VU VRIJE UNIVERSITEIT AMSTERDAM

Spatial Economics

Subsidizing Miscanthus and Minimum Ethanol Fuel Share Standards for 2020

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Article Info

Article history:
Concept version 14 June 2013
Final version 28 June 2013

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Second assessor: Peter Mulder

Keywords:
Bioethanol
Economic Analysis
Miscanthus
Spatial Distribution
Subsidy
2020 fuel standards
CO_2 Reduction

Abstract

Several policy measures to reach 2020 biofuel market share goals have been analysed. Economic potentials of conventional crops have been compared to the economic performance of Miscanthus after which required subsidies have been assessed. At two different market prices social effects of policies focusing at distributing subsidies most efficiently, minimizing land-use impact and incorporating Miscanthus under CAP have been assessed. It is found that under several policy options, a subsidy on Miscanthus is able to reach the goals set for 2020 in a sustainable way while at the same time producing social benefits larger than the aggregate subsidies allocated. A spatial heterogeneous subsidy based on soil and water-table characteristics is shown to substantially decrease needed budget for subsidies. Under all scenario's such a subsidy is found to create net social benefits for society. Furthermore it was shown that focusing on minimized impact on land-use, will reduce social benefits and is able to create net social costs for society under some scenario's. While minimum aggregate subsidies based on spatially heterogeneous characteristics were found to be able to reach policy goals at minimum costs, highest net social benefits were found when a spatial homogenous CAP subsidy between € 218,25 and € 310,74 is allocated per year per hectare.

Bo Andrée, 2013

1. Introduction

Carbon dioxide emission reduction is a topic high on the agenda for a lot of countries. One of the important contributions in the battle against carbon emissions will be the switch to the use of natural energy sources. In recent years a lot of research has been done on the potential of natural energy sources. It has already been shown that energy from biomass is able to facilitate large parts of the energy supply on different levels of demand. Studies on the bioenergy potential on different scale levels have been carried out by Hoogwijk et al., (2005); Smeets and Faaij, (2007) and Dornburg et al., (2008), who assessed bioenergy potential on world scale. Van Dam et al., (2007); de Wit and Faaij, (2010); Fischer et al., (2010a,b) assessed bioenergy potential at European scale level, and van den Broek et al., (2001); Batidzirai et al., (2006); Styles and Jones, (2007), assessed bioenergy potential on a national level.

An important realization in assessing bioenergy potential is the fact that there is spatial variation in production characteristics. This notion has been applied by Diogo et al., (2012), who assessed bioenergy potential of Miscanthus on a national scale. Van der Hilst et al. (2010) assessed bioenergy potential of Miscanthus in the northern part of the Netherlands. Both studies focus on the Netherlands and take into account spatial heterogeneity, making them able to pinpoint specific areas of interest and relating the spatial variability of potential feedstock production costs to different economic scenarios.

This research elaborates on the aforementioned work done by Van der Hilst et al. and Diogo et al., and uses comparable methods to calculate bioenergy potential and competitive advantage of Miscanthus in relation to other agricultural land uses. Different studies ascribed high potential yields to Miscanthus (Elbersen et al., 2005; de Wolf and van der Klooster, 2006; van der Voort et al., 2008), making it a suitable crop for energy production. Van der Hilst et al. showed that Miscanthus was more economically viable than sugar beets, therefore this research focusses solely on Miscanthus as a biofuel source. A spatial economic model is developed that simulates decision making at the farmer level. In a comprehensive analysis spatial variation in the net present value of bioenergy potential is compared to spatial variation in net present value of current land use. Based on this, the spatial distribution of opportunity costs for local Miscanthus bioenergy potential is calculated. A spatial distribution of minimum subsidy is assessed by assuming a farmer would grow Miscanthus when there are no or negative opportunity costs (opportunity gains). Based on the spatial distribution of minimum subsidies it is possible to make different aggregations related to different requirements.

This spatial economic model is linked to biofuel market share standards set by the European Union for the year 2020 and includes a broad assessment on the net present value of current land-use. Prices and values used by Van der Hilst et al. and Diogo et al. in their comparable approach are updated with values found in more recent literature. In contrast to previous research, the focus in in this study lies on actual policy implementations needed to reach goals set by the European Union, instead of exploring spatial effects or relations themselves. Instead of a bottom-up approach in which possibilities are assessed based on spatial characteristics, this research can be seen as following both a top-down approach, assessing efficient ways to fulfil goals set on a higher level, and a bottom-up approach, working towards fulfilling these goals from a local scale.

The main question that will be answered in this study;

"What is the minimum aggregate subsidy needed in the Netherlands to reach European 2020 fuel standards through growing Miscanthus and how does this relate to other subsidy options from a social welfare point of view?"

This paper is organised as follows. I provide a theoretical analysis on the opportunity costs for growing Miscanthus. Based on opportunity costs calculated at two different market price levels for Miscanthus, different subsidy options are analysed. The first option is directed at spending government money only where it is most efficiently used, the second option is directed at minimizing impact on land-use. A third option is directed at increasing practical feasibility. In this last option it is analysed what could happen if Miscanthus is incorporated in the current European CAP subsidies.

The last option is not specifically directed at reaching the 2020 market share standards but is likely to overstep these minimum market share goals.

In section 2, insights are provided in the methodology used. Section 3 presents the subsidy estimates of the different policy options that were analysed and summarises the results in a comprehensive cost-benefit analysis. A discussion follows in section 4, in which is reflected on the methodology used and the implications of the results generated. Section 5 provides an answer to the main research question and presents the different conclusions that can be drawn based on the research done.

2. Methodology

This section provides insights in the methodology used in assessing different subsidy options. Based on European policy goals, Section 2.1 describes calculated required biofuel market share growth. This is used as a satisfying condition for subsidy policy measures assessed by the economic performance land-use model developed in section 2.2. Section 2.3 delineates how this model is used to calculate aggregate subsidies based on different possible policy measures. In section 2.4 it is described how these different possible policy measures are paralleled in a cost-benefit analysis.

2.1 Assessing Required Growth in Biofuel Production

First the policy goals set for 2020 and the European methods of calculating bioenergy market share are brought forward in section 2.1.1. In section 2.1.2 insights are provided in current fuel market shares. Section 2.1.3 relates the current biofuel market share to the biofuel market share required to reach 2020 policy goals. From there I advance towards assessing needed growth in biofuel production to reach said policy goals.

2.1.1 Policy Goals and European Method on Assessing Market Share

The United States set targets for a minimum of 16% ethanol market share in the total fuel market (Anderson, 2011). In Europe targets are more broadly defined. In 2020, a minimum of 20% of total energy usage must be generated from renewable sources (MEZ, 2011). Within the transport sector specifically, 10% of energy usage must come from renewable sources (Fonseca et al., 2010; European Energy Commission, 2010). To limit land conversion and limit effects within the food industry, the European Commission proposed in October 2012 that only half of the renewable sources may come from food-based bio-fuels, the other half must come from fuel sources generated from other sources (European Energy Commission, 2010). Though specific renewable energy goals may vary per member state, it is agreed upon that all countries must obtain the 10% share within the transport sector by 2020.

The way fuel share is calculated is by the following formula (Grinsven and Kampman, 2013):

$$\text{Share of RE} = \frac{\begin{array}{c}\text{All types of energy from renewable sources}\\ \text{consumed in all forms of transport}\end{array}}{\begin{array}{c}\text{Energy consumption of petrol, diesel,}\\ \text{biofuels consumed in road and rail transport,}\\ \text{and electricity in the transport sector}\end{array}} \qquad (1)$$

It is important to note that fuels are weighted by their energy equivalents in Joules. Furthermore, the European Union concluded that there should be multiplication factors to promote non-food biofuels. *"Non-food cellulosic material, and lignocellulosic material shall be considered to be twice that made by other biofuels"* (Grinsven and Kampman, 2013). Therefore the effective minimum target differs from the counted weights in reaching the target.

2.1.2 Current Biofuel Market Share

The report on compliance of company obligations to report on quantities of fuels used and sold mentions that in 2011 4.31% of the fuel used in the Netherlands was based on bio-fuels, from which 40% is reached through double counting non-food biofuels (NEA, 2012). From this, one can calculate that in that same year 2,586% of the energy used in transport was based on food-based bio-fuels, and 0,862% was based on non-food based bio-fuel. The same report mentions a total energy use of 542,6 PJ in the whole transport sector (NEA, 2012). The aforementioned research on second generation biofuel generation in the Netherlands performed by Diogo and others, note a total energy use of 610,7 PJ in 2009 within the transport sector. They refer to Eurostat in their paper. The Panorama of Energy, published by Eurostat, gives an overview of fuel usage per European member country and for 2004 it mentions 15620 thousand Ton of Oil Equivalent, which corresponds to 654 PJ (Eurostat, 2006). For different years energy usage within the transport sector was gathered.

Year	Energy Usage	Source
2011	542,6 PJ	NEA,2012
2009	610,7 PJ	Eurostat 2011, Cited by Diogo, Koomen and van der Hilst
2006	654,0 PJ	Eurostat, 2009
2004	629,6 PJ	Eurostat, 2006

Table 1 Energy Usage in Recent Years

Total Energy usage within the Transport Sector based on figures provided by NEA and Eurostat. One PJ is equivalent to 1000 TJ or one million GJ.

Average energy use in the transport sector in the Netherlands based on the figures presented above, is calculated at 610 PJ. It is assumed that efficiency improvements in combustion systems and increase in car possession cancel each other out as decreasing and increasing effects on the energy usage within the transport sector, so to calculate the minimum biofuel supply in 2020, the average of 610 PJ is used as a reference number.

2.1.3 Required Growth in Biofuel Production

Caloric energy content of Miscanthus is assumed to be 17GJ per Oven Dry Ton (odt). The Best Practice Guidelines, which are published with the aim to introduce farmers to Miscanthus, mention a net calorific value of 17GJ/odt (Caslin et al., 2010). Van der Hilst et al. (2010) cite Christian et al. (2001) in their assumption of 18GJ/odt energy content of Miscanthus. The Sustainable Energy Authority of Ireland state a 17GJ/odt energy content of Miscanthus (2010). Brosse et al. (2012) state that the caloric energy content of Miscanthus lies within the range of 17–20 GJ/odt, depending on the sample specific combustion quality.

To prevent overestimation in favour of high Miscanthus energy potential, an expected average of 17GJ/odt is taken in this analysis for every oven dry ton of Miscanthus grown. Lignocellulosic energy conversion is assumed to be 35% (Hamelinck et al. (2005), cited by Van der Hilst et al., 2010). This means that the biofuel energy after converting Miscanthus to ethanol is 5.95GJ/odt.

Two options are considered to reach the 2020 goals. x1 (goal one): only the minimum part of non-food based biofuel will be taken account for, it is assumed that without further subsidy growth in food based biofuel will help reaching 2020 fuel standards, leaving the food based biofuel out of this analysis. A total growth of 1.679.294 odt in Miscanthus production is required; x2 (goal two): all growth needed in biofuel market share will be accounted for by Miscanthus production, taking double counting into account. No extra growth in food based bio fuel will be needed. A growth of 2.916.722 odt in Miscanthus production is required. This option requires more hectare of land to be used for Miscanthus, a higher subsidy is required. CO_2 emissions are further reduced than in option A.

	Actual Percentage	Multiplication Factor	Counted Percentage	TJ Needed	Miscanthus odt
Total Energy	100,00%	1	100,00%	610.000	102.521.008
Goal Miscanthus [x1]	*2,500%*	*2*	*5,000%*	*152.500*	*2.563.025*
Goal food based	5,000%	1	5,000%	30.500	5.126.050
Goal Miscanthus only [x2]	***5,000%***	***1***	***5,000%***	***30.500***	***5.126.050***
Current Miscanthus	*0,862%*	*2*	*1,724%*	*5.258*	*883.731*
Current food-based biofuel	2,586%	1	2,586%	15.775	2.651.193
Current total biofuel	4,310%	1	4,310%	26.291	4.418.656
Growth Miscanthus [x1]	*1,638%*	*2*	*3,276%*	*9.992*	*1.679.294*
Growth non food	2,414%	1	2,414%	14725.4	2.474.857
Growth Miscanthus only [x2]	***2,845%***	***2***	***5,690%***	***17354.5***	***2.916.723***

Table 2 Biofuel Goals, Current Market Shares, and Required Growth

x1: Reaching goals so that Miscanthus is grown in combination with growth in food based biofuel;
x2: Reaching goals so that Miscanthus is grown without any further growth in food based biofuel.
The last column stipulates required Miscanthus production assuming potential biofuel energy of 5.95GJ/odt Miscanthus and a yearly total energy usage of 610 PJ.

Minimum aggregate subsidy and according land conversion will be assessed based on the assumption that the government can either use her money to import bio-fuels from the market or subsidize farmers to grow Miscanthus. Assuming that money will be spend efficiently, it will be calculated where in the Netherlands Miscanthus should be grown and how much aggregate subsidy on Miscanthus growing is needed to reach the 2020 goals if Miscanthus is grown on those areas where subsidy is most efficient in terms of subsidy per unit of product. Subsidy in euro per unit of energy should is required to be below the import price per unit of energy.
The minimum tax on conventional fuels necessary to support the proposed subsidies will be calculated. Finally an assessment on welfare effects of the different proposed methods to reach 2020 fuel share standards will be provided.

2.2 Land-Use Modelling

In this section I develop a spatial economic model for the agricultural sector in the Netherlands in which a farmer allocates crops according to the economic value of the crops. The model used in this research aims to replicate the decision making process at the farmer level. To do so, I view the Netherlands as consisting of a number of cells indexed by c with corresponding arable land-use type i. Farmers are assumed to be profit maximizing agents who grow those crops that would maximize their profit. It is assumed that farmers are aware of the possibility of their lands and the according costs and benefits.

Different components determine the economic performance of different crops. Using yield values, it is assessed how much product farmers can generate. Using crop specific costs and benefits the economic performance based on the local physical characteristics of land is calculated. By linking net present values of crops to land-use data, the economic performance of conventional land use is assessed. These are compared to the economic performance of Miscanthus to estimate opportunity costs.

Section 2.2.1 describes how yield values for different agricultural products are obtained. Section 2.2.2 elaborates on economic performance and delineates how net present values are obtained. In section 2.2.3 it is explained how subsidies are calculated based on the economic performance assessment in section 2.2.2.

2.2.1 Yield Values

To assess the economic value of conventional land-use, first crop-specific yield values were calculated. The yields are then associated with costs and benefits made at different levels of field productivity. The future costs and benefits are discounted and finally a comparison between conventional land-use and Miscanthus is made in net present value. Minimum subsidy is then assessed by calculating opportunity costs for growing Miscanthus.

