0	1	0	1

4.4.1 Multinomial Logit Model

In choice modelling, the probability (P_i) that a particular alternative *i* is chosen from the available set of alternatives *C* depends on the utility (*U*) of the alternatives. The utility of an alternative (*U*) consists of a deterministic component (*V*) and a stochastic component (ε). This is in accordance with the Random Utility (RU) theory on which choice modelling is based and can be depicted (Train, 2003) as follows:

$$P_i = Prob\big(U_i \ \geq \ U_j\big) = Prob\big(V_i + \varepsilon_i \geq V_j + \varepsilon_j\big) \ \ \forall \, i \neq j \in C \qquad (4.1)$$

The most used model to analyse discrete choice experiments is the conditional logit or multinomial logit (MNL) model developed by McFadden (1974). Although MNL is a basic model with strong assumptions, it is popular due to the fact that the model is easy to use and interpret. One of the assumptions is that the value respondents place on each attribute of the alternatives does not vary across respondents. To clarify, it assumes complete homogeneous preferences in the sample. Further, the MNL model is also based on the *independence of irrelevant alternatives* (IIA) assumption (Hensher *et al.*, 2005). IIA means that the probability of choosing one alternative over another is not influenced by the presence or absence of any additional alternatives in the choice set.

The MNL model is defined by the following equation (Louviere *et al.*, 2000):

$$P_i = \frac{1}{\sum_{j=1}^{C} e^{-(V_i - V_j)}} \qquad (4.2)$$

Based on the attribute coefficients from the MNL analysis, we also calculated the WTP values for changes in attribute levels. The marginal willingness to pay (MWTP) for a change in a qualitative attribute is the marginal rate of substitution between the respective attribute and the cost attribute (Kjaer, 2005):

$$MWTP_i = -\left(\frac{\beta_{xi}}{\beta_{cost}}\right) \qquad (4.4)$$

The delta method, which is the default in STATA, was used to calculate confidence intervals for the WTP measures (Hole, 2007).

Although widely used, the MNL model has several well-known shortcomings. By allowing for unrestricted substitution patterns, random taste variation and correlation in unobserved factors over time, the mixed logit (MXL) model obviates three major limitations of the MNL model (Train, 2003). For this reason, the choice experiment has also been analysed based on the MXL model.

4.4.2 Mixed Logit Model

Mixed logit (MXL) is a flexible model that can approximate any random utility model (McFadden and Train, 2000). In contrast to the MNL model, it allows the coefficients in the model to vary across respondents. This implies that the MXL model takes into account the taste variation in respondents' preferences (Hensher, 2005). Basically, the MXL model is a generalisation of the MNL model and can be summarised by the following equation (Louviere *et al.*, 2000):

$$P(j|\mu_i) = \frac{\exp(\alpha_{ji}+\theta_j z_i+\varphi_j f_{ji}+\beta_{ji} x_{ji})}{\sum_{j=1}^{C} \exp(\alpha_{ji}+\theta_j z_i+\varphi_j f_{ji}+\beta_{ji} x_{ji})} \tag{4.3}$$

In this equation, the probability of alternative *j* being chosen conditional on the individual-specific random disturbance of unobserved heterogeneity (μ_i) is expressed as a function of (1) a fixed or random alternative-specific constant (α_{ji}), (2) a vector of non-random parameters (φ_j), (3) a parameter vector that is randomly distributed across individuals (β_{ji}), (4) a vector of individual-specific socio-economic characteristics (z_i) and (5) two vectors of individual-specific and alternative-specific attributes (f_{ji} *and* x_{ji}). In STATA, we estimated the MXL model using the maximum simulated likelihood estimation described by Haan and Uhlendorff (2006).

Although the MXL model allows preference heterogeneity, it does not give any information on where this variation in respondents' preferences originates from. In order to focus on this subject, we also performed a latent class analysis.

4.4.3 Latent Class Model

The latent class (LC) model assumes that the population consist of a certain number of latent classes, also referred to as segments. These classes are based on preference heterogeneity and within each class, preferences of individuals are assumed to be identical (Green and Hensher, 2013). In other words, LC segments the sample in classes which have homogeneous preferences within those classes, but heterogeneous preferences between classes.

In STATA, LC models are fitted through an expectation-maximization algorithm proposed by Bhat (1997) and Train (2008). Because the number of classes is unknown a priori, we estimated four LC models with different numbers of classes, ranging from two to five latent classes. Subsequently, the best LC model was chosen based on two goodness-of-fit measures, namely the Consistent Akaike Information Criterion (CAIC) and the Bayesian Information Criterion (BIC) (Keane and Wasi, 2013).

5. Results and discussion

In total, 252 people residing in Haspengouw started the online survey. However, to make comparisons across results possible, we decided to discuss the results based on the 193 respondents who successfully completed the survey. As in many socio-economic data collection methods, our approach made individuals decide for themselves whether they participated. This results in a data bias, known as self-selection bias, as individuals with strong opinions about the research topic in question are more likely to participate (Heckman, 2010).

5.1 Descriptive analysis

The vast majority of respondents in our sample is, to a greater or lesser extent, in favour of the conservation of traditional orchards in Haspengouw. More than half of the respondents even declared that conserving traditional orchards is very important to them. Similar results are observed for the conservation of typical Flemish landscapes in general as well as for nature conservation in Flanders (Figure 9). Because of self-selection into the sample, these observations are not generalizable for the entire population of Haspengouw. Nevertheless, these findings indicate that the rapid deterioration of the situation of traditional orchards concerns people living in Haspengouw.