Each crop reacts uniquely to extensive water or drought. Yield reductions depend on soil and water-tables, and are taken from the HELP-2005 report from Bakel et al. (2005). These damage scores are designed to be used with eq. (2) below to calculate total damages, expressed as yield reduction values. For each specific crop, yield values are calculated bij eq. (3). Expected net yield is then given by eq. (4)

$$Dtot_{c,i} = Dwa_{c,i} + \left[\frac{100 - Dwa_{c,i}}{100} * Ddr_{c,i}\right] \tag{2}$$

$$Yn_{c,i} = 100 - Dtot_{c,i} \tag{3}$$

$$Y_{c,i} = Ymax_{c,i} * Yn_{c,i} \tag{4}$$

Where:
$Dtot_{c,i}$ are the total damages in cell *c* for land use *i*;
$Dwa_{c,i}$ are damages due to extensive water in cell *c* for land use *i*;
$Ddr_{c,i}$ are damages due to drought in cell *c* for land use *I*;
$Yn_{c,i}$ is the net yield in percentages in cell *c* for land use *i* taking into account damages due to drought or extensive water;
$Y_{c,i}$ is the expected net yield in odt in cell *c* for land use *i*;
$Ymax_{c,i}$ is the maximum achievable yield in cell *c* for land use *i*;

Yield values for Miscanthus are not covered by the HELP-2005 tables. Yields for Miscanthus were based on data taken from Christian et al. (2001) and Lewandowski et al. (2003), who assessed yield values for Miscanthus by assuming the same sensitivity to water as corn but lower sensitivity to drought referring to the deeper rooting system of Miscanthus.

All yield values are expressed in percentages of total yield. Whereas yield values used by van der Hilst et al. (2010), and Diogo et al. (2012) are categorized in respectively 10 per cent and 5 per cent increments. All yield values in this study have increments of one per cent, which correspond to the level of detail in the original HELP-2005 tables.

2.2.2 Assessing Net Present Values

When the amount of generated product is known for each cell, prices and costs can be taken into account to assess the spatial distribution of economic performance. Net present value for each crop is calculated by eq. (5) for annual crops, and eq. (6) for perennial crops. The calculations for the benefit and cost components are given by respectively eq. (7) and eq. (8) and take in to account the yields calculated by eq. (4).

$$NPV_{c,i} = \sum_{y=o}^{n} \frac{B_{c,i,y} - C_{c,i,y}}{(1+r)^y} \tag{5}$$

Where:
$NPV_{c,i}$ is the net present value in cell *c* derived from land use *i* in year 0;
$B_{c,i,y}$ are the private benefits in cell *c* of land use *i* in year *y*;
$C_{c,i,y}$ are the private costs in cell *c*, including the initial investment in year 0, of land use *i* in year *y*;
r is the discount rate;
n is the lifetime of the project.

For perennial crops, NPV was calculated based on annuities.

$$NPV_{c,i} = A_{c,i} * \left[\frac{1-(1+r)^{-n}}{r}\right] \tag{6}$$

Where:
$NPV_{c,i}$ is the net present value derived from land use *i* in cell *c* in year 0;
$A_{c,i}$ is the annuity or annual payment in cell *c* for land use *i*;
r is the discount rate;
n is the lifetime of the project.

Lifetime for perennial crops is 20 years, (Van der Hilst et al., 2010; Diogo et al., 2012). Therefore *n* is set at 20 years for both annual and perennial crops to have equal comparisons. The discount rate is set at 3%. Van der Hilst et al. use a discount rate of 5.5% in their assessment referring it as a *"realistic interest rate for farmer loans"* (de Wolf and van der Klooster, 2006, cited by van der Hilst et al., 2010). This rate is not corrected for inflation though, which is required in all economic analyses (Kahn, 2004). The inflation corrected discount rate is set at 3%, assuming an average inflation rate of 2.5%.

In both formulas the characteristics within cell *c* bring an NPV for each different land use *i*. The private benefits and costs depending on land use *i* in cell *c*, needed for the net present value calculations, are given by:

$$B_{c,i,y} = S_{c,i,y} + \sum_{p=1}^{n} Y_{c,p} * P_{p,y} \tag{7}$$

Where:
$B_{c,i,y}$ are the private benefits derived in cell *c* from land use *i* in year *y*;
$S_{c,i,y}$ is the subsidy in cell *c* per unit of land with the size of cell *c* using land use *i* in year *y*;
p is the (co-)product generated by land use *i*;
n are the units of product and co-product generated by land use *i*;
$Y_{c,p}$ is the yield in cell *c* for (co-)product *p*;
$P_{p,y}$ is the price of (co-)product *p* in year *y.*

$$C_{c,i,y} = LC + FOC_{i,y} + IC_{i,y} + FC_{i,y} + \sum_{p=1}^{n} Y_{c,p} * SC_{p,y} \tag{8}$$

Where:
$C_{c,i,y}$ are the private costs resulting from land use *i* in cell *c* in year *y*;
LC are the land costs;
$FOC_{i,y}$ are the field operation costs resulting from land use *i* in year *y*;
$IC_{i,y}$ are the input costs resulting from land use *i* in year *y*;
$FC_{i,y}$ are the fixed costs resulting from land use *i* in cell *c* in year *y*;
p is a (co-)product generated by land use *i*;
n are the number of products and co-products generated by land use *i*;
$Y_{c,p}$ is the yield of (co-)product *p* in cell *c*;
$SC_{p,y}$ are the storing costs of (co-)product *p* in year *y*.

All prices, costs, subsidies and maximum achievable yields are included in the appendix.

Land use *i* is linked to the 'Basisregistratie percelen 2012' (MEZLI, 2013), which is a land-use dataset obtained from the agriculture and innovation division of the ministry of economic affairs and depicts agricultural land use based on company reports from 2012. Therefore all calculations for cell *c* reflect estimates for the land use as observed in 2012. Since the land-use dataset reflects the situation on a fixed moment in time crop cycles are implemented to simulate average net present value of various crop rotation schemes throughout multiple years. The crop rotation schemes used are based on the rotation schemes used by Diogo et al. (2012), but slightly altered to suit the land-use data. The original crop rotation schemes were first published by LEI in 2007 (LEI CBS, 2007) and included marginal percentages of fallow land and 'other crops'. Specific data on these categories were not available and these categories were thus removed after which the rotation schemes where normalized to count up to 100%. Two different rotation schemes are distinguished based on the main soil type on which crops are cultivated.
The original rotation schemes also included industrial potatoes, on which no detailed data was available. Instead, data for feeding potatoes and seed potatoes was used. For each cell the NPV was calculated for both options, after which the highest was used in calculating opportunity costs for growing Miscanthus.

Crop Type	Clay	Sand
Winter Wheat	0,25	
Summer barley	0,125	0,3590
Feeding potatoes or Seed Potatoes (most profitable)	0,1875	0,3846
Sugar beet	0,125	0,2564
Maize	0,3125	
Total	1	1

Table 3 Crop Rotations
Crop rotations are differentiated between sand a clay soils. The numbers in the columns below clay and sand represent the weights addressed to the crop type in calculating net present values attribution in calculating net present values for the total rotation scheme.

Net present values were calculated for each crop part of a rotation scheme and then weighted by their importance within the rotation scheme, which are depicted in table 3. Eq. (9) shows the net present value calculation for rotations on clay soils.

$$NPVclayrotation_c = 0{,}25 * NPVwinterwheat_c + 0{,}125 * NPVsummerbarley_c + \ldots \quad (9)$$

2.2.3 Subsidies

Subsidies were calculated based on opportunity costs for growing Miscanthus. As shown by eq. (10), opportunity costs for growing Miscanthus were assessed by subtracting the expected net present value of Miscanthus from the net present value of observed conventional land-use patterns.

$$OCm_c = NPV_{c,i} - NPVm_{c,} \quad (10)$$

Where:
OCm_c is the net present value of the opportunity costs in for growing Miscanthus in cell *c* in year 0;
$NPV_{c,i}$ is the net present value derived from land use *i* in cell *c* in year 0;
$NPVm_{c,}$ is the net present value for Miscanthus in cell *c* in year 0.

It is assumed that the minimum subsidy required to form a large enough incentive for a farmer to grow Miscanthus, is when the opportunity costs drop below zero. Subsidies must therefore equal or exceed opportunity costs, which must equal or exceed zero.

$$Sm_c \geq 0 : OCm_c \leq 0 \quad (11)$$

Where:
Sm_c is minimum subsidy in cell *c* for growing Miscanthus, in net present value.

The minimum annual subsidies where calculated by transforming the net present value to an annuity by rewriting eq. (6) into:

$$Sy_c = \frac{Sm_c}{\left[\frac{1-(1+r)^{-n}}{r}\right]} \quad (12)$$

Where:
Sy_c is the minimum annual subsidy required in cell *c* to make opportunity costs for growing Miscanthus zero.

2.3 Aggregating Subsidies

This section describes how aggregate subsidy values are calculated for different policy measures. Section 2.3.1 describes a spatial heterogeneous subsidy system that allocates the minimum required subsidy per cell based on the local efficiency of the allocated subsidy. Methods put forward in section 2.3.2 are directed at minimising land use impact. A spatial heterogeneous minimum subsidy is allocated among those agricultural grounds were Miscanthus has the highest yield. Section 2.3.3 is directed at assessing a spatial homogenous subsidy that allocates a subsidy that is constant throughout space.

In section 4 a discussion on feasibility of the different policy options is given.

2.3.1 Aggregated Spatial Heterogeneous Minimum Subsidy

By aggregating minimum subsidies calculated for every cell, a spatial heterogeneous subsidy policy is assessed that allocates the exact minimum required subsidy to each farmer. Cells were aggregated in various ways to meet the 2020 market share standards. Total subsidy was then calculated by aggregating the minimum required subsidy from singular cells in a way that requirements for a specific policy were met. Eq. (13) shows how total subsidy was calculated for each policy option. Different policy options were assessed by applying different conditions to the summations.

$$S = \sum_{1}^{c} S_c \tag{13}$$

Where:
S is the total minimum subsidy required;
S_c is the minimum subsidy required in cell *c.*

One aggregation was made so that aggregated subsidy was minimized while still sufficient to reach the fuel standards. This method allocates subsidy in cells based on efficiency. Cells were ranked according to the efficiency of the subsidy in that same cell which is calculated by eq. (14).

$$e_c = \frac{Sy_c}{Ym_c} \tag{14}$$

Where:
e_c is the minimum subsidy in cell *c* per ton odt of Miscanthus produced in cell *c.* It is essentially the subsidy costs for each ton of dry matter produced in cell *c*;
Ym_c is the yield in odt for Miscanthus in cell *c.*

Within the summation, the first cell has a lower subsidy per ton of Miscanthus than the next cell. So the aggregation fulfils the following condition:

$$e_{c(\mathrm{n}-1)} \leq e_{c(\mathrm{n})} \text{ AND } \sum_{1}^{c} Ym_c = x1 \text{ OR } x2 \tag{15}$$

Where:
$x1$ is the minimum required amount of Miscanthus to reach 2020 market share standards in conjunction with a growth in food based bioethanol;
$x2$ is the minimum required amount of Miscanthus to reach 2020 market share standards without a further development of food based bioethanol;
n is the number of the cell. (Not to be confused with *n,* which is the lifetime of the project and not included in this formula).

2.3.2 Aggregated Subsidy with Minimum Impact on Land Use

A second aggregation was made focusing on minimizing impact on land use. This option does not aim to allocate subsidy for Miscanthus there where subsidy is most efficient, but there where yields are highest so that a minimum amount of land is required to reach the targets set. This aggregation aims to reduce impact on landscape in a quantitative way, which is not necessarily the same as reducing impact on landscape in a qualitative way. It is implicitly assumed that cultural landscape values within arable lands are the same throughout the Netherlands. If this assumption would be true, quantitative impact reduction would correspond to qualitative impact reduction. Research by de Vries et al. (2007) shows that the distribution of landscape appreciation is not equally spread out over the Netherlands, but that the range of landscape appreciation values within arable areas is relatively small. The approach of a quantitative reduction in land-use impact would therefore largely be in line with a qualitative reduction as well.

Quantitative reduction on landscape impact was performed by ranking cells so that the yield of a cell is larger or equal to the next cell in ranking, and the minimum subsidy is smaller or equal to the next cell in ranking. Then cell are aggregated to reach the 2020 targets. Eq. (16) states that the first cell in the summation has a higher yield than the second cell added. So yield per cell added to the summation is declining when $\sum_1^c Ym_c$ nears *x1* or *x2*. Per level of yield *Ym*, within the summation some cells have the same yield because they have the same water and soil conditions, a second condition applies, Eq. (17) applies the same condition as Eq. (15) conditional on $Ym_{c(\mathrm{n}-1)}$ being equal to $Ym_{c(\mathrm{n})}$. The sum of Miscanthus yields per cell must equal the requirements of the goals set, *x1* for further development of food-based biofuels and *x2* if no further development in food-based biofuels is accounted for.

$$Ym_{c(\mathrm{n}-1)} \geq Ym_{c(\mathrm{n})} \qquad (16)$$

$$\text{IF } Ym_{c(\mathrm{n}-1)} = Ym_{c(\mathrm{n})} \text{ THAN } e_{c(\mathrm{n}-1)} \leq e_{c(\mathrm{n})} \text{ AND } \sum_1^c Ym_c = x1 \text{ OR } x2 \qquad (17)$$

2.3.3 CAP Subsidy for Miscanthus Equal to Current Food Crop CAP Subsidies

A third possibility to reach 2020 targets is analysed. Right now energy crops receive European aid of € 45/ha (European Union, 2007). Crops that are cultivated as food source can receive European aid under the Common Agricultural Policy, depending on the type of crop and type of agricultural grounds. The CAP subsidies vary and can amount up to € 446 euro/ha (de Wolf and van der Klooster, 2006). One possibility would be to incorporate Miscanthus into the Common Agricultural Policy. CAP support was originally set up to ensure adequate food supply in Europe (European Commission Directorate-General for Agriculture, 2000). Right now countries are already encouraged to impel on non-food based biofuels through double counting. During the years, priority of CAP moved from ensuring adequate food supply to adequate provision of public goods through agriculture (Cooper et al., 2009). It would be in line with both the former CAP priorities and the current goals to support Miscanthus so that it is able to outcompete the production of edible crops for food based bioethanol and able to supply adequate environmental quality through reducing carbon emissions.

Insights in the legal aspects for such a policy implementation are not elaborated here, but it was one of the possible policy measures proposed by Diogo et al. (2012) as well.

To assess the effects of such a policy change, cells were aggregated so that an annual payment of € 446 would be enough to reduce opportunity costs for growing Miscanthus to zero for the whole aggregation. Under the assumption of Eq. (11), it follows that every cell that could potentially start growing Miscanthus under a CAP subsidy of € 446 per hectare per year, must apply to the following condition:

$$Sy_c \leq 446 \qquad (18)$$

2.3.4 CAP at Level of Spatial Heterogeneous Minimum Subsidies

To assess spatial homogenous subsidies at different levels of subsidy that can be compared to spatial heterogeneous subsidies assessed by the methods in sections 2.3.1 and 2.3.2 , assessments were also made by taking the highest occurring subsidy in the spatial assessments on minimum subsidy. This amount of subsidy is then allocated to every farmer instead of the minimum subsidy that they would require. If cells are selected based on the condition stated in Eq. (15), Then Sy_c is substituted with the highest occurring subsidy in the whole sequence.

$$Scap_c = \lim_{c \to c(\max \mathrm{n})} \sup Sy_c \tag{19}$$

Where:
$Scap_c$ is the spatial homogenous CAP subsidy for cell *c*;
c(max n) is the cell with the highest number.

Similar to Eq. (18), the following condition applies to spatial homogenous aggregations:

$$Sy_c \leq Scap \tag{20}$$

The CAP subsidy *Scap* is equal to the highest yearly subsidy *Sy* occurring in the whole sequence *c,* limited by the last cell in the selection. Meaning that within the whole aggregation each cell gets a subsidy allocated equal to the highest minimum required subsidy occurring within the aggregation. Each farmers get a subsidy equal to the subsidy needed to convince that farmer who needs most subsidy to be convinced.

2.4 Cost Benefit Analysis

All policy measures considered were analysed at two different price levels for Miscanthus. Assessments were done for a market price of € 60/odt and € 70/odt. Since a market for Miscanthus is still developing, market prices are not yet available (Hilst et al., 2010). De Wolf and van der Klooster assessed the market price for Miscanthus based on market prices for straw and assumed a market price of € 50/odt for Miscanthus (2006). Since this research aims to replicate decision making at the farmer level, it is important to realize that prices should be picked accordingly. In this case scientific reports, that are mostly unavailable for farmers, are less leading in the decision process than literature available to farmers. Scurlock (1999), referred to prices for straw and woodchips and assessed a price between € 32 and € 80 per odt in Europe. Caslin et al. (2010) mention a market price of € 60 at 20% moist content which would correspond to € 75/odt. In their payback calculations they use a price of € 65 per odt, which is exactly in the middle of the two price levels picked in this study.

All costs are costs for the government for financing the subsidy. Costs are calculated by comparing the required subsidy with CAP subsidies that are already distributed among cells. So costs are negative when current subsidies for conventional land uses are higher than the proposed subsidy for Miscanthus, and positive when current subsidies for conventional land uses are below the proposed subsidy for Miscanthus.

$$C_c = Sm_c - S_{c,i} \tag{21}$$

Where:
C_c are the social costs in net present value in cell *c* for the proposed subsidy.

After which total costs *C* are given by eq. (22):

$$C = \sum_{1}^{c} C_c \tag{22}$$

The total costs are translated to an according tax on conventional fuels that is required to sustain the subsidies by eq. (23). Although research by Anderson (2011) showed that there are differences in willingness to pay for conventional fuels and biofuels, it is assumed that both fuels are perfects substitutes as assumed in analyses done by Holland et al. (2008). Furthermore it is assumed that the price elasticity for overall fuel demand is 0, previous research indicates that elasticity in the short run is likely to be below 0.1 (Small and Dender, 2007; Hughes, Knittel and Sperling, 2008). It is thus assumed that price elasticity for overall fuel demand is uncorrelated with the willingness to pay for a specific fuel type.

A rising price for conventional fuels makes biofuels more viable. This could imply that biofuels need less subsidy when conventional fuels are taxed to raise funds for subsidies on biofuels. Iterative steps have not been taken to incorporate this effect. Also since it is assumed that biofuels and conventional fuels are perfect substitutes, it is implicitly assumed that this effect does not take place because consumers will simply consume the cheapest barrels on the market first, disregarding whether these contain biofuels or conventional fuels. This approach is unlikely to impose large inaccuracies given the fact that fuel demand is inelastic (Anderson, 2011).

$$T = \frac{C}{\left[\frac{\mathrm{E}_{tot} - \mathrm{E}m_{tot}}{\mathrm{E}g_{liter}}\right]} \tag{23}$$

Where:
T is a tax per liter of gasoline;
E_{tot} is the total energy demand in the transport sector, in this case 610PJ;
$\mathrm{E}m_{tot}$ the total energy supplied by Miscanthus;
$\mathrm{E}g_{liter}$ the per liter energy content of gasoline.

Social benefits are assessed in terms of reduced carbon emissions. For all policy measures the energetic value of Miscanthus grown is translated to units of gasoline saved. The prevented carbon emissions are calculated by assuming 88.3 gram CO_2eq / MJ (NEA,2012). This figure is the European reference for greenhouse gas emissions within the transport sector and covers the greenhouse emissions throughout the whole lifecycle of fuels. 88.3 gram CO_2eq is the value used by the Dutch Emission Authority in calculating emission reductions by biofuels (NEA,2012).

In calculating benefits from avoided emissions, € 20/ton CO_2 was used. There has been much discussion about the economic value, marginal abatement costs and marginal social costs of CO_2 emissions. In 2010 a U.S. government working group estimated marginal damages at 21$, roughly € 16, per ton of CO_2 (Interagency Working Group on Social Costs of Carbon, 2010). Ackerman and Stanton showed that with the same model used, marginal damage could be assessed up to 1500$ (approx. € 1134.38) ton /CO_2 by lowering the discount rate and increasing climate sensitivity (2012). They state that there is reason to believe that marginal damages should be assessed at higher value than currently done by the U.S. government workgroup. Thureson and Hope (2012), who did research on the temporal effects on marginal damages of CO_2, used 28$, roughly 21.34€, as a baseline and showed that the economic damages will rise in the future. Price, Thornton and Nelson (2007), refer to prices of above € 40 per ton in their shadow price assessment of CO_2 emissions. The €

20 used in this analysis addresses the concerns of researchers that economic value of CO_2 emissions is currently addressed to low by the U.S. workgroup and also incorporates the fact that marginal damages are expected to rise in the future, but is still quite lenient compared to the estimates of some researchers.

For all scenarios carbon sequestration is taken into account as a social benefit through reducing carbon levels in the air. As long as Miscanthus land cover is maintained, 8.8 tons of carbon can be sequestrated in the root systems (Caslin et al., 2010).

Benefits from emission reduction and carbon sequestration per cell are calculated with eq. (24), total benefits are given by eq. (25).

$$B_c = (E_c * MD_{CO2} * Ym_c * \alpha \mathrm{E}m) + (CS_c * MD_{CO2}) \tag{24}$$

Where:
B_c are the social benefits from cell *c*;
E_c are the carbon emissions per unit of energy. In this case 0,883 gram per GJ;
MD_{CO2} are the marginal damages of a unit of emitted carbon. In this case € 20 per ton;
Ym_c the amount of Miscanthus produced in cell *c*;
α the lignocellulosic conversion rate of miscanthus to ethanol. In this case 35%;
E*m* the net caloric value of Miscanthus, in this case 17GJ/odt;
CS_c the amount of carbon sequestrated in cell *c.*

After which the total benefits *B* are given by:

$$B = \sum_{1}^{c} B_c \tag{25}$$

The cost benefit analysis tries to assign monetary values to social welfare. Important to realize is that prices used in this analysis may differ from actual prices, but the cost benefit analysis still represents how different subsidy scenarios relate to each other.

3. Results

3.1 Spatial Distribution of Yield, Opportunity Costs and Efficiency of Subsidies

Below depicted, are the yield values for Miscanthus. Similar yield maps were created for the main occurring agricultural land-use types in the Netherlands: corn, grains, grasslands, potatoes, sugar beets and flower bulbs.

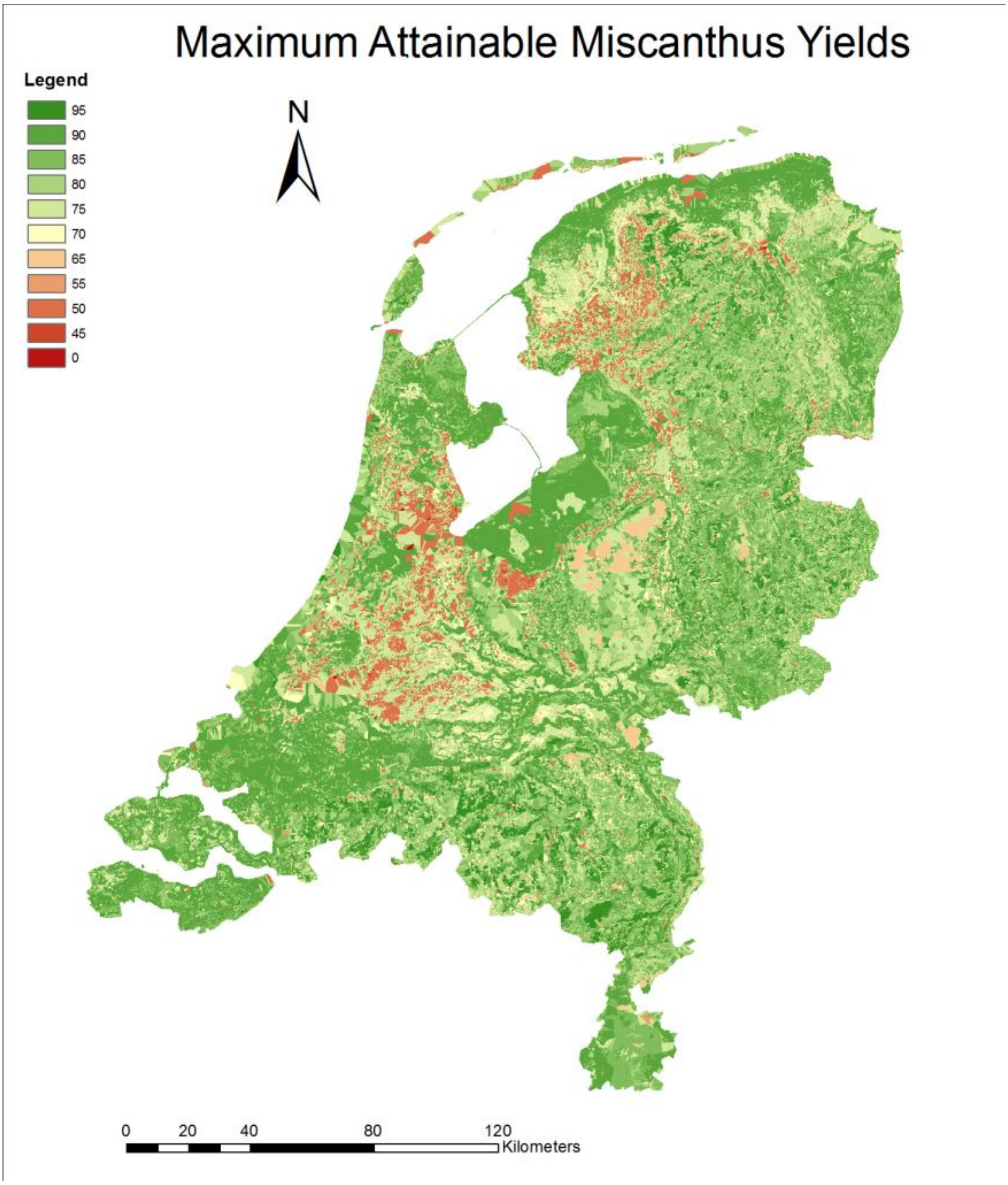

Figure 1
Yield values for Miscanthus based on interpolated water-tables and soil characteristics.

The yield values for different types of agricultural land use were related to net present values, which are included in the appendix. In the instance of Miscanthus a yield value of 100 corresponds to a net present value of € 5371,58 per hectare for the whole perennial cycle of twenty years. At a yield value of 90, this value is € 3386,75.

By subtracting the net present values for Miscanthus from the net present values from current observed conventional land-use types, opportunity costs were mapped.

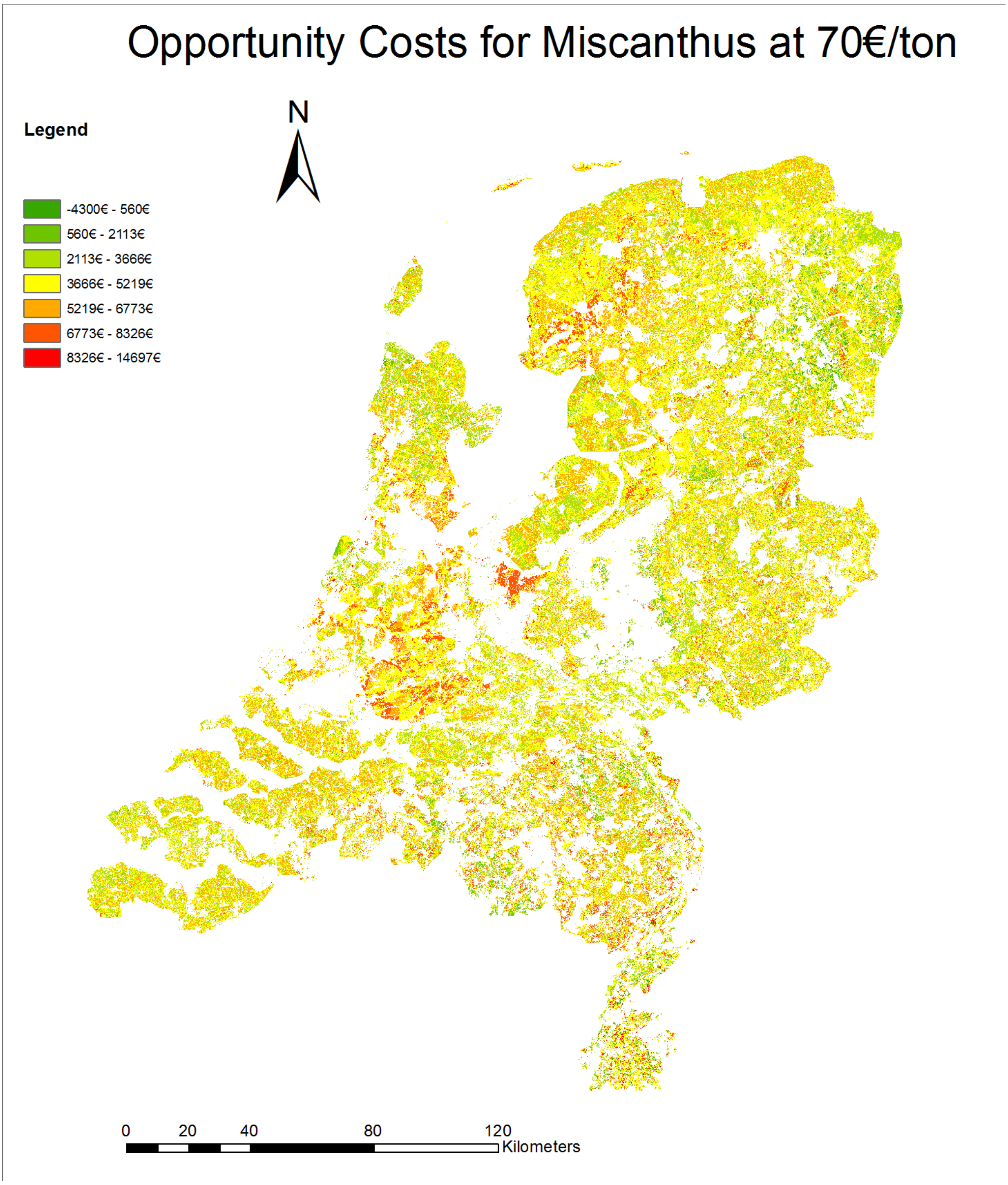

Figure 2

Opportunity costs when the market price equals € 70 per ton dry matter. The relative spatial competiveness of Miscanthus remains the same when the market price drops to € 60 per ton dry matter, absolute values increase as farmers earn less at a lower market price. Non arable lands, mainly urban and nature areas, are excluded in this map.

The values are related to net present value of the total subsidy in a period of twenty years, the full perennial crop cycle of Miscanthus. Distributing a lump sum in the first year equal to the net present value depicted in the map above would also be sufficient, so this could also be seen as a onetime start up subsidy on seeds or any other investment occurring in the first year. In this map subsidies are not related to yields, meaning that green areas are not necessarily the areas of priority when distributing subsidies. Results were also obtained at € 60/odt market price.

To map where subsidies would actually be allocated efficiently, net present values were related to yields for Miscanthus.