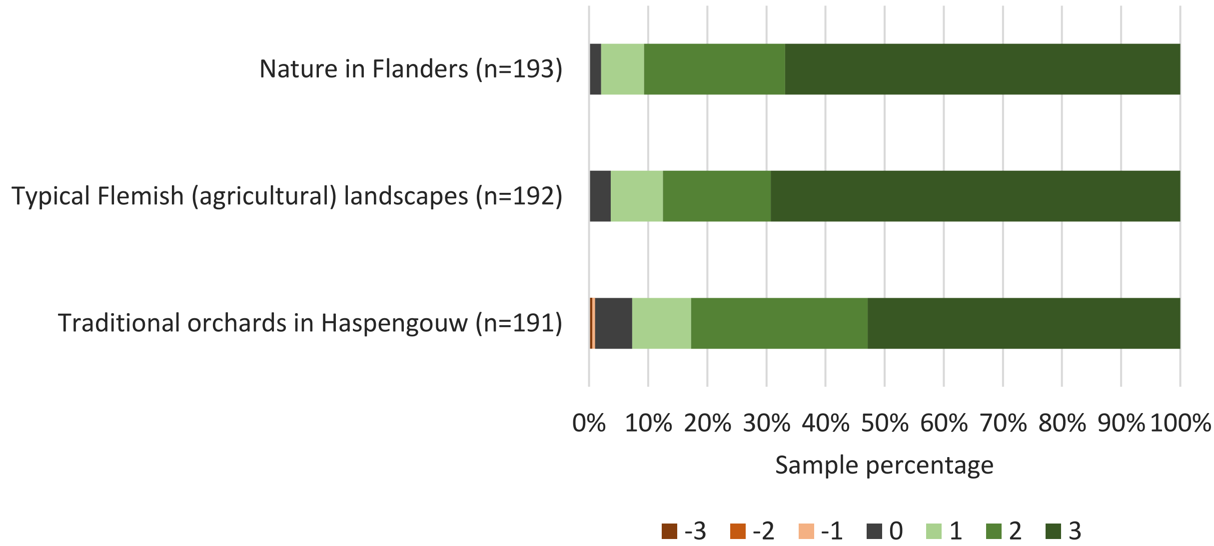


Figure 9: Importance conservation of nature, typical landscapes and traditional orchards. Ranging from totally not important (-3) to very important (+3)

The respondents stated diverse reasons for the importance of conserving of traditional orchards in Haspengouw, from which two main reasons arose. The first frequently mentioned reason was the landscape aesthetics associated with traditional orchards. They contribute to a diverse landscape, especially in contrast with 'industrial' and 'monotone' modern orchards. Second, traditional orchards are considered cultural heritage and typical for Haspengouw. They are inherently connected with the identity of the region and future generations should be able to enjoy them. Numerous individuals indicated to be personally attached to traditional orchards in their surroundings and believe that traditions should, at least to some extent, be respected.

Additionally, three other arguments for conservation of these landscape elements in Haspengouw were also commonly mentioned. First, traditional orchards are cherished for their ecological value and associated biodiversity. They create suitable habitats for numerous species, including the little owl (*Athene noctua)* and the garden dormouse (*Eliomys quercinus)*. Further, traditional orchards are perceived as important for attracting tourists. In turn, tourism is beneficial for the broader economy in Haspengouw. Third, traditional orchards are also appreciated because they entail old fruit cultivars. These cultivars are considered naturalistic heritage themselves and valued for their taste, genetic diversity and traditional processing possibilities.

Numerous respondents confirmed the trend of disappearing traditional orchards in their surroundings. Furthermore, they indicated that a substantial part of the remaining traditional orchards are being neglected. Although most respondents are dissatisfied with this situation, they also acknowledge that traditional orchards have limited economic value compared to modern, large-scale orchards.

5.2 Econometric analysis

5.2.1 Multinomial logit and mixed logit analysis

The estimated multinomial logit (MNL) and mixed logit (MXL) model are shown in Table 6. Comparing both models, all corresponding coefficients have the same sign and comparable significance levels. However, in contrast to the MNL model, the MXL model does not assume complete homogeneous preferences. If the standard deviation of a certain parameter is significant in the MXL model, there is preference heterogeneity on this parameter across respondents (Revelt and Train, 1998). At the 5% significance level, eight of these standard deviations are significant, indicating that preferences do indeed vary in our sample. To further investigate this variation in preferences, we also performed a latent class analysis.