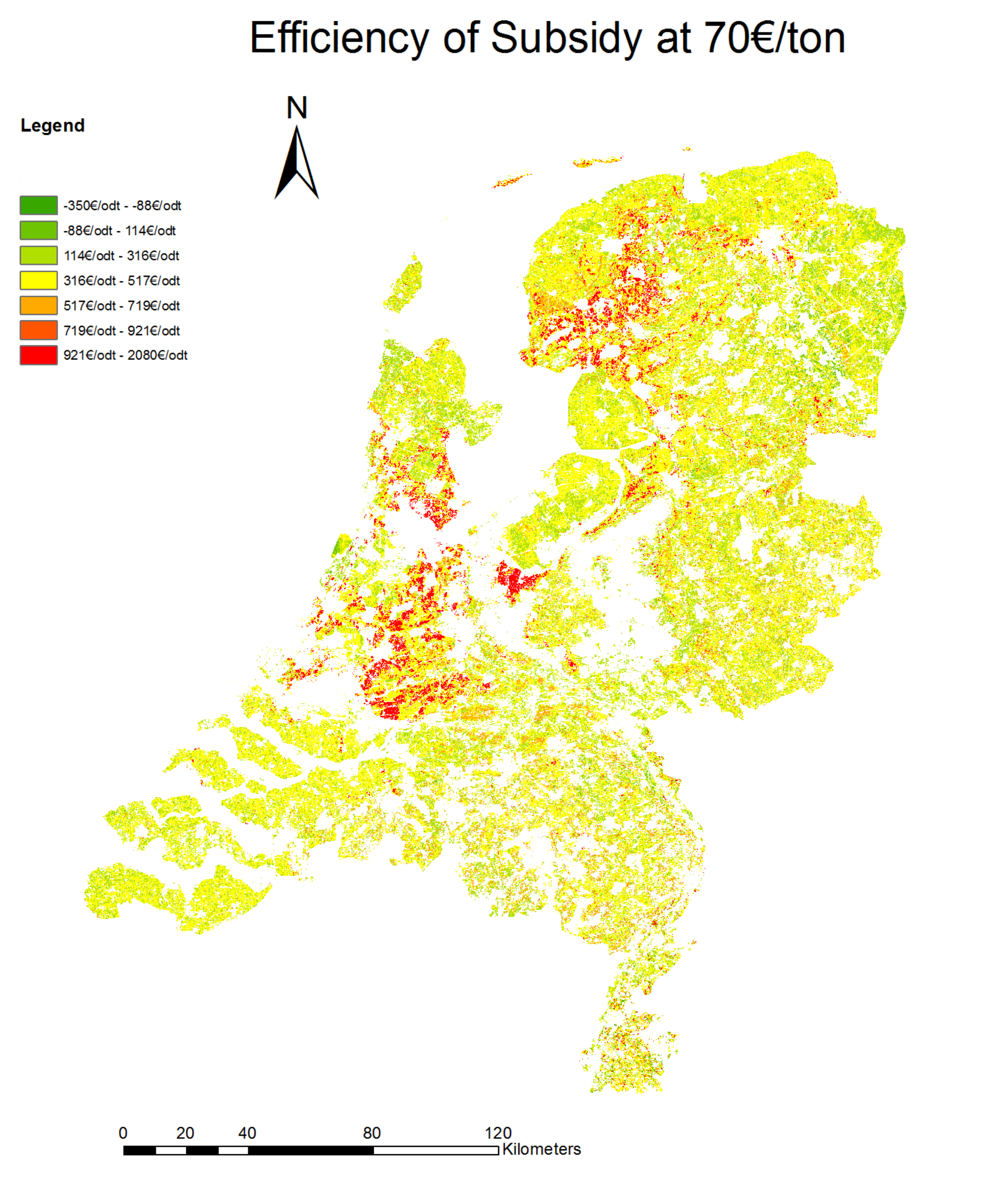

Figure 3

Efficiency of subsidy is expressed as the amount of subsidy per ton of Miscanthus produced in cell *c*. Cells requiring little subsidy to be converted to Miscanthus growing farmers but with little yield can show up as red areas, whereas in figure 2 they would show up as green areas.

It is visible on the map above that relating opportunity costs to yields results in more contrast. More areas show up either red or green. It is visible that mainly in Groningen, Drenthe, Flevo-Land and

North Holland subsidies would be efficiently allocated. When aggregating according to efficiency, these are the areas that subsidies are allocated with priority.

Visible on the maps and legends is that some areas actually turn up as negative opportunity costs. This means that those areas would already be generating higher profits when Miscanthus would be cultivated, even without help of further subsidy. The amount of cells are to low and to widely spread to visualize on a map. But the cells were analysed in aggregate, and the following results were obtained:

Already Profitable	x1 60	x2 60	x1 70	x2 70
Biofuels from food in GJ	14725400	0	14725400	0
Miscanthus needed in GJ	9991800	17354500	9991800	17354500
Net Energy per odt	5,95	5,95	5,95	5,95
Price per ton	€ 60	€ 60	€ 70	€ 70
Miscanthus needed odt	1679294	2916723	1679294	2916723
Total yield in odt	36056	36056	79457	79457
Total Energy in GJ	214530	214530	472770	472770
Percentage of *growth* needed	2,147%	1,236%	4,731%	2,724%
Total area in ha	3074	3074	7084	7084
Percentage of total arable land	0,171%	0,171%	0, 394%	0, 394%

Table 4

x1 and x2 refer respectively to reaching 2020 market share standards by only investing in Miscanthus in conjunction with a growth in food-based biofuel (x1), and reaching 2020 market share standards without further development in food-based biofuel. 60 and 70 refer respectively to a market price of € 60 and € 70 per oven dry ton of Miscanthus.

As depicted in the table above, areas that show up as already profitable are only able to contribute to a small part of the growth needed to reach policy goals set for 2020; in the range of 1.236% - 4.731% of the total growth needed. In further assessments, areas included in the table above were excluded. The cells either violate the assumption that farmers would start growing Miscanthus when it is the most profitable crop to cultivate, or Miscanthus could already be grown there. Either way these areas are viewed as special cases.

3.2 Aggregated Subsidies

3.2.1 *Aggregated Spatial Heterogeneous Minimum Subsidy*

Spatial heterogeneous minimum subsidies are based on subsidy efficiency, of which the spatial distribution is depicted in figure 3. Visual representations of all subsidy options included in the tables can be found in the appendix. In all results, x1 refers to the goal of only fulfilling the non-food based growth in biofuel market share through Miscanthus coupled with further development in food based biofuels. X2 refers to fulfilling the goals set for 2020 without any further development in food based biofuels. In this last case, Miscanthus accounts for the whole growth in biofuel market share. The numbers 60 and 70 refer to the scenario in which market prices for Miscanthus average out at respectively € 60/odt and € 70/odt.

The table on the next page depicts the results obtained from the minimum aggregate subsidy assessments. In this more theoretical scenario, each farmer would exactly receive that amount of subsidy that results in zero opportunity costs for growing Miscanthus. While such a policy implementation has low practical feasibility, it can be seen as a benchmark on which different policies can be tested since the amount of aggregated subsidy is at its minimum.

Minimum Aggregate Subsidies	**x1 60**	**x2 60**	**x1 70**	**x2 70**
Biofuels from food in GJ	14725400	0	14725400	0
Growth in Miscanthus GJ	9991800	17354500	9991800	17354500
Net energy per odt	5,95	5,95	5,95	5,95
Price per ton	€ 60	€ 60	€ 70	€ 70
Miscanthus needed odt	1679294	2916723	1679294	2916723
Total yield in odt	1679305	2916732	1679301	2916726
Total Energy GJ	9991861	17354555	9991841	17354522
Total Counted Energy GJ	19983722	34709109	19983681	34709044
Counted percentage of total energy need	3,276%	5,690%	3,276%	5,690%
Actual percentage of total energy need	1,638%	2,845%	1,638%	2,845%
Goal reach in Potentials	100,001%	100,000%	100,000%	100,000%
Total area in ha	145075	246807	144946	246323
Percentage of total arable land	8,071%	13,731%	8,064%	13,704%
NPV of aggregated minimum subsidy	€ 519.260.768	€ 1.008.367.660	€ 289.475.776	€ 600.100.959
Average NPV minimum subsidy per hectare	€ 3.579,26	€ 4.085,65	€ 1.997,13	€ 2.436,24
Average subsidy per hectare per year	€ 240,58	€ 274,62	€ 134,24	€ 163,75
Aggregated minimum subsidy per year	€ 34.902.480	€ 67.778.146	€ 19.457.319	€ 40.336.211
Highest monthly subsidy	€ 310,74	€ 344,68	€ 198,35	€ 218,25
Average €/GJ	€ 3,49	€ 3,91	€ 1,95	€ 2,32
Highest €/GJ	€ 4,27	€ 4,48	€ 2,72	€ 2,84

Table 5

x1 and x2 refer respectively to reaching 2020 market share standards by only investing in Miscanthus in conjunction with a growth in food-based biofuel (x1), and reaching 2020 market share standards without further development in food-based biofuel. 60 and 70 refer respectively to a market price of € 60 and € 70 per oven dry ton of Miscanthus.

A shift in market price from € 70 to € 60 while holding all other market prices for different crops constant means a shift from a required total subsidy of € 289.475.776 to € 519.260.768. This means that a 16.7% decrease in market price can cause a 79.4% increase in needed subsidies. Such an amplification effect should be seen as an incentive to allocate subsidies according to estimates on the low side of market prices. Over subsidizing will then create a buffer so that when market prices drop, it will not instantly cause opportunity losses for farmers. It is for this reason that, while actual market prices might be expected to be move between € 60 and € 70, the results obtained at a market price of € 60 should be seen as more closely to realistic subsidies for practical implementation that could incite farmers to grow Miscanthus in a sustainable way; more resistant to slight market shocks.

Furthermore it is visible that raising the goal from x1 to x2, increasing respective energy need from 1.679.294 GJ to 2.916.732 GJ (a 73.7% increase), raises the percentage from total arable land from around 8.1% to 13.7% (a70% increase). This means that when goals are raised, the extra amounts of Miscanthus will be grown on slightly better yielding parcels.

When market prices average out at € 70, increasing the goals from x1 to x2 (a70% increase in arable land cover) raises the total required budget with 107.3% (from € 289.475.776 to € 600.100.959). This means that next to slightly better yields in the extra parcels, the required subsidies increase rapidly with every extra parcel in incorporated in the aggregation. This reflects to the approach used in the assessment; subsidy efficient cells are allocated a subsidy with priority to cells with lower subsidy efficiency. At a market price of € 60 this discrepancy is lower (a 94% increase relative to 70% increase in required land). This means that when choosing a subsidy level based on lower market prices, increasing the goal from x1 to x2 seems to require a relative smaller budget increase then when choosing subsidies based on higher market prices.

Finally these results indicate that when subsidies are efficiently allocated, the amount of subsidy in the end product (energy), remains under € 4,48. Prices for imported Miscanthus within Europe are in the range of € 3,50 –5,00/GJ for pellets from Eastern Europe, and € 4,50 – € 6,50 /GJ for pellets from Scandinavia (Hamelinck et al., 2005b). Assuming that pallets can always be imported at € 6,50/GJ, there is no reason to believe that subsidies can better be spend at aiding lignocellulosic ethanol production facilities in importing Miscanthus.

3.2.2 *Aggregated Subsidy with Minimum Impact on Land Use*

Minimum Impact on Land-Use	MIMP x1 60	MIMP x2 60	MIMP x1 70	MIMP x2 70
Biofuels from food in GJ	14725400	0	14725400	0
Growth in Miscanthus GJ	9991800	17354500	9991800	17354500
Net energy per odt	5,95	5,95	5,95	5,95
Price per ton	60	60	70	70
Miscanthus needed odt	1679294	2916723	1679294	2916723
Total yield in odt	1679302	2916735	1679296	2916729
Total Energy GJ	9991845	17354571	9991812	17354538
Total Counted Energy GJ	19983689	34709142	19983624	34709077
Counted percentage of total energy need	3,276%	5,690%	3,276%	5,690%
Actual percentage of total energy need	1,638%	2,845%	1,638%	2,845%
Goal reach in Potentials	100,000%	100,000%	100,000%	100,000%
Total area in ha	134026	234570	134026	234569
Percentage of total arable land	7,46%	13,05%	7,46%	13,05%
NPV of aggregated	€ 614.210.896	€ 1.104.559.107	€ 372.837.953	€ 684.018.538

minimum subsidy				
Average NPV minimum subsidy per hectare	€ 4582,77	€ 4.708,87	€ 2.781,83	€ 2.916,07
Average subsidy per hectare per year	€ 308,03	€ 316,51	€ 186,98	€ 196,01
Aggregated minimum subsidy per year	€ 41.284.620	€ 74.243.722	€ 25.060.567	€ 45.976.790
Highest monthly subsidy	€ 474,95	€ 474,95	€ 348,51	€ 348,51
Average €/GJ	€ 4,13	€ 4,28	€ 2,51	€ 2,65
Highest €/GJ	€ 6,14	€ 6,14	€ 4,51	€ 4,51

Table 6

MIMP refers to Minimising IMPact on land use. x1 and x2 refer respectively to reaching 2020 market share standards by only investing in Miscanthus in conjunction with a growth in food-based biofuel (x1), and reaching 2020 market share standards without further development in food-based biofuel. 60 and 70 refer respectively to a market price of € 60 and € 70 per oven dry ton of Miscanthus.

Aggregated subsidies with minimum impact on land use are based on yield values, of which the spatial distribution is depicted in figure 1. Minimizing impacts on land use brings a relative small decrease in total land-cover change to a relatively large increase in required budget. In the case of minimizing land-use impact while aiming at attaining the market share level required for x2 at a market price of € 60, a decrease from 13.731% to 13.05% of total arable lands converted (a 5% decrease), increases minimum required budget from € 1.008.367.660 to € 1.104.559.107 (9.54% increase). This means that focusing on minimizing land use impact in a quantitative way has only a small potential of decreasing impact when compared to focusing on allocating subsidy efficiently ,while increasing the budget needed 90.8% more (5% versus 9.54%) than impact on land-used is decreased. This means that decreasing impact on land use is costly and only favourable if it brings substantial benefits to society: at least great enough to outweigh the extra costs. Benefits from decreasing impact on land-use patterns are not quantified in this assessment.

3.2.3 CAP at Level of Spatial Heterogeneous Minimum Subsidies

CAP subsidies equal to highest subsidies in minimum aggregate subsidy approach	CAP x1 60	CAP x2 60	CAP x1 70	CAP x2 70
Biofuels from food in GJ	14725400	0	14725400	0
Growth in Miscanthus GJ	9991800	17354500	9991800	17354500
Net energy per odt	5,95	5,95	5,95	5,95
Price per ton	60	60	70	70
Miscanthus needed odt	1679294	2916723	1679294	2916723
Total yield in odt	2340777	5588498	2041222	5124920
Total Energy GJ	13927624	33251563	12145272	30493272
Total Counted Energy GJ	27855247	6650313	24290543	60986543
Counted percentage of total energy need	4,566%	10,902%	3,982%	9,998%
Actual percentage of total energy need	2,283%	5,451%	1,991%	4,999%
Goal reach in Potentials	139,391%	191,602%	121,552%	175,708%

Total area in ha	209650	479292	180029	436677
Percentage of total arable land	11,664%	26,665%	10,016%	24,294%
NPV of aggregated minimum subsidy	€ 969.210.340	€ 2.457.810.592	€ 531.264.633	€ 1.417.887.604
Average NPV minimum subsidy per hectare	€ 4.623,00	€ 5.128,00	€ 2.951,00	€ 3.247,00
Average subsidy per hectare per year	€ 310,74	€ 344,68	€ 198,35	€ 218,25
Aggregated minimum subsidy per year	€ 65.146.159	€ 165.203.478	€ 35.709.328	€ 95.304.319
Highest monthly subsidy	€ 310,74	€ 344,68	€ 198,35	€ 218,25
Average €/GJ	€ 4,68	€ 4,97	€ 2,94	€ 3,13
Highest €/GJ	€ 7,61	€ 7,61	€ 4,42	€ 4,42

Table 7

CAP refers to allocating a spatial homogenous subsidy similar to current European CAP subsidies. x1 and x2 refer respectively to reaching 2020 market share standards by only investing in Miscanthus in conjunction with a growth in food-based biofuel (x1), and reaching 2020 market share standards without further development in food-based biofuel. 60 and 70 refer respectively to a market price of € 60 and € 70 per oven dry ton of Miscanthus.

This assessments aims to simulate the scenario in which Miscanthus would be included in the European Common Agricultural Policy and the subsidy levels would be related to the highest occurring subsidy in the scenario where farmers are allocated a minimum subsidy based on their farm specific characteristics. This policy implementation is more feasible since it is non-discriminating. As visible in the table, average monthly subsidies equal the highest monthly subsidies.

Total required budget increases significantly as all farmers that require less subsidy are over subsidized. An important feature of this policy is that it does not specifically focus at targeting the exact area needed to reach policy levels. This means that a CAP subsidy high enough to target an area exactly big enough to fulfil x2 goals could in fact be lower than the CAP subsidies mentioned in the table at x2 scenarios. This is because subsidizing through CAP at subsidy levels related to the highest monthly prices occurring in x1 scenarios, could already partially fulfil x2 goals, visible in the tables as goals in potentials exceed 100%. This means that when aiming at fulfilling goals x1 or x2, it is, unlike the scenarios where farmers are exactly paid the minimum required subsidy, not necessary to set subsidy levels based on lower market prices. The buffer that prevents against market shocks is already incorporated in a CAP subsidy system since goals are potentially over reached.

Average subsidy costs at the end product all remain under € 6,50/GJ. The highest subsidies at the end product of € 7,61/GJ exceed the import price available on the market, but the cells at which this subsidy occurs can only be spatially targeted by policies without changing the CAP subsidies proposed. Which is not analysed further. Also policies directed at importing Miscanthus only to replace that what would be produced by farmers who receive more than € 6,50/GJ, could be seen as discriminating and creating inequalities among farmer’s income based on characteristics they cannot influence in the short run; soil and water-tables. One way to implement such a policy is to set minimum yield requirements for farmers who apply for subsidy, meaning that they only receive subsidy if they reach minimum produced yield requirements. Such a policy could scare off farmers to grow Miscanthus since they will anticipate on the chance of not reaching production requirements and incorporate the risk costs in their production function even when the costs are not actually made; farmers will require compensation for the risk of not reaching minimum production yields.

3.2.4 CAP Subsidy for Miscanthus Equal to Current Food Crop CAP Subsidies

Incorporating Miscanthus in the CAP at the same subsidy level as other CAP crops receive has the biggest potential to reach goals set for 2020. When Miscanthus is subsidized according to the subsidy that other crops receive, 58,0% - 92,8% of the arable lands are potentially more profitable when Miscanthus is cultivated. What is most noteworthy is that the actual percentage of the energy need in the transport sector will still largely rely on conventional fuel sources. When 92,8% of the arable lands in the Netherlands is cultivated, only 18,2% of the actual energy required (no double counting used) in the transport sector could be supplied, assuming no further technical improvements in lignocellulosic ethanol conversion rates and average Miscanthus yields.

Unlike all other policy options assessed, the required budget for maintaining a CAP at € 446, grows when market prices raise. This is due to the fact that as when market prices rise, more land becomes profitable for Miscanthus. So when market prices rise, more farmers are expected to apply for a subsidy.

CAP Subsidy at levels of crops currently under CAP	**446 CAP 60**	**446 CAP 70**
Net energy per odt	5,95	5,95
Price per ton	60	70
Total yield in odt	12004294	18728490,27
Total Energy GJ	71425552	111434517,10
Total Counted Energy GJ	142851104	222869034,2
Counted percentage of total energy need	23,418%	36,536%
Actual percentage of total energy need	11,709%	18,268%
Total area in ha	1041895	1668775
Percentage of total arable land	57,965%	92,841%
NPV of aggregated minimum subsidy	€ 6.913.348.570	€ 11.072.912.517
Average NPV minimum subsidy per hectare	€ 6.635,35	€ 6.635,35
Average subsidy per hectare per year	€ 446,00	€ 446,00
Aggregated minimum subsidy per year	€ 464.685.616,00	€ 744.273.650,00
Highest monthly subsidy	€ 446,00	€ 446,00
Average €/GJ	€ 6,51	€ 6,68

Highest €/GJ	€ 9,50	€ 10,64

Table 8

446 Refers to equalling subsidies to current CAP subsidies which are at € 446 per year per hectare. The level of subsidy is in this case based on other subsidies and not a subsidy level that resulted from calculations made in this research. CAP refers to allocating a spatial homogenous subsidy similar to current European CAP subsidies. 60 and 70 refer respectively to a market price of € 60 and € 70 per oven dry ton of Miscanthus.

Furthermore a CAP of € 446 allocated at market price of respectively € 60 and € 70 corresponds to an average subsidy at the end product of € 6,51 and € 6,68 exceeding an import price of € 6,50 mentioned by (Hamelinck et al., 2005b). This means that by lowering the CAP subsidy, profits for society can be achieved. When a continues import price of € 6,50/GJ is assumed to be available on the market, average subsidies at the end product should be lower than that. Otherwise it would be more efficient to import Miscanthus than to cultivate it in the Netherlands. When assuming a CAP subsidy at € 6,50/GJ, it can be assessed what the exact maximum level of CAP would be to maximize social profits.

$$CAP^{*} = \left[\frac{\frac{€\ 6{,}50}{GJ} * Total\ Energy\ generated\ by\ CAP\ affected\ cells}{Total\ Area\ receiving\ CAP} \right]$$

This is an iterative calculation since it's input relies on predictions from the assessments on CAP subsidies from the previous table. The output has a slightly lower potential area affected, with different characteristics, over which the new cap is allocated. Without re-iterating, this approach is only useful for minor corrections. The following results were obtained:

Maximum CAP subsidies below import prices.	446 CAP 60	446 CAP 70
CAP*	€ 445,60	€ 434,05

Table 9

CAP* refers to the optimal subsidy level distributed in a homogenous subsidy system when taking external import prices into account. 446 Refers to equalling subsidies to current CAP subsidies which are at € 446 per year per hectare. The level of subsidy is in this case based on other subsidies and not a subsidy level that resulted from calculations made in this research. CAP refers to allocating a spatial homogenous subsidy similar to current European CAP subsidies. 60 and 70 refer respectively to a market price of € 60 and € 70 per oven dry ton of Miscanthus.

This shows that at a price level of € 60 the optimal CAP subsidy level is really close to the € 446 prescribed for conventional crops. This relates to the fact that import prices are assumed to be available at € 6,50 at all times, while the average subsidy at end product is € 6,51. At market price levels of € 70/odt a larger discrepancy is found between the optimal CAP* and prescribed CAP for conventional crops. When plugging the CAP* in the same assessment for CAP at a market price of € 70, the following results were obtained:

CAP Subsidy at levels of crops currently under CAP	CAP* 70
Net energy per odt	5,95
Price per ton	60
Total yield in odt	18594234
Total Energy GJ	110635695

Total area in ha	1656784
NPV of aggregated minimum subsidy	€ 10.698.795.280
Average NPV minimum subsidy per hectare	€ 6.458
Average subsidy per hectare per year	€ 434,05
Aggregated minimum subsidy per year	€ 719.127.095,20
Highest monthly subsidy	€ 434,05
Average €/GJ	€ 6,50
Highest €/GJ	€ 10,64

Table 10

CAP* refers to the optimal subsidy level distributed in a homogenous subsidy system when taking external import prices into account. 70 refers to a market price of € 70 per oven dry ton of Miscanthus.

The table shows that subsidy at the end product now doesn't exceed the available import price of € 6,50. Profits would be maximized if the extra amount of Miscanthus that was originally produced at prices above € 6,50 would now be imported at € 6,50. € 434,05 can be seen as the maximum CAP till which it would be more viable to produce Miscanthus in the Netherlands than importing it from elsewhere.

3.3 Comprehensive Cost Benefit Results

To calculate the actual costs of the options discussed, required subsidies were compared to the subsidies already distributed among conventional land-uses. Furthermore the costs for energy crop subsidies are incorporated. The costs are compared to the benefits from saved emissions and sequestered carbon. Return on investment is calculated by dividing the total benefits by the total costs.

It is shown that at a marginal damage of € 20 per ton of emitted CO_2 in all policy options aimed at distributing subsidies at minimum levels, the benefits from prevented emissions outweigh the costs of the subsidies required. When aiming for goal x1 at a market price of € 70, the minimum required aggregate subsidy distributed among farmers would actually be smaller than the current aggregate CAP subsidies distributed among the same farmers.

At low market prices, minimizing impact on land-use give a profit return on the subsidy below hundred per cent, resulting in net negative effects for society if the benefits of minimizing impact on land-use do not outweigh the costs on the balance.

When a market price of € 70 is available, distributing a CAP of € 218,25, the highest occurring subsidy found in the minimum required subsidy assessment based on the same goal and market price, would give the highest benefits to society: € 62.812.149. When a market price of € 60 is available, a CAP subsidy based on x1 assessments gives highest profits to society. At a subsidy of € 310,74, the society get € 29.403.379 of profits. In both scenario's the average subsidy at the end product remains under continues available import prices.

Incorporating Miscanthus under the current CAP of € 446 would imply losses for society at all prices between € 60 and € 70. As noted earlier, when maintaining a CAP at € 446 more budget is required at higher market prices. It is visible in the cost benefits analysis that maintaining a CAP at € 446 is the only policy option that has decreasing social benefits when market prices rise. In fact, social costs increase at higher market prices.

In all CAP options aimed at distributing subsidies at the highest occurring subsidy found in the assessments for minimum subsidies, the balance show positive effects for society. In all options except for those in which Miscanthus is incorporated in the CAP at the same price level of € 446, the tax that consumers have to pay extra at the pump station remains below 1cent per litre.

An important footnote to the cost benefit analysis is that subsidies paid to farmers show up as costs for society, while in fact only a monetary transfer happens within the society. Real losses to society can only occur when this cash flow harms society in an external way. If subsidy would be spent more beneficial elsewhere opportunity losses can however still occur.

	Subsidy	Energy Crop Subsidy	*Total Costs*	Saved Emissions	Carbon Sequest-ration	*Total Benefits*	Balance	Litres of Conventional Gasoline Used	Tax per litre Gaso-line	Tax per 1000 litre of Gaso-line	Return on Invest-ment
x1 60	€ 10.758.945	€ 6.528.375	*€ 17.287.320*	€ 17.645.626	€ 25.533.200	*€ 43.178.826*	***€ 25.891.507***	17.143.089.688	0,10 ct	100,84 ct	249,77%
x2 60	€ 41.265.815	€ 11.106.315	*€ 52.372.130*	€ 30.648.143	€ 43.438.032	*€ 74.086.175*	***€ 21.714.045***	16.932.727.012	0,31 ct	309,30 ct	141,46%
x1 70	-€ 5.078.873	€ 6.522.570	*€ 1.443.697*	€ 17.645.591	€ 25.510.496	*€ 43.156.086*	***€ 41.712.390***	17.143.090.269	0,01 ct	8,42 ct	2989,28%
x2 70	€ 14.703.891	€ 11.084.535	*€ 25.788.426*	€ 30.648.086	€ 43.352.848	*€ 74.000.933*	***€ 48.212.508***	16.932.727.942	0,15 ct	152,30 ct	286,95%
x1 60 CAP	€ 22.656.954	€ 9.434.250	*€ 32.091.204*	€ 24.596.184	€ 36.898.400	*€ 61.494.583*	***€ 29.403.379***	17.030.639.322	0,19 ct	188,43 ct	191,62%
x2 60 CAP	€ 111.861.519	€ 21.568.140	*€ 133.429.659*	€ 58.722.260	€ 84.355.392	*€ 143.077.652*	***€ 9.647.994***	16.478.526.772	0,81 ct	809,72 ct	107,23%
x1 70 CAP	€ 2.393.243	€ 8.101.305	*€ 10.494.548*	€ 21.448.550	€ 31.685.104	*€ 53.133.653*	***€ 42.639.106***	17.081.563.668	0,06 ct	61,44 ct	506,30%
X2 70 CAP	€ 48.243.655	€ 19.650.465	*€ 67.894.120*	€ 53.851.118	€ 76.855.152	*€ 130.706.269*	***€ 62.812.149***	16.557.335.100	0,41 ct	410,05 ct	192,51%
MIMP x1 60	€ 39.695.316	€ 6.031.170	*€ 45.726.486*	€ 17.645.598	€ 23.588.576	*€ 41.234.173*	***-€ 4.492.312***	17.143.090.153	0,27 ct	266,73 ct	90,18%
MIMP x2 60	€ 72.654.367	€ 10.555.650	*€ 83.210.017*	€ 30.648.172	€ 41.284.320	*€ 71.932.492*	***-€ 11.277.525***	16.932.726.547	0,49 ct	491,42 ct	86,45%
MIMP x1 70	€ 23.363.854	€ 6.031.170	*€ 29.395.024*	€ 17.645.540	€ 23.588.576	*€ 41.234.116*	***€ 11.839.093***	17.143.091.082	0,17 ct	171,47 ct	140,28%
MIMP x2 70	€ 44.280.045	€ 10.555.605	*€ 54.835.650*	€ 30.648.115	€ 41.284.144	*€ 71.932.258*	***€ 17.096.608***	16.932.727.477	0,32 ct	323,84 ct	131,18%
446 CAP 60	€ 336.569.738	€ 47.185.650	*€ 383.755.388*	€ 127.000.760	€ 184.548.320	*€ 309.511.044*	***-€ 73.943.967***	15.373.875.431	2,50 ct	2.496,15 ct	80,72%
446 CAP 70	€ 527.427.287	€ 75.728.025	*€ 603.155.312*	€ 198.466.035	€ 296.180.720	*€ 490.497.757*	***-€ 112.024.405***	14.217.666.482	4,24 ct	4.242,29 ct	81,41%

Table 11

Policy measures discussed in previous sections are contained in the left column. The reference to components of the policy measure names are included in the tables in previous sections, where policy measures are discussed separately. Negative figures are marked by a red colouring. Land-use impact reduction is not quantified in monetary terms. The balance might therefore differ from assessments that include monetary quantified effects of land-use change and according change in landscape appreciation.