Table 6: Results multinomial logit and mixed logit model

Attribute	Attribute level	Multinomial logit	Mixed logit	
		Coefficient	Mean	Standard deviation
Monthly donation		-0.0178***	-0.0249***	0.0521***
		(0.0030)	*(0.0054)*	*(0.0072)*
ASC		0.9408***	3.3097***	2.8503***
		(0.2107)	*(0.5711)*	*(0.4086)*
Distribution	*Base level: Concentrated*			
	Clustered	0.3641***	0.5197***	0.0024
		(0.0872)	*(0.1296)*	*(0.1839)*
	Evenly distributed	1.0534***	1.6511***	1.3114***
		(0.1334)	*(0.1872)*	*(0.1831)*
Total area	*Base level: Decrease*			
	Constant	0.3534***	0.5688***	0.2262
		(0.1079)	*(0.1444)*	*(0.2625)*
	Increase	0.6457***	0.8906***	0.5376***
		(0.1143)	*(0.1421)*	*(0.1913)*
Fruit tree diversity	*Base level: Low*			
	Average	0.1879**	0.2442**	0.0573
		(0.0859)	*(0.1150)*	*(0.2855)*
	High	0.5305***	0.6273***	0.0246
		(0.1065)	*(0.1361)*	*(0.2558)*
Ecological value	*Base level: Low*			
	Average	0.5005***	0.6968***	0.5082**
		(0.0967)	*(0.1314)*	*(0.2268)*
	High	0.7467***	0.9825***	0.6858***
		(0.1262)	*(0.1567)*	*(0.2249)*
Condition	*Base level: Degraded*			
	Average	0.4310***	0.7908***	0.2418
		(0.1190)	*(0.1565)*	*(0.2214)*
	Good/Healthy	0.8918***	1.4359***	0.9186***
		(0.1383)	*(0.1955)*	*(0.1738)*
Recreational value	*Base level: Low*			
	Average	-0.2231**	-0.2743**	0.06549
		(0.0948)	*(0.1315)*	*(0.1671)*
	High	0.09667	0.0645	0.5535***
		(0.0881)	*(0.1154)*	*(0.1606)*

Note: (1) *,** and *** denote 10%, 5% and 1% significance level, respectively
(2) Standard errors between brackets
(3) For both models, ASC coefficient is also positive with effects coding
(4) Number of respondents = 193

Not surprisingly, the fact that people prefer to make a small financial contribution over a large financial contribution is confirmed by the significant (at 1% level) negative cost attribute in both models.

The coefficient of *ASC* is positive and significant at the 1% significance level. This means that the respondents want to avoid the business as usual scenario. That is to say, they prefer a situation in which traditional orchards do not disappear within ten years in Haspengouw. When estimating both models with effects coding instead of dummy coding (Table 5), the *ASC* coefficient is also significant positive. This indicates that avoiding the business as usual scenario itself is preferred, independent of which changes this precisely encompasses.

Looking at the distribution of traditional orchards over the landscape in Haspengouw, it is clear that respondents have a profound preference for a more even distribution. A too high concentration of traditional orchards in one or two places would resemble an 'open-air museum'. As expected, respondents prefer an increase in the total area of traditional orchards in Haspengouw. However, the coefficients of the *distribution* attribute are larger than those of the *total area* attribute, suggesting that respondents attach more importance to the distribution of traditional orchards than to their total area. A plausible explanation is that, because many traditional orchards in Haspengouw are neglected at the moment, there is little belief among respondents that a larger area of traditional orchards can be properly conserved.

Based on the MXL and MNL model, there is a significant preference for high levels of the attributes *fruit tree diversity*, *ecological value* and *condition*. Comparing these attributes, *condition* is relative the most important one. In part, this can be explained because a degraded traditional orchard can be harmful for the landscape aesthetics associated with these landscape elements. Further, the average respondent seems to attach more value to the ecological value of a traditional orchard than to its diversity in fruit trees.

The last attribute discussed here is *recreational value*. The low level is preferred over the average level and the high level is not significantly different from zero. This suggest that respondents prefer either low or high levels of recreation, but not in between. Moreover, *recreational value* was the least decisive attribute for respondents (Appendix A). Overall, the average individual seems to be rather neutral towards the recreational value of traditional orchards in Haspengouw.

Table 7 gives the willingness to pay (WTP) values and associated confidence intervals based on the MNL model. For completeness, the WTP confidence intervals based on the MXL model are also included in the appendices (Appendix B). These WTP values can be interpret as the amount of money (€) per month the average respondent is willing to donate for a certain situation of traditional orchards in Haspengouw. Based on Table 7, it seems to be the case that there is a high WTP for the conservation of traditional orchards. However, because of self-selection into the sample (self-selection bias) and the fact that a choice experiment is hypothetical (hypothetical bias), the true WTP for the average person living in Haspengouw is presumably lower.

Table 7: Willingness to pay confidence intervals based on multinomial logit model

Attribute	Attribute level	WTP	95% confidence interval
ASC		52.8	[27.2 ; 83.4]
Distribution	*Base level: Concentrated*		
	Clustered	20.5	[9.9 ; 30.97]
	Evenly distributed	59.2	[36.7 ; 81.5]
Total area	*Base level: Decrease*		
	Constant	19.8	[7.7 ; 32.0]
	Increase	36.3	[21.1 ; 51.4]
Fruit tree diversity	*Base level: Low*		
	Average	10.6	[1.1 ; 20.0]
	High	29.79	[17.4 ; 42.1]
Ecological value	*Base: Low*		
	Average	28.11	[15.3 ; 40.9]
	High	41.9	[22.6 ; 61.3]
Condition	*Base level: Degraded*		
	Average	24.2	[10.1 ; 38.3]
	Good/Healthy	50.1	[29.9 ; 70.3]
Recreational value	*Base level: Low*		
	Average	-12.5	[-23.9 ; -1.1]
	High	5.4	[-4.4 ; 15.3]

5.2.2 Latent class analysis

As the MXL model indicated preference heterogeneity across respondents for more than half of the parameters, we decided to also perform a latent class (LC) analysis. By performing a LC analysis, the sample is segmented in classes which have homogeneous preferences within those classes, but heterogeneous preferences between classes. Because the number of classes is unknown a priori, four LC models were estimated, ranging from two to five latent classes. Subsequently, the LC model with two classes was selected based on the information criteria CAIC and BIC (Appendix C). This model is shown in Table 8.

The LC model identifies two segments in our sample. A relatively small segment (class 1), with 19% of respondents belonging to this segment, and a larger segment (class 2), representing 81% of the sample. Class 2 has a higher *ASC* compared to class 1, indicating that respondents belonging to this class are more eager to avoid the business as usual scenario. Furthermore, all other coefficients for attributes levels are also higher for class 2. Although this is true for all attributes, the most notable difference is found for *ecological value*. While respondents belonging to class 1 are rather neutral towards the ecological value of traditional orchards in Haspengouw, class 2 represents respondents who have a clear preference for traditional orchards with a high ecological value. Overall, we can conclude that respondents belonging in class 2 find it relatively more important to conserve traditional orchards in Haspengouw.

Table 8: Results latent class model with two classes

Attribute	**Attribute level**	**Class 1** (19%)	**Class 2** (81%)
ASC		0.4851	14.2083
		(0.3764)	*(18.4251)*
Monthly donation		-0.0602***	-0.01613***
		(0.0090)	*(0.0038)*
Distribution	*Base level: Concentrated*		
	Clustered	0.2361	0.5723***
		(0.2438)	*(0.1257)*
	Evenly distributed	0.7360***	1.4475***
		(0.2532)	*(0.1494)*
Total area	*Base level: Decrease*		
	Constant	-0.3019	0.7934***
		(0.2433)	*(0.1480)*
	Increase	0.5172**	0.9932***
		(0.2363)	*(0.1354)*
Fruit tree diversity	*Base level: Low*		
	Average	0.0041	0.2311**
		(0.2304)	*(0.1023)*
	High	0.2795	0.8070***
		(0.2411)	*(0.1316)*
Ecological value	*Base level: Low*		
	Average	0.1781	0.7468***
		(0.2298)	*(0.1159)*
	High	-0.1389	1.1463***
		(0.2583)	*(0.1565)*
Condition	*Base level: Degraded*		
	Average	0.5856**	0.7545***
		(0.2666)	*(0.1704)*
	Good/Healthy	0.7548***	1.3472***
		(0.2801)	*(0.2020)*
Recreational value	*Base level: Low*		
	Average	-0.3084	-0.2158*
		(0.2379)	*(0.1192)*
	High	-0.1012	0.0056
		(0.2216)	*(0.0968)*

In Table 9, several characteristics of both classes are compared. The considered socio-economic characteristics of both classes are very similar. Further, also the share of respondents who are member of a nature organisation (e.g. *Greenpeace*, *Natuurpunt* or *Limburgs Landschap*) does not significantly differ between both groups. Actually, the only observed difference (significant at the 10% level) is the frequency of outdoor recreation. Taking everything together, it seems reasonable to assume that the difference between the classes is mainly the result of unobserved individual-specific preferences.

Table 9: Characteristics of classes

Characteristics	**Class 1** (19%)	**Class 2** (81%)	**Sample** (n=198)
Age (years)	40.7	41.6	41.4
Male (dummy)	45.8%	57.8%	55.5%
Children[1] (dummy)	54.3%	53.5%	53.7%
Average household size	3.3	3.1	3.2
Higher education[2] (dummy)	65.7%	63.3%	63.7%
Nature organisation[3] (dummy)	25.7%	30.4%	29.5%
Frequent outdoor recreation[4] (dummy)*	40.0%	57.6%	54.4%
Preservation traditional orchards is crucial[5] (dummy)**	37.1%	55.7%	52.3%

Note: (1) * and ** denote significant difference at 10% and 5% significance level, respectively (2) [1]at least one child; [2]more than secondary education; [3]member or financial donor of nature organisation (e.g. Natuurpunt, Greenpeace and Limburgs Landschap); [4]more than once a week; [5]respondents denoted that preservation of traditional orchards in Haspengouw is very important

6. Conclusion

The objective of this thesis was to describe the attitude of people residing in Haspengouw towards traditional orchards. The vast majority of our sample has a profound preference for their conservation and is eager to avoid the business as usual scenario. Based on a latent class analysis, we found that differences across respondents are mainly the result of unobserved, individual-specific preferences rather than their socio-economic characteristics. Because our data collection method made individuals decide for themselves whether they participated in the survey, our sample is not representative for the entire population of Haspengouw. Although this sample bias, our findings indicate that there is a social demand for an improvement in the situation of traditional orchards in Haspengouw.

Overall, two main reasons exist for the importance of conserving traditional orchards according to inhabitants of Haspengouw. The first main reason is the landscape aesthetics associated with them. Second, traditional orchards are considered cultural heritage, typical for Haspengouw and inherently connected with the identity of the region. Further, traditional orchards are also appreciated for their ecological value, their role in attracting tourists and their entailed old fruit cultivars.

In general, respondents acknowledged that traditional orchards have limited economic value for their owners compared to modern, large scale orchards. Based on the multinomial logit and mixed logit model, we found a high willingness to pay among respondents for the conservation of traditional orchards. The former model suggest that the average respondent in our sample is willing to contribute between €27 and €83 per month to deviate from the business as usual scenario. However, because of self-selection into the sample (self-selection bias) and the hypothetical nature of choice experiments (hypothetical bias), the true willingness to pay for an average individual living in Haspengouw is presumably lower. Nevertheless, it seems to be the case that there is a substantial willingness to financially contribute for the conservation of traditional orchards in Haspengouw.