4. Discussion

4.1 Reflection on the Overall Method

Economic performance of arable lands is assumed to be the main factor in the decision process of the farmer in allocating different agricultural crops. Preferences based on personal experience, traditions or neighbourhood factors have not been included in this assessment. It is however expected that there should be great collinearity between economic performance of land and other preferences factors, since it would be logical that farmers on average grow crops that yield best on their lands and thus also have the greatest experience in growing that particular crop. Furthermore it could be expected that neighbours also grow that crop since their parcels consist of the same soil and water-tables since these phenomena are usually comparable within neighbourhood regions. Personal preferences do however play a role in land conversion elasticity's (Barr et al., 2010), which eventually could be used to assess the actual land conversion.
Acreage elasticity's have not been included in this study, all results are related to potentials and it will be important, disregarding the policy option implemented, that the government actively promotes the growth of Miscanthus and increases awareness among farmers of the economic potentials. It can be expected that even when subsidies are high enough to make Miscanthus profitable, required land conversion will not take place in the near future since farmers will have to wait till long-term contractual agreements expire. If an assessment on the buyout value of contractual agreements and long term private investments could be added to the approach used, results focused on short term land conversion could be obtained. The net present value method used does however picture the relative economic performance of land in the long run and it can be expected that implementing subsidies will eventually make farmers change crop allocations till a new equilibrium in land distribution is reached.

An important notion to this study is that, while based on the decision process of farmers, calculations are done per hectare instead of per parcel. Farmers could however base their decision on a system of multiple parcels. It is attempted to incorporate this effect through implementation of crop cycles.

While a lot of theoretic research is available, it will be important to monitor future developments and incorporate practical experiences and findings from the field in future elaborations within this field of research. Whenever a policy would be implemented, market prices, yields, and calculated net present values should be fitted with values monitored in the field.

4.2 Discussion Regarding Results and Plausibility of Different Outcomes

On average it has been found that there are a lot of social profits to be gained by implementing a subsidy on Miscanthus. The most important food note to this research is that the proposed CAP subsidies do not account for trans boundary effects. CAP would be a subsidy distributed on European level, effectively lowering production costs for Miscanthus across the whole European market. In this research it is assumed that an exogenous market price of € 6,50 is always available. When a CAP would be implemented for the whole European Union, it can be expected that this price will drop, making it more attractive to import Miscanthus from other countries. It was found in this research that at a homogenous subsidy above € 434,05 within the Netherlands, inefficiencies arise due to higher subsidy costs than end product market prices. When homogenous subsidies are allocated throughout Europe, this effect can be expected at a lower CAP subsidy than found in this research. Furthermore the exogenous import prices is assumed to be unrelated to market effects from subsidies assessed in this study, while this might not be the case. If Miscanthus ends up in the international market, it could affect prices on the international markets and thus affect the import price which was assumed to be exogenous in this research. The effects of a CAP implementation should therefore be assessed on European scale before statements can be made about the net effects. Findings in this research do however represent the effects of a spatial homogenous subsidy that would only be distributed within the Netherlands.

The spatial minimum subsidy assessments can be seen as benchmarks regarding minimizing costs. While the practical feasibility would not be very high, it does however show cost minimizing potentials of a spatial heterogeneous subsidy system. Derivate policy measures could be developed and analysed in which farmers are for example subsidized based on the soil type they are situated on.

Important in this research is that, while focused at reaching the goals set for 2020, it aims at doing so in a sustainable way. Miscanthus yields vary throughout the perennial crop cycle and in calculating the energy gains from Miscanthus, average yields over the full twenty year cycle are used to mimic the continuous flow of available Miscanthus on the market. If however Miscanthus is planted now, in the year 2020 the yields would be higher than the average yields. Reaching the 2020 goals in a non-sustainable onetime only way therefore requires less land conversion and less subsidy.

4.3 Comparison with Research by Others

Land-use modelling performed in this research is partly in line with the approach in research done by van der Hilst and others and Diogo and others. There are some important differences in methodology and results though that should be mentioned. The main difference in the overall research goal is that research by van der Hilst and others seek to explore spatial energy potentials through land-use modelling in order to describe where land-use is most likely to occur (Vander Hilst and others) and what costs would be at those locations. Diogo and others use land-use modelling to describe where Miscanthus would most likely be cultivated depending on different subsidy levels or economic scenario's. This research aims to combine both aspects and prescribe different subsidy policies that would be needed to reach policy goals set by the European union, and describe the characteristics of these subsidies. The focus lies in a more in depth quantification of the characteristics of spatial energy potentials in aggregate and policy measures in monetary terms.

Important differences with the approach by Diogo and others is that this research focusses on developing Miscanthus based on current land-use patterns, similar to the exploratory analysis done by van der Hilst and others. The Land-use Scanner used by Diogo and others is based on economic scenario's. It takes into account future demand for land for different uses such as urban development and infrastructure and then let all land-use types compete with each other in an economic bidding for land use. It assigns land use according to claims and economic value of different land-use types. Therefore it, to some extent, implicitly incorporates the assumption that land use is optimized based on economic terms in the future. In research from Diogo and others, and also in this research, it was shown that for some arable lands Miscanthus is already expected to have a better economic performance than observed conventional land use. The assumption that land use has an equilibrium on the economic optimum found by net present value calculations does therefore not hold probably because it is very hard to quantify all immaterial aspects in net present value calculations that in fact do influence decision processes in the real world. This research works on the implicit assumption that the discrepancy between the economic optimum found by net present value calculations and observable land-use patterns remains more or less the same in the short future. But it negates land-use claims that the land-use scanner does incorporate.

Furthermore this research is based on average market prices of multiple recent years including prices for 2012, whereas research by van der Hilst and others and Diogo and others base their assessments on product prices from the year 2006 only.

Some differences in results should also be mentioned here. In both the research from Diogo and others as well as van der Hilst and others, Miscanthus competes best with pasture areas. This is because net present values for pastures are calculated according to silo grass sales instead of dairy farming and according milk sales. In this research the dairy farming system was simulated and net present values for dairy farming were found to be much higher than the net present value calculations for pastures done by van der Hilst and others and Diogo and others. This resulted in a more equally distribution of net present values of current observable land use. Miscanthus therefore is not allocated mainly within pastures but spreads out over the Netherlands more equally.

5. Conclusion

In this analysis several policy measures to reach 2020 biofuel market share goals have been analysed. Economic potentials of conventional crops have been compared to the economic performance of Miscanthus after which required subsidies have been assessed. At two different market prices social effects of policies focusing at distributing subsidies most efficiently, minimizing land-use impact and incorporating Miscanthus under CAP have been assessed. It is found that under several policy options, a subsidy on Miscanthus is able to reach the goals set for 2020 in a sustainable way while at the same time producing social benefits larger than the aggregate subsidies allocated.

A spatial heterogeneous subsidy based on soil and water-table characteristics is shown to substantially decrease needed budget for subsidies. Under all scenario's such a subsidy is found to create net social benefits for society. An amplification effect between price drops and minimum subsidy required was found and spatial heterogeneous subsidies based on low assessments of market prices will therefore be able to create a buffer that prevents against market shocks while still resulting in net benefits for society.

Furthermore it was shown that focusing on minimizing impact on land-use will reduce social benefits and is able to create net social costs for society under some scenario's if the benefits from preventing damage to landscape appreciation values are insufficient.

While minimum aggregate subsidies based on spatially heterogeneous characteristics were found to be able to reach policy goals at minimum costs, highest net social benefits were found when a CAP subsidy between € 218,25 and € 310,74 is allocated. Incorporating Miscanthus under the CAP at a subsidy level of € 446/ha will imply net social losses to society and is therefore not advisable. When an import price of € 6,50 is assumed to be constantly available, CAP subsidies for Miscanthus should not exceed € 434,05 when market prices are € 70/odt. When CAP exceed € 434,05 at this market price level, subsidy at the end product would exceed available market prices for Miscanthus.

Trans boundary effects were not accounted for in this study, while a CAP between € 218,25 and € 310,74 is most advisable from a social welfare view, it would be recommendable to analyse such a policy implementation further on European level. A drop in available market prices could imply that Miscanthus could be grown more efficient elsewhere and then imported to the Netherlands.

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Appendix

Costs are taken from the supplementary Data from Hilst et al. (2010), unless noted otherwise. Product prices are taken from CBS (2012), who published all product prices in the Land- en Tuinbouwcijfers 2012. The Values for Flower bulbs are taken from BINternet (LEI Wageningen, 2013).

Production Costs and Benefits

Crop	Summer wheat clay	Summer wheat sand	Winter wheat clay	Winter wheat sand
Production costs (euro/ha)				
Seeds	68,8	60,2	75,3	64,5
Spraying	150,3	150,3	379,6	236,6
Field Operations	849,5	780,6	911,4	823,3
Fixed Costs	27,0	27,0	27,0	4,4
Fertilizer	116,2	153,8	170,2	186,0
CAP Subsidies (euro/ha)				
	446,0	**446,0**	**446,0**	**446,0**
Maximum yield (ton/ha)				
Main product t/ha	7,1	6,6	9,6	7,8
Co product t/ha	3,8	3,5	4,4	4,0
Yield related costs (euro/ton)				
Yield related costs	1,0	1,0	1,0	1,0
Insurance costs	2,3	2,4	3,0	2,8
Product price (euro/ton)				
Main product	155,8	155,8	155,8	155,8
Co product	50,0	50,0	50,0	50,0

Crop	Summer barley clay	Summer barley sand	Winter barley clay	Winter barley sand
Production costs (euro/ha)				
Seeds	63,6	61,2	51,6	51,6
Spraying	145,7	183,4	227,2	228,4
Field Operations	821,2	737,0	857,8	772,6
Fixed Costs	27,0	4,4	27,0	27,0
Fertilizer	61,2	119,9	131,8	181,2
CAP Subsidies (euro/ha)				
	446,0	**446,0**	**446,0**	**310,0**
Maximum yield (ton/ha)				
Main product t/ha	6,6	6,6	6,5	6,5
Co product t/ha	3,3	3,0	3,5	3,2
Yield related costs (euro/ton)				
Yield related costs	1,0	1,0	2,0	1,0
Insurance costs	2,5	2,4	2,2	3,7
Product price (euro/ton)				
Main product	146,5	146,5	146,5	146,5
Co product	60,0	60,0	60,0	60,0

Crop	Feeding potatoes clay	Feeding potatoes sand	Seed potatoes clay	Seed potatoes sand
Production costs (euro/ha)				
Seeds	621,0	621,0	1159,6	1330,0
Spraying	781,1	884,6	991,3	690,8
Field Operations	1500,4	1457,6	2323,0	1842,9
Fixed Costs	78,4	276,8	384,0	125,7
Fertilizer	361,5	376,9	253,6	240,4
CAP Subsidies (euro/ha)				
	0,0	**0,0**	**0,0**	**0,0**
Maximum yield (ton/ha)				
Main product t/ha	49,0	57,0	33,0	33,0
Co product t/ha	0,0	0,0	0,0	0,0
Yield related costs (euro/ton)				
Yield related costs	2,6	2,6	4,1	4,1
Insurance costs	11,5	18,5	16,5	17,2
Product price (euro/ton)				
Main product	112,0	112,0	200,0	200,0
Co product	0,0	0,0	0,0	0,0

Crop	Sugar beets clay	Sugar beets sand	Feeding corn clay	Feeding corn sand
Production costs (euro/ha)				
Seeds	234,3	236,5	202,4	193,6
Spraying	288,4	315,3	118,4	118,4
Field Operations	1066,1	1009,6	990,3	928,4
Fixed Costs	146,3	195,3	26,6	49,3
Fertilizer	191,4	244,6	153,6	214,4
CAP Subsidies (euro/ha)				
	275,0	**265,0**	**420,0**	**420,0**
Maximum yield (ton/ha)				
Main product t/ha	65,0	63,0	47,1	47,1
Co product t/ha	0,0	0,0	0,0	0,0
Yield related costs (euro/ton)				
Yield related costs	0,0	0,0	0,0	0,0
Insurance costs	13,9	15,4	5,0	6,3
Product price (euro/ton)				
Main product	44,3	44,3	45,6	45,6
Co product	0,0	0,0	40,0	40,0

Miscanthus

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Production costs (euro/ha)																				
Field Operation costs	695,3	362,4	387,9	448,0	446,8	462,1	446,8	462,1	446,8	462,1	446,8	462,1	446,8	462,1	446,8	462,1	446,8	462,1	446,8	593,7
Seeds	3600,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Spraying	131,9	24,8	0,0	24,8	0,0	24,8	0,0	24,8	0,0	24,8	0,0	24,8	0,0	24,8	0,0	24,8	0,0	24,8	0,0	49,6
Fertilizer	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0
Fixed costs	49,7	4,4	4,4	4,4	4,4	4,4	4,4	4,4	4,4	49,7	4,4	4,4	4,4	4,4	4,4	4,4	4,4	4,4	4,4	4,4
Total Costs	4481,9	396,6	397,2	482,2	456,2	496,3	456,2	496,3	456,2	541,7	456,2	496,3	456,2	496,3	456,2	496,3	456,2	496,3	456,2	652,6
Subsidies (euro/ha)																				
	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
Maximum yield (ton/ha)																				
	1,5	7,0	11,0	14,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0
Yield related costs (euro/ton)																				
	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6
Product price (euro/ton)																				
	60/70	60/70	60/70	60/70	60/70	60/70	60/70	60/70	60/70	60/70	60/70	60/70	60/70	60/70	60/70	60/70	60/70	60/70	60/70	60/70

Miscanthus prices we're based on different sources, as noted in the methodology section of the main study.

Flower Bulbs

Opbrengsten (per ha)	
Agriculture	16,87
Flower bulbs	570,27
Vegetables	2,87
Flowers	52,97
Cattle	11,83
Other	74,87
Extraordinary	6,85
Total	734,23
Costs (/ha)	
Anima land plants	179,8
Energy	30,9
Immaterial	12,43
Material	158,6
Wages	101,07
Third parties	89,27
Financing costs	54,87
General Costs	32,23
Extraordinary	0,1
Unpaid work year * Average Wage	41,61
Total (/ha)	**700,81**
Fixed Costs (/ha)	**289,07**
Fixed profits	**111**
Variable profits	**623,23**

Average wage was taken from CBS Statline.

Dairy Farming

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Production costs (euro/ha)																				
Field operation costs	1160,1	768,7	768,7	768,7	768,7	943,7	768,7	768,7	768,7	768,7	943,7	768,7	768,7	768,7	768,7	943,7	768,7	768,7	768,7	768,7
Seeds	32,1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spraying	65,0	5,4	5,4	5,4	5,4	47,0	5,4	5,4	5,4	5,4	47,0	5,4	5,4	5,4	5,4	47,0	5,4	5,4	5,4	5,4
Herd upkeep	324	324	324	324	324	324	324	324	324	324	324	324	324	324	324	324	324	324	324	324
Milk processing	3511	3511	3511	3511	3511	3511	3511	3511	3511	3511	3511	3511	3511	3511	3511	3511	3511	3511	3511	3511
Herd investment	1790	0,0	0,0	0,0	0,0	1790	0,0	0,0	0,0	0,0	1790	0,0	0,0	0,0	0,0	1790	0,0	0,0	0,0	0,0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Costs	**6882**	**4609**	**4609**	**4609**	**4609**	**6615**	**4609**	**4609**	**4609**	**4609**	**6615**	**4609**	**4609**	**4609**	**4609**	**6615**	**4609**	**4609**	**4609**	**4609**
Yield dependent Costs euro / ton																				
Feeding Corn	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46
Maximum Grass yield (ton/ha)																				
	12,2	12,2	12,2	12,2	12,2	12,2	12,2	12,2	12,2	12,2	12,2	12,2	12,2	12,2	12,2	12,2	12,2	12,2	12,2	12,2
Milk Production (ton/ha)																				
	16,72	16,72	16,72	16,72	16,72	16,72	16,72	16,72	16,72	16,72	16,72	16,72	16,72	16,72	16,72	16,72	16,72	16,72	16,72	16,72
Product price (euro/ton)																				
	322	322	322	322	322	322	322	322	322	322	322	322	322	322	322	322	322	322	322	322

Field operation costs and seed costs are based on the pasture assessment from van der Hilst et al. (2010). Corn costs and milk product prices are taken from CBS, land- en Tuinbouwcijfers 2012 (2012). All other costs are taken from Koe & Wij, who publish company results from participating companies within the cattle industry each year in their ‘Beweiden of Opstallen’ studies. Milk processing costs are based on Booij. A. (2004). Average lifetime of cows before replacement is based on Gosselink et al (2008). In calculating NPV it is assumed that cows feed on grass and get supplemented with corn when grass yields are too low. Edible grass supply is assessed based on Eniskillen et al. (2008). Feeding corn dry matter was based on Weißbach et al. (2008), to calculate energy content. Grass and corn are supplement each other based on caloric values taken from Kolver et al. (2001) and Gosselink et al. (2008). Milk conversion densities to tons are taken from Paar (2009).