In order to reflect societal preferences, conservation efforts should focus on scenic and bequest values associated with traditional orchards. The former can be achieved by making sure that traditional orchards are evenly distributed over the landscape, a minimal (critical) area in Haspengouw remains and their maintenance is guaranteed. Additionally, the ecological features of traditional orchards and their diversity in fruit trees are also explicitly appreciated by society. Based on our findings, people residing in Haspengouw seem to be rather neutral towards the recreational possibilities of traditional orchards.

References

Adamowicz, W., Louviere, J. and Williams, M. (1994). Combining Revealed and Stated Preference Methods for Valuing Environmental Amenities. *Journal of Environmental Economics and Management*, 26(3), pp.271-292.

Anderies, J., Janssen, M., and Ostrom, E. (2004). A Framework to Analyze the Robustness of Social-ecological Systems from an Institutional Perspective. *Ecology and Society*, 9(1).

Baltas, G. and Doyle, P. (2001). Random utility models in marketing research: a survey. *Journal of Business Research*, 51(2), pp.115-125.

Bennett, J. and Blamey, R. (2001). *The choice Modelling approach to Environmental Valuation.* Cheltenham, UK: E. Elgar.

Bennett, E., Peterson, G. and Gordon, L. (2009). Understanding relationships among multiple ecosystem services. *Ecology Letters*, 12(12), pp.1394-1404.

Bergstorm, T., Blume, L. and Varian, H. (1986). On the provision of public goods. *Journal of Public Economics*, 29(1), pp.25-49.

Berkes, F., Colding, F. and Folke, C. (2002). Navigating Social-Ecological Systems: Building Resilience for Complexity and Change. Cambridge University Press, Cambridge, UK. *Ecology and Society,* 9(1).

Bhat, C. (1997). An endogenous segmentation mode choice model with an application in intercity travel. *Transportation Science,* 31, pp.34-48.

Biggs, R., Schluter, M., Biggs, D., Bohensky, E., BurnSilver, S., Cundill, G., Dakos, V., Daw, T., Evans, L., Kotschy, K., Leitch, A., Meek, C., Quinla, A., Raudsepp-Hearne, C., Robards, M., Schoon, M., Schultz, L. and West, P. (2012). Towards Principles for Enhancing the Resilience of Ecosystem Services. *Annual Review of Environment and Resources*, 37, pp. 421-448.

Blamey, R., Bennett, J., Louviere, J., Morrison, M. and Rolfe, J. (2000). A test of policy labels in environmental choice modelling studies. *Ecological Economics*, 32(2), pp.269-286.

Bonnichsen, O. and Ladenburg, J. (2015). Reducing Status Quo Bias in Choice Experiments. *Nordic Journal of Health Economics*, 3(1), pp.47-67.

Brauman, K., Daily, G., Duarte, T. and Mooney, H. (2007). The Nature and Value of Ecosystem Services: An Overview Highlighting Hydrologic Services. *Annual Review of Environment and Resources*, 32(1), pp.67-98.

Buckley, E. and Croson, R. (2006). Income and wealth heterogeneity in the voluntary provision of linear public goods. *Journal of Public Economics*, 90(4-5), pp.935-955.

Chan, K., Balvanear, P., Benessaiah, K., Chapman, M., Diaz, S., Gomez-Baggethun, E., Gould, R., Hannahs, N., Jax, K., Klain, S., *et al*. (2016). Why protect nature? Rethinking Values and the

Environment. *Proceedings of the National Academy of Sciences of the United States of America (PNAS),* 113(6), pp. 1462-1465.

Chang, H. (2009). Rethinking public policy in agriculture: lessons from history, distant and recent. *The Journal of Peasant Studies*, 36(3), pp.477-515.

Chung, C., Boyer, T. and Han, S. (2011). How many choice sets and alternatives are optimal? Consistency in choice experiments. *Agribusiness*, 27(1), pp.114-125.

Coast, J. and Horrocks, S. (2007). Developing attributes and levels for discrete choice experiments using qualitative methods. *Journal of Health Services Research & Policy*, 12(1), pp.25-30.

Cooper, T., Hart, K. and Baldock, D. (2009). *The Provision of Public Goods Through Agriculture in the European Union*, Report for DG Agriculture and Rural development, Contract No 30-CE-0233091/00-28, Institute for European Environmental Policy (IEEP): London.

Courtney, P., Hill, G. and Roberts, D. (2006) The role of natural heritage in rural development: An analysis of economic linkages in Scotland, *Journal of Rural Studies*, 22(4), pp. 469-484.

Déjeant-Pons, M. (2006). The European Landscape Convention. *Landscape Research*, 31(4), pp.363-384.

DeShazo, J. and Fermo, G. (2002). Designing Choice Sets for Stated Preference Methods: The Effects of Complexity on Choice Consistency. *Journal of Environmental Economics and Management*, 44(1), pp.123-143.

Díaz, S., *et al*. (2015). The IPBES Conceptual Framework — connecting nature and people. *Current Opinion in Environmental Sustainability,* 14, pp.1-16.

Diriken, P. (2013). *Het Haspengouws Landschap in evolutie,* GEORETO

Drummond, M., Sculpher, M., Claxton, K., Stoddart, G. and Torrance, G. (2015). *Methods for the economic evaluation of health care programmes*. Oxford (United Kingdom): Oxford University Press.

Dwyer, J., Short, C., Berriet-Solliec, M., Gael-Lataste, F., Pham, H-V., Affleck, M., Courtney, P. and Déprès, C. (2015). *Public Goods and Ecosystem Services from Agriculture and Forestry – a conceptual approach.* PEGASUS.

European Environment Agency. (2005). *The European environment — State and outlook 2005.* EEA Report No 1/2005, EEA: Copenhagen

Fisher, W. and Turnovsky, S. (1998). Public Investment, Congestion and Private Capital Accumulation. *The Economic Journal,* 108(447), pp.399-413.

Garrod, G. and Willis, K. (1992). Valuing goods' characteristics: An application of the hedonic price method to environmental attributes. *Journal of Environmental Management*, 34(1), pp.59-76.

Gliessman, S. (2010). Landscape Multifunctionality and Agriculture. *Journal of Sustainable Agriculture*, 34(5), pp.465-465.

Gray, J. (2000). The Common Agricultural Policy and the Re-Invention of the Rural in the European Community. *Sociologia Ruralis*, 40(1), pp.30-52.

Green, P. and Srinivasan, V. (1978). Conjoint Analysis in Consumer Research: Issues and Outlook. *Journal of Consumer Research*, 5(2), pp.103-123.

Greene, H. and Hensher, D. (2013). Revealing additional dimensions of preference heterogeneity in a latent class mixed multinomial logit model. *Applied Economics*, 45(14), pp.1897-1902.

Haan, P. and Uhlendorff, A. (2006). Estimation of multinomial logit models with unobserved heterogeneity using maximum simulated likelihood. *The Stata Journal,* 6(2), pp.229-245.

Hall, J., Viney, R., Haas, M. and Louviere, J. (2004). Using stated preference discrete choice modelling to evaluate health care programs. *Journal of Business Research*, 57(9), pp.1026-1032.

Havlik, P., Veysset, P., Boisson, J. M., Lherm, M. and Jacquet, F. (2005). Joint analysis under uncertainty and multifunctionality of agriculture: Policy considerations and applied analysis. *European Review of Agricultural Economics*, 32 (4), pp. 489-515.

Heckman, J. (2010). Selection Bias and Self-Selection. In: Durlauf S.N., Blume L.E. (eds) *Microeconometrics. The New Palgrave Economics Collection*. Palgrave Macmillan: London.

Hanley, N., Mourato, S. and Wright, R. (2002). Choice Modelling Approaches: A Superior Alternative for Environmental Valuation?. *Journal of Economic Surveys*, 15(3), pp.435-462.

Hanley, N., Schläpfer, F. and Spurgeon, J. (2003). Aggregating the benefits of environmental improvements: distance-decay functions for use and non-use values. *Journal of Environmental Management*, 68(3), pp.297-304.

Hensher, D., Rose, J. and Greene, W. (2005). Applied Choice Analysis, A Primer. Cambridge University Press: New York.

Hensher, D. (2006). How do respondents process stated choice experiments? Attribute consideration under varying information load. *Journal of Applied Econometrics*, 21(6), pp.861-878.

Hodge, I. (2008). "To what extent are environmental externalities a joint product of agriculture? Overview and policy implications" in *Multifunctionality in agriculture: evaluating the degree of jointness, policy implications*, OECD Publications: Paris.

Hole, A. (2007). A comparison of approaches to estimating confidence intervals for willingness to pay measures. *Health Economics*, 16(8), pp.827-840.

Hoyos, D. (2010). The state of the art of environmental valuation with discrete choice experiments. *Ecological Economics*, 69(8), pp.1595-1603.

JMP. (2016). *JMP 12 Online Documentation - Discrete Choice Designs*. [online] Available at: http://www.jmp.com/support/help/Discrete_Choice_Designs.shtml#65506 [Accessed 4 Apr. 2017].

Pascual, U. *et al*. (2017). Valuing nature's contributions to people: the IPBES approach. *Current Opinion in Environmental Sustainability*, 26-27, pp.7-16.

Keane, M. and Wasi, N. (2013). Comparing alternative models of heterogeneity in consumer choice behaviour. *Journal of Applied Economics,* 28, pp. 1018-1045.

Kessels, R., Jones, B. and Goos, P. (2011). Bayesian optimal designs for discrete choice experiments with partial profiles. *Journal of Choice Modelling*, 4(3), pp.52-74.

Kjaer, T. (2005). A review of the discrete choice experiment – with emphasis on its application in health care. *Health Economics Papers,* 2005(1).

Kløjgaard, M., Bech, M. and Søgaard, R. (2012). Designing a Stated Choice Experiment: The Value of a Qualitative Process. *Journal of Choice Modelling*, 5(2), pp.1-18.

Kainer, K., DiGiano, M., Duchelle, A., Wadt, L., Bruna, E. and Dain, J. (2009). Partnering for Greater Success: Local Stakeholders and Research in Tropical Biology and Conservation. *Biotropica*, 41(5), pp.555-562.

Krinsky, I. and Robb, A. (1986). On approximating the statistical properties of elasticities. *Review of Economics and Statistics*, 68, pp.715-719.