Net Present Value Results

Yield	Summer wheat clay	Summer wheat sand	Winter wheat clay	Winter wheat sand	Summer barley clay	Summer barley sand	Winter barley clay	Winter barley sand
1	€ 7.546,95	€ 6.765,81	€ 8.326,38	€ 7.686,01	€ 6.980,37	€ 6.909,69	€ 4.251,10	€ 2.424,67
0,99	€ 7.357,54	€ 6.590,15	€ 8.076,87	€ 7.479,92	€ 6.810,48	€ 6.742,42	€ 4.082,22	€ 2.258,97
0,98	€ 7.168,14	€ 6.414,48	€ 7.827,36	€ 7.273,82	€ 6.640,58	€ 6.575,16	€ 3.913,35	€ 2.093,27
0,97	€ 6.978,73	€ 6.238,82	€ 7.577,85	€ 7.067,72	€ 6.470,69	€ 6.407,90	€ 3.744,48	€ 1.927,58
0,96	€ 6.789,33	€ 6.063,16	€ 7.328,34	€ 6.861,63	€ 6.300,79	€ 6.240,64	€ 3.575,60	€ 1.761,88
0,95	€ 6.599,92	€ 5.887,50	€ 7.078,82	€ 6.655,53	€ 6.130,90	€ 6.073,38	€ 3.406,73	€ 1.596,18
0,94	€ 6.410,51	€ 5.711,84	€ 6.829,31	€ 6.449,44	€ 5.961,00	€ 5.906,12	€ 3.237,86	€ 1.430,49
0,93	€ 6.221,11	€ 5.536,17	€ 6.579,80	€ 6.243,34	€ 5.791,10	€ 5.738,85	€ 3.068,98	€ 1.264,79
0,92	€ 6.031,70	€ 5.360,51	€ 6.330,29	€ 6.037,25	€ 5.621,21	€ 5.571,59	€ 2.900,11	€ 1.099,09
0,91	€ 5.842,30	€ 5.184,85	€ 6.080,78	€ 5.831,15	€ 5.451,31	€ 5.404,33	€ 2.731,24	€ 933,40
0,9	€ 5.652,89	€ 5.009,19	€ 5.831,27	€ 5.625,05	€ 5.281,42	€ 5.237,07	€ 2.562,36	€ 767,70
0,89	€ 5.463,48	€ 4.833,53	€ 5.581,76	€ 5.418,96	€ 5.111,52	€ 5.069,81	€ 2.393,49	€ 602,00
0,88	€ 5.274,08	€ 4.657,86	€ 5.332,25	€ 5.212,86	€ 4.941,63	€ 4.902,54	€ 2.224,62	€ 436,31
0,87	€ 5.084,67	€ 4.482,20	€ 5.082,74	€ 5.006,77	€ 4.771,73	€ 4.735,28	€ 2.055,74	€ 270,61
0,86	€ 4.895,27	€ 4.306,54	€ 4.833,23	€ 4.800,67	€ 4.601,84	€ 4.568,02	€ 1.886,87	€ 104,91
0,85	€ 4.705,86	€ 4.130,88	€ 4.583,72	€ 4.594,57	€ 4.431,94	€ 4.400,76	€ 1.718,00	-€ 60,78
0,84	€ 4.516,46	€ 3.955,22	€ 4.334,21	€ 4.388,48	€ 4.262,04	€ 4.233,50	€ 1.549,12	-€ 226,48
0,83	€ 4.327,05	€ 3.779,55	€ 4.084,70	€ 4.182,38	€ 4.092,15	€ 4.066,24	€ 1.380,25	-€ 392,18
0,82	€ 4.137,64	€ 3.603,89	€ 3.835,19	€ 3.976,29	€ 3.922,25	€ 3.898,97	€ 1.211,38	-€ 557,87
0,81	€ 3.948,24	€ 3.428,23	€ 3.585,68	€ 3.770,19	€ 3.752,36	€ 3.731,71	€ 1.042,50	-€ 723,57
0,8	€ 3.758,83	€ 3.252,57	€ 3.336,17	€ 3.564,09	€ 3.582,46	€ 3.564,45	€ 873,63	-€ 889,27
0,79	€ 3.569,43	€ 3.076,91	€ 3.086,65	€ 3.358,00	€ 3.412,57	€ 3.397,19	€ 704,76	-€ 1.054,96
0,78	€ 3.380,02	€ 2.901,24	€ 2.837,14	€ 3.151,90	€ 3.242,67	€ 3.229,93	€ 535,89	-€ 1.220,66
0,77	€ 3.190,61	€ 2.725,58	€ 2.587,63	€ 2.945,81	€ 3.072,78	€ 3.062,66	€ 367,01	-€ 1.386,36
0,76	€ 3.001,21	€ 2.549,92	€ 2.338,12	€ 2.739,71	€ 2.902,88	€ 2.895,40	€ 198,14	-€ 1.552,05
0,75	€ 2.811,80	€ 2.374,26	€ 2.088,61	€ 2.533,62	€ 2.732,98	€ 2.728,14	€ 29,27	-€ 1.717,75
0,74	€ 2.622,40	€ 2.198,60	€ 1.839,10	€ 2.327,52	€ 2.563,09	€ 2.560,88	-€ 139,61	-€ 1.883,45
0,73	€ 2.432,99	€ 2.022,93	€ 1.589,59	€ 2.121,42	€ 2.393,19	€ 2.393,62	-€ 308,48	-€ 2.049,14
0,72	€ 2.243,58	€ 1.847,27	€ 1.340,08	€ 1.915,33	€ 2.223,30	€ 2.226,36	-€ 477,35	-€ 2.214,84
0,71	€ 2.054,18	€ 1.671,61	€ 1.090,57	€ 1.709,23	€ 2.053,40	€ 2.059,09	-€ 646,23	-€ 2.380,54
0,7	€ 1.864,77	€ 1.495,95	€ 841,06	€ 1.503,14	€ 1.883,51	€ 1.891,83	-€ 815,10	-€ 2.546,23
0,69	€ 1.675,37	€ 1.320,29	€ 591,55	€ 1.297,04	€ 1.713,61	€ 1.724,57	-€ 983,97	-€ 2.711,93
0,68	€ 1.485,96	€ 1.144,62	€ 342,04	€ 1.090,94	€ 1.543,72	€ 1.557,31	-€ 1.152,85	-€ 2.877,63
0,67	€ 1.296,56	€ 968,96	€ 92,53	€ 884,85	€ 1.373,82	€ 1.390,05	-€ 1.321,72	-€ 3.043,32
0,66	€ 1.107,15	€ 793,30	-€ 156,98	€ 678,75	€ 1.203,92	€ 1.222,79	-€ 1.490,59	-€ 3.209,02
0,65	€ 917,74	€ 617,64	-€ 406,49	€ 472,66	€ 1.034,03	€ 1.055,52	-€ 1.659,47	-€ 3.374,72
0,64	€ 728,34	€ 441,98	-€ 656,00	€ 266,56	€ 864,13	€ 888,26	-€ 1.828,34	-€ 3.540,41
0,63	€ 538,93	€ 266,31	-€ 905,52	€ 60,46	€ 694,24	€ 721,00	-€ 1.997,21	-€ 3.706,11
0,62	€ 349,53	€ 90,65	-€ 1.155,03	-€ 145,63	€ 524,34	€ 553,74	-€ 2.166,09	-€ 3.871,80
0,61	€ 160,12	-€ 85,01	-€ 1.404,54	-€ 351,73	€ 354,45	€ 386,48	-€ 2.334,96	-€ 4.037,50
0,6	-€ 29,29	-€ 260,67	-€ 1.654,05	-€ 557,82	€ 184,55	€ 219,21	-€ 2.503,83	-€ 4.203,20
0,59	-€ 218,69	-€ 436,33	-€ 1.903,56	-€ 763,92	€ 14,66	€ 51,95	-€ 2.672,70	-€ 4.368,89

0,58	-€ 408,10	-€ 612,00	-€ 2.153,07	-€ 970,01	-€ 155,24	-€ 115,31	-€ 2.841,58	-€ 4.534,59
0,57	-€ 597,50	-€ 787,66	-€ 2.402,58	-€ 1.176,11	-€ 325,14	-€ 282,57	-€ 3.010,45	-€ 4.700,29
0,56	-€ 786,91	-€ 963,32	-€ 2.652,09	-€ 1.382,21	-€ 495,03	-€ 449,83	-€ 3.179,32	-€ 4.865,98
0,55	-€ 976,31	-€ 1.138,98	-€ 2.901,60	-€ 1.588,30	-€ 664,93	-€ 617,09	-€ 3.348,20	-€ 5.031,68
0,54	-€ 1.165,72	-€ 1.314,64	-€ 3.151,11	-€ 1.794,40	-€ 834,82	-€ 784,36	-€ 3.517,07	-€ 5.197,38
0,53	-€ 1.355,13	-€ 1.490,31	-€ 3.400,62	-€ 2.000,49	-€ 1.004,72	-€ 951,62	-€ 3.685,94	-€ 5.363,07
0,52	-€ 1.544,53	-€ 1.665,97	-€ 3.650,13	-€ 2.206,59	-€ 1.174,61	-€ 1.118,88	-€ 3.854,82	-€ 5.528,77
0,51	-€ 1.733,94	-€ 1.841,63	-€ 3.899,64	-€ 2.412,69	-€ 1.344,51	-€ 1.286,14	-€ 4.023,69	-€ 5.694,47
0,5	-€ 1.923,34	-€ 2.017,29	-€ 4.149,15	-€ 2.618,78	-€ 1.514,40	-€ 1.453,40	-€ 4.192,56	-€ 5.860,16
0,49	-€ 2.112,75	-€ 2.192,95	-€ 4.398,66	-€ 2.824,88	-€ 1.684,30	-€ 1.620,67	-€ 4.361,44	-€ 6.025,86
0,48	-€ 2.302,16	-€ 2.368,62	-€ 4.648,17	-€ 3.030,97	-€ 1.854,20	-€ 1.787,93	-€ 4.530,31	-€ 6.191,56
0,47	-€ 2.491,56	-€ 2.544,28	-€ 4.897,69	-€ 3.237,07	-€ 2.024,09	-€ 1.955,19	-€ 4.699,18	-€ 6.357,25
0,46	-€ 2.680,97	-€ 2.719,94	-€ 5.147,20	-€ 3.443,16	-€ 2.193,99	-€ 2.122,45	-€ 4.868,06	-€ 6.522,95
0,45	-€ 2.870,37	-€ 2.895,60	-€ 5.396,71	-€ 3.649,26	-€ 2.363,88	-€ 2.289,71	-€ 5.036,93	-€ 6.688,65
0,44	-€ 3.059,78	-€ 3.071,26	-€ 5.646,22	-€ 3.855,36	-€ 2.533,78	-€ 2.456,97	-€ 5.205,80	-€ 6.854,34
0,43	-€ 3.249,19	-€ 3.246,93	-€ 5.895,73	-€ 4.061,45	-€ 2.703,67	-€ 2.624,24	-€ 5.374,68	-€ 7.020,04
0,42	-€ 3.438,59	-€ 3.422,59	-€ 6.145,24	-€ 4.267,55	-€ 2.873,57	-€ 2.791,50	-€ 5.543,55	-€ 7.185,74
0,41	-€ 3.628,00	-€ 3.598,25	-€ 6.394,75	-€ 4.473,64	-€ 3.043,46	-€ 2.958,76	-€ 5.712,42	-€ 7.351,43
0,4	-€ 3.817,40	-€ 3.773,91	-€ 6.644,26	-€ 4.679,74	-€ 3.213,36	-€ 3.126,02	-€ 5.881,30	-€ 7.517,13
0,39	-€ 4.006,81	-€ 3.949,57	-€ 6.893,77	-€ 4.885,84	-€ 3.383,26	-€ 3.293,28	-€ 6.050,17	-€ 7.682,83
0,38	-€ 4.196,21	-€ 4.125,24	-€ 7.143,28	-€ 5.091,93	-€ 3.553,15	-€ 3.460,55	-€ 6.219,04	-€ 7.848,52
0,37	-€ 4.385,62	-€ 4.300,90	-€ 7.392,79	-€ 5.298,03	-€ 3.723,05	-€ 3.627,81	-€ 6.387,91	-€ 8.014,22
0,36	-€ 4.575,03	-€ 4.476,56	-€ 7.642,30	-€ 5.504,12	-€ 3.892,94	-€ 3.795,07	-€ 6.556,79	-€ 8.179,92
0,35	-€ 4.764,43	-€ 4.652,22	-€ 7.891,81	-€ 5.710,22	-€ 4.062,84	-€ 3.962,33	-€ 6.725,66	-€ 8.345,61
0,34	-€ 4.953,84	-€ 4.827,88	-€ 8.141,32	-€ 5.916,32	-€ 4.232,73	-€ 4.129,59	-€ 6.894,53	-€ 8.511,31
0,33	-€ 5.143,24	-€ 5.003,54	-€ 8.390,83	-€ 6.122,41	-€ 4.402,63	-€ 4.296,85	-€ 7.063,41	-€ 8.677,01
0,32	-€ 5.332,65	-€ 5.179,21	-€ 8.640,34	-€ 6.328,51	-€ 4.572,52	-€ 4.464,12	-€ 7.232,28	-€ 8.842,70
0,31	-€ 5.522,06	-€ 5.354,87	-€ 8.889,86	-€ 6.534,60	-€ 4.742,42	-€ 4.631,38	-€ 7.401,15	-€ 9.008,40
0,3	-€ 5.711,46	-€ 5.530,53	-€ 9.139,37	-€ 6.740,70	-€ 4.912,32	-€ 4.798,64	-€ 7.570,03	-€ 9.174,10
0,29	-€ 5.900,87	-€ 5.706,19	-€ 9.388,88	-€ 6.946,79	-€ 5.082,21	-€ 4.965,90	-€ 7.738,90	-€ 9.339,79
0,28	-€ 6.090,27	-€ 5.881,85	-€ 9.638,39	-€ 7.152,89	-€ 5.252,11	-€ 5.133,16	-€ 7.907,77	-€ 9.505,49
0,27	-€ 6.279,68	-€ 6.057,52	-€ 9.887,90	-€ 7.358,99	-€ 5.422,00	-€ 5.300,42	-€ 8.076,65	-€ 9.671,19
0,26	-€ 6.469,09	-€ 6.233,18	-€ 10.137,41	-€ 7.565,08	-€ 5.591,90	-€ 5.467,69	-€ 8.245,52	-€ 9.836,88
0,25	-€ 6.658,49	-€ 6.408,84	-€ 10.386,92	-€ 7.771,18	-€ 5.761,79	-€ 5.634,95	-€ 8.414,39	-€ 10.002,58
0,24	-€ 6.847,90	-€ 6.584,50	-€ 10.636,43	-€ 7.977,27	-€ 5.931,69	-€ 5.802,21	-€ 8.583,27	-€ 10.168,28
0,23	-€ 7.037,30	-€ 6.760,16	-€ 10.885,94	-€ 8.183,37	-€ 6.101,58	-€ 5.969,47	-€ 8.752,14	-€ 10.333,97
0,22	-€ 7.226,71	-€ 6.935,83	-€ 11.135,45	-€ 8.389,47	-€ 6.271,48	-€ 6.136,73	-€ 8.921,01	-€ 10.499,67
0,21	-€ 7.416,11	-€ 7.111,49	-€ 11.384,96	-€ 8.595,56	-€ 6.441,38	-€ 6.304,00	-€ 9.089,89	-€ 10.665,37
0,2	-€ 7.605,52	-€ 7.287,15	-€ 11.634,47	-€ 8.801,66	-€ 6.611,27	-€ 6.471,26	-€ 9.258,76	-€ 10.831,06
0,19	-€ 7.794,93	-€ 7.462,81	-€ 11.883,98	-€ 9.007,75	-€ 6.781,17	-€ 6.638,52	-€ 9.427,63	-€ 10.996,76
0,18	-€ 7.984,33	-€ 7.638,47	-€ 12.133,49	-€ 9.213,85	-€ 6.951,06	-€ 6.805,78	-€ 9.596,51	-€ 11.162,46
0,17	-€ 8.173,74	-€ 7.814,14	-€ 12.383,00	-€ 9.419,95	-€ 7.120,96	-€ 6.973,04	-€ 9.765,38	-€ 11.328,15
0,16	-€ 8.363,14	-€ 7.989,80	-€ 12.632,52	-€ 9.626,04	-€ 7.290,85	-€ 7.140,30	-€ 9.934,25	-€ 11.493,85
0,15	-€ 8.552,55	-€ 8.165,46	-€ 12.882,03	-€ 9.832,14	-€ 7.460,75	-€ 7.307,57	-€ 10.103,12	-€ 11.659,55
0,14	-€ 8.741,96	-€ 8.341,12	-€ 13.131,54	-€ 10.038,23	-€ 7.630,64	-€ 7.474,83	-€ 10.272,00	-€ 11.825,24
0,13	-€ 8.931,36	-€ 8.516,78	-€ 13.381,05	-€ 10.244,33	-€ 7.800,54	-€ 7.642,09	-€ 10.440,87	-€ 11.990,94