Jack, B., Kousky, C. and Sims, K. (2008). Designing payments for ecosystem services: Lessons from previous experience with incentive-based mechanisms. *Proceedings of the National Academy of Sciences*, 105(28), pp.9465-9470.

Lancaster, K. (1966). A New Approach to Consumer Theory. *Journal of Political Economy*, 74(2), pp.132-157.

Lele, S., Springate-Baginski, O., Lakerveld, R., Deb, D. and Dash, P. (2013). Ecosystem Services: Origins, Contributions, Pitfalls, and Alternatives. *Conservation and Society,* 11, pp.343-358.

Mangham, L., Hanson, K. and McPake, B. (2008). How to do (or not to do)... Designing a discrete choice experiment for application in a low-income country. *Health Policy and Planning*, 24(2), pp.151-158.

Mays, N. and Pope, C. (2000). Qualitative research in health care: Assessing quality in qualitative research. *BMJ*, 320(7226), pp.50-52.

McFadden, D. (1974). Conditional logit analysis of qualitative choice behaviour. In: *Frontiers of Econometrics*. Academic press: London.

McFadden, D. and Train, K. (2000). Mixed MNL models for discrete response*. Journal of applied econometrics,* 15*,* pp.447-470.

Millennium Ecosystem Assessment. (2005). *Ecosystems and Human Well-being: Synthesis.* Island Press, Washington, DC.

Mills, J., Winter, W. and Powell, J. (2000). *The Socio-economic Impacts of Implementing the UK Biodiversity Action Plan for Species-rich Hedges in Devon*, English Nature Research Reports No. 397, English Nature: Peterborough.

Moore, W. (1995). Rational rebels, overcoming the free-rider problem. *Political Research Quarterly,* 48(2), pp.417-454.

Morrison, M. (2000). Choice Modelling, Non-Use Values and Benefit Transfer. *Economic Analysis and Policy*, 30(1), pp.13-32.

Musgrave, R. (1959). The Theory of Public Finance. *The Economic Journal*, 69(276), pp.766-770.

Nationale Boomgaardenstichting. (2015). *Hoogstamfruitbomen in Limburg – Deel 1-Peren met 84 vruchtbeschrijvingen*.

Norton, L., Inwood, H., Crowe, A. and Baker, A. (2012). Trialling a method to quantify the 'cultural services' of the English landscape using Countryside Survey data. *Land Use Policy*, 29(2), pp.449-455.

OECD (1974). *The polluter pays principle*, Council Recommendation C(74):223.

OECD (1998). *Agriculture and the environment: Issues and policies,* OECD Publications: Paris

OECD (2001). *Improving the environmental performance of agriculture: Policy options and market approaches,* OECD Publications: Paris.

Perman, R., McGilvary, J. and Common, M. (2003). *Natural resource and environmental economics*. Harlow: Pearson education

Raufflet, E. (2000). Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience. Cambridge University Press, New York. *Conservation Ecology*, 4(2).

Redman, C., Grove, M. J. and Kuby, L. (2004). Integrating Social Science into the Long Term Ecological Research (LTER) Network: Social Dimensions of Ecological Change and Ecological Dimensions of Social Change. *Ecosystems*, 7(2), pp.161-171.

Revelt, D. and Train, K. (1998). Mixed Logit with Repeated Choices: Households' Choices of Appliance Efficiency Level. *Review of Economics and Statistics,* 80(4), pp.647-657.

Rodríguez, J., Beard, T., Bennett, E., Cumming, G., Cork, S., Agard, J., Dobson, A., and Peterson, G. (2006). Trade-offs across space, time and ecosystem services. *Ecology and Society,* 11(1).

Rowcroft, P., Smith, S., Clarke, L., Thomson, K., and Reed, M. (2011). *Barriers and opportunities to the use of payments for ecosystem services, Final report prepared for Defra September 2011*. URS Scott Wilson, London.

Samuelson, P. (1954). The Pure Theory of Public Expenditure. *The Review of Economics and Statistics*, 36(4), pp.387-389.

Shepsle, K. and Weingast, B. (1984). Political Solutions to Market Problems. *American Political Science Review*, 78(02), pp.417-434.

Swanwick, C., Hanley, N. and Termansen, M. (2007). *Scoping Study on Agricultural Landscape Valuation*, Department for Environment, Food and Rural Affairs.

Train, K. (2003). *Discrete choice methods with simulation*. Cambridge: Cambridge University Press.

Train, K. (2008). EM Algorithms for Nonparametric Estimation of Mixing Distributions. *Journal of choice modelling,* 1(1), pp.40-69.

Venkatachalam, L. (2004). The contingent valuation method: a review. *Environmental Impact Assessment Review*, 24(1), pp.89-124.

Viladomiu, L. and Rosell, J. (2004). Olive oil production and the rural economy of Spain, in: Brouwer, F. (ed.) *Sustaining agriculture and the rural environment, governance, policy and multifunctionality*, Edward Elgar Publishing: Cheltenham.

Wascher, D.M. (2004). Landscape Indicator Development: Steps towards a European approach, in: Jongman, R. (ed.) *The New Dimensions of the European Landscape: Frontis Series No. 4,* Kluver Academic Publishers: Dordrecht.

Willinger, M. and Ziegelmeyer, A. (1999). Framing and cooperation in public good games: an experiment with an interior solution. *Economics Letters*, 65(3), pp.323-328.

Willis, K. and Garrod, G. (1991). An individual travel-cost method of evaluating forest recreation. *Journal of Agricultural Economics*, 42(1), pp.33-42.

Appendices

Appendix A

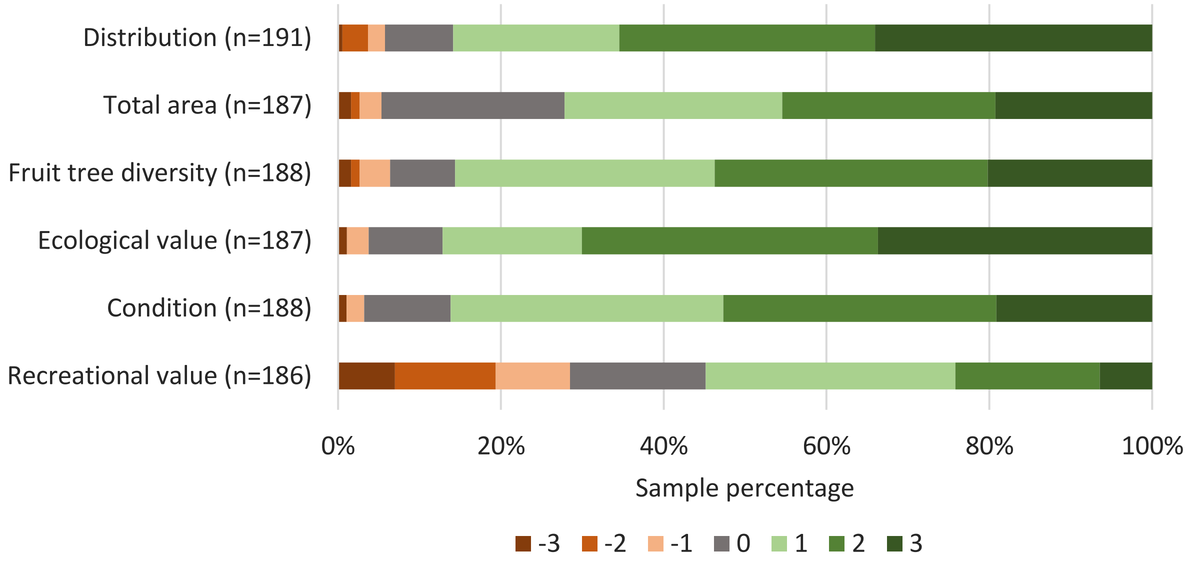


Figure: Decisiveness attributes. Ranging from totally not decisive (-3) to very decisive (+3)

Appendix B

Table: Willingness to pay confidence intervals based on mixed logit model

Attribute	Attribute level	WTP	95% confidence interval
ASC		132.4	[59.7 ; 205.7]
Distribution	*Base level= Concentrated*		
	Clustered	20.8	[9.2 ; 32.4]
	Evenly distributed	66.1	[36.8 ; 95.3]
Total area	*Base level = Decrease*		
	Constant	22.8	[10.5 ; 35.0]
	Increase	35.6	[19.0 ; 52.3]
Diversity of fruit trees	*Base level = Low*		
	Average	9.8	[0.6 ; 18.9]
	High	25.1	[11.9 ; 38.3]
Ecological value	*Base level = Low*		
	Average	27.9	[14.0 ; 41.7]
	High	39.3	[20.3 ; 58.3]
Condition	*Base level = Degraded*		
	Average	31.6	[16.0 ; 47.2]
	Good/Healthy	57.4	[32.7 ; 82.2]
Recreational value	*Base level = Low*		
	Average	-11.0	[-22.5 ; 0.5]
	High	2.6	[-6.5 ; 11.7]

Appendix C

Table: Information criteria for latent class models

Number of latent classes	CAIC	BIC
2	2895.198	2865.322
3	2909.322	2866.198
4	2936.52	2877.52
5	3004.683	2930.683

Popularized summary

Traditional orchards are a remainder of the rich history in fruit cultivation in Haspengouw, which is the geophysical region in the southern part of the province Limburg in Belgium. Since 1950, there has been a shift from traditional orchards towards more productive, large-scale modern orchards. Although only a few hundred hectares are left in Haspengouw, the number of traditional orchards is still diminishing at a fast pace. The presence of these remaining traditional orchards is appreciated for its scenic, bequest and ecological value.

Several organisations, including *Nationale Boomgaardenstichting, Regionaal Landschap Haspengouw en Voeren* and more recently *agentschap Onroerend Erfgoed*, strive for the conservation of traditional orchards in Haspengouw. However, in order to create a socially desirable outcome for these landscape elements, conservation efforts should be based on societal preferences. As such, this thesis focusses on the attitude of people living in Haspengouw towards traditional orchards in their region by means of a choice experiment.

To conduct a relevant and meaningful research, the composition of the choice experiment was based on interviews with policy makers and targeted respondents. After the experimental design, an online survey was used to collect data from 252 individuals living in Haspengouw. Subsequently, the choice experiment was analysed by estimating three distinctive models.

The main conclusion of this thesis is that overall, there is a social demand for improving the situation of traditional orchards in Haspengouw. Our findings also suggest that there is a substantial willingness to pay for the conservation of these landscape elements. Additionally, the characteristics of traditional orchards in Haspengouw valued most by people living in the region and arguments for their conservation are discussed. Overall, this societal information can provide valuable insight for policy makers that strive for a socially desired outcome.