0,12	-€ 9.120,77	-€ 8.692,45	-€ 13.630,56	-€ 10.450,42	-€ 7.970,44	-€ 7.809,35	-€ 10.609,74	-€ 12.156,64
0,11	-€ 9.310,17	-€ 8.868,11	-€ 13.880,07	-€ 10.656,52	-€ 8.140,33	-€ 7.976,61	-€ 10.778,62	-€ 12.322,33
0,1	-€ 9.499,58	-€ 9.043,77	-€ 14.129,58	-€ 10.862,62	-€ 8.310,23	-€ 8.143,88	-€ 10.947,49	-€ 12.488,03
0,09	-€ 9.688,99	-€ 9.219,43	-€ 14.379,09	-€ 11.068,71	-€ 8.480,12	-€ 8.311,14	-€ 11.116,36	-€ 12.653,73
0,08	-€ 9.878,39	-€ 9.395,09	-€ 14.628,60	-€ 11.274,81	-€ 8.650,02	-€ 8.478,40	-€ 11.285,24	-€ 12.819,42
0,07	-€ 10.067,80	-€ 9.570,76	-€ 14.878,11	-€ 11.480,90	-€ 8.819,91	-€ 8.645,66	-€ 11.454,11	-€ 12.985,12
0,06	-€ 10.257,20	-€ 9.746,42	-€ 15.127,62	-€ 11.687,00	-€ 8.989,81	-€ 8.812,92	-€ 11.622,98	-€ 13.150,82
0,05	-€ 10.446,61	-€ 9.922,08	-€ 15.377,13	-€ 11.893,10	-€ 9.159,70	-€ 8.980,18	-€ 11.791,86	-€ 13.316,51
0,04	-€ 10.636,01	-€ 10.097,74	-€ 15.626,64	-€ 12.099,19	-€ 9.329,60	-€ 9.147,45	-€ 11.960,73	-€ 13.482,21
0,03	-€ 10.825,42	-€ 10.273,40	-€ 15.876,15	-€ 12.305,29	-€ 9.499,50	-€ 9.314,71	-€ 12.129,60	-€ 13.647,91
0,02	-€ 11.014,83	-€ 10.449,07	-€ 16.125,66	-€ 12.511,38	-€ 9.669,39	-€ 9.481,97	-€ 12.298,48	-€ 13.813,60
0,01	-€ 11.204,23	-€ 10.624,73	-€ 16.375,17	-€ 12.717,48	-€ 9.839,29	-€ 9.649,23	-€ 12.467,35	-€ 13.979,30
0	-€ 11.393,64	-€ 10.800,39	-€ 16.624,69	-€ 12.923,58	-€ 10.009,18	-€ 9.816,49	-€ 12.636,22	-€ 14.145,00

Yield	Feeding potatoes clay	Feeding potatoes sand	Seed potatoes clay	Seed potatoes sand	Sugar beet clay	Sugar beet sand	Feeding corn clay	Feeding corn sand
1	€ 21.635,60	€ 23.263,78	€ 12.045,33	€ 24.840,94	€ 4.866,72	€ 1.239,61	€ 12.483,57	€ 11.340,21
0,99	€ 20.921,99	€ 22.493,03	€ 11.164,41	€ 23.963,26	€ 4.572,35	€ 968,89	€ 12.199,36	€ 11.065,52
0,98	€ 20.208,38	€ 21.722,29	€ 10.283,49	€ 23.085,57	€ 4.277,98	€ 698,18	€ 11.915,14	€ 10.790,83
0,97	€ 19.494,77	€ 20.951,55	€ 9.402,56	€ 22.207,89	€ 3.983,61	€ 427,46	€ 11.630,92	€ 10.516,14
0,96	€ 18.781,16	€ 20.180,81	€ 8.521,64	€ 21.330,21	€ 3.689,24	€ 156,75	€ 11.346,70	€ 10.241,45
0,95	€ 18.067,54	€ 19.410,07	€ 7.640,72	€ 20.452,52	€ 3.394,87	-€ 113,97	€ 11.062,48	€ 9.966,76
0,94	€ 17.353,93	€ 18.639,33	€ 6.759,79	€ 19.574,84	€ 3.100,50	-€ 384,68	€ 10.778,27	€ 9.692,07
0,93	€ 16.640,32	€ 17.868,59	€ 5.878,87	€ 18.697,16	€ 2.806,13	-€ 655,40	€ 10.494,05	€ 9.417,38
0,92	€ 15.926,71	€ 17.097,85	€ 4.997,95	€ 17.819,47	€ 2.511,76	-€ 926,11	€ 10.209,83	€ 9.142,69
0,91	€ 15.213,10	€ 16.327,11	€ 4.117,02	€ 16.941,79	€ 2.217,39	-€ 1.196,83	€ 9.925,61	€ 8.868,00
0,9	€ 14.499,49	€ 15.556,37	€ 3.236,10	€ 16.064,11	€ 1.923,02	-€ 1.467,54	€ 9.641,39	€ 8.593,31
0,89	€ 13.785,88	€ 14.785,62	€ 2.355,17	€ 15.186,42	€ 1.628,65	-€ 1.738,26	€ 9.357,18	€ 8.318,62
0,88	€ 13.072,27	€ 14.014,88	€ 1.474,25	€ 14.308,74	€ 1.334,28	-€ 2.008,97	€ 9.072,96	€ 8.043,93
0,87	€ 12.358,66	€ 13.244,14	€ 593,33	€ 13.431,06	€ 1.039,91	-€ 2.279,69	€ 8.788,74	€ 7.769,24
0,86	€ 11.645,04	€ 12.473,40	-€ 287,60	€ 12.553,37	€ 745,54	-€ 2.550,40	€ 8.504,52	€ 7.494,55
0,85	€ 10.931,43	€ 11.702,66	-€ 1.168,52	€ 11.675,69	€ 451,17	-€ 2.821,12	€ 8.220,30	€ 7.219,86
0,84	€ 10.217,82	€ 10.931,92	-€ 2.049,44	€ 10.798,01	€ 156,79	-€ 3.091,83	€ 7.936,09	€ 6.945,17
0,83	€ 9.504,21	€ 10.161,18	-€ 2.930,37	€ 9.920,32	-€ 137,58	-€ 3.362,55	€ 7.651,87	€ 6.670,48
0,82	€ 8.790,60	€ 9.390,44	-€ 3.811,29	€ 9.042,64	-€ 431,95	-€ 3.633,26	€ 7.367,65	€ 6.395,79
0,81	€ 8.076,99	€ 8.619,70	-€ 4.692,21	€ 8.164,96	-€ 726,32	-€ 3.903,98	€ 7.083,43	€ 6.121,10
0,8	€ 7.363,38	€ 7.848,95	-€ 5.573,14	€ 7.287,27	-€ 1.020,69	-€ 4.174,69	€ 6.799,21	€ 5.846,41
0,79	€ 6.649,77	€ 7.078,21	-€ 6.454,06	€ 6.409,59	-€ 1.315,06	-€ 4.445,41	€ 6.515,00	€ 5.571,72
0,78	€ 5.936,15	€ 6.307,47	-€ 7.334,98	€ 5.531,91	-€ 1.609,43	-€ 4.716,12	€ 6.230,78	€ 5.297,03
0,77	€ 5.222,54	€ 5.536,73	-€ 8.215,91	€ 4.654,23	-€ 1.903,80	-€ 4.986,84	€ 5.946,56	€ 5.022,34
0,76	€ 4.508,93	€ 4.765,99	-€ 9.096,83	€ 3.776,54	-€ 2.198,17	-€ 5.257,55	€ 5.662,34	€ 4.747,65
0,75	€ 3.795,32	€ 3.995,25	-€ 9.977,76	€ 2.898,86	-€ 2.492,54	-€ 5.528,27	€ 5.378,12	€ 4.472,96
0,74	€ 3.081,71	€ 3.224,51	-€ 10.858,68	€ 2.021,18	-€ 2.786,91	-€ 5.798,98	€ 5.093,91	€ 4.198,27
0,73	€ 2.368,10	€ 2.453,77	-€ 11.739,60	€ 1.143,49	-€ 3.081,28	-€ 6.069,70	€ 4.809,69	€ 3.923,58
0,72	€ 1.654,49	€ 1.683,03	-€ 12.620,53	€ 265,81	-€ 3.375,65	-€ 6.340,41	€ 4.525,47	€ 3.648,89
0,71	€ 940,88	€ 912,28	-€ 13.501,45	-€ 611,87	-€ 3.670,02	-€ 6.611,13	€ 4.241,25	€ 3.374,20
0,7	€ 227,26	€ 141,54	-€ 14.382,37	-€ 1.489,56	-€ 3.964,39	-€ 6.881,84	€ 3.957,03	€ 3.099,51
0,69	-€ 486,35	-€ 629,20	-€ 15.263,30	-€ 2.367,24	-€ 4.258,76	-€ 7.152,56	€ 3.672,82	€ 2.824,82
0,68	-€ 1.199,96	-€ 1.399,94	-€ 16.144,22	-€ 3.244,92	-€ 4.553,13	-€ 7.423,27	€ 3.388,60	€ 2.550,13
0,67	-€ 1.913,57	-€ 2.170,68	-€ 17.025,14	-€ 4.122,61	-€ 4.847,50	-€ 7.693,98	€ 3.104,38	€ 2.275,44
0,66	-€ 2.627,18	-€ 2.941,42	-€ 17.906,07	-€ 5.000,29	-€ 5.141,88	-€ 7.964,70	€ 2.820,16	€ 2.000,75
0,65	-€ 3.340,79	-€ 3.712,16	-€ 18.786,99	-€ 5.877,97	-€ 5.436,25	-€ 8.235,41	€ 2.535,94	€ 1.726,06
0,64	-€ 4.054,40	-€ 4.482,90	-€ 19.667,91	-€ 6.755,66	-€ 5.730,62	-€ 8.506,13	€ 2.251,73	€ 1.451,37
0,63	-€ 4.768,01	-€ 5.253,64	-€ 20.548,84	-€ 7.633,34	-€ 6.024,99	-€ 8.776,84	€ 1.967,51	€ 1.176,68
0,62	-€ 5.481,63	-€ 6.024,38	-€ 21.429,76	-€ 8.511,02	-€ 6.319,36	-€ 9.047,56	€ 1.683,29	€ 901,99
0,61	-€ 6.195,24	-€ 6.795,13	-€ 22.310,69	-€ 9.388,71	-€ 6.613,73	-€ 9.318,27	€ 1.399,07	€ 627,30
0,6	-€ 6.908,85	-€ 7.565,87	-€ 23.191,61	-€ 10.266,39	-€ 6.908,10	-€ 9.588,99	€ 1.114,86	€ 352,61
0,59	-€ 7.622,46	-€ 8.336,61	-€ 24.072,53	-€ 11.144,07	-€ 7.202,47	-€ 9.859,70	€ 830,64	€ 77,92

0,58	-€ 8.336,07	-€ 9.107,35	-€ 24.953,46	-€ 12.021,76	-€ 7.496,84	-€ 10.130,42	€ 546,42	-€ 196,77
0,57	-€ 9.049,68	-€ 9.878,09	-€ 25.834,38	-€ 12.899,44	-€ 7.791,21	-€ 10.401,13	€ 262,20	-€ 471,46
0,56	-€ 9.763,29	-€ 10.648,83	-€ 26.715,30	-€ 13.777,12	-€ 8.085,58	-€ 10.671,85	-€ 22,02	-€ 746,15
0,55	-€ 10.476,90	-€ 11.419,57	-€ 27.596,23	-€ 14.654,81	-€ 8.379,95	-€ 10.942,56	-€ 306,23	-€ 1.020,84
0,54	-€ 11.190,51	-€ 12.190,31	-€ 28.477,15	-€ 15.532,49	-€ 8.674,32	-€ 11.213,28	-€ 590,45	-€ 1.295,53
0,53	-€ 11.904,13	-€ 12.961,05	-€ 29.358,07	-€ 16.410,17	-€ 8.968,69	-€ 11.483,99	-€ 874,67	-€ 1.570,22
0,52	-€ 12.617,74	-€ 13.731,80	-€ 30.239,00	-€ 17.287,86	-€ 9.263,06	-€ 11.754,71	-€ 1.158,89	-€ 1.844,91
0,51	-€ 13.331,35	-€ 14.502,54	-€ 31.119,92	-€ 18.165,54	-€ 9.557,43	-€ 12.025,42	-€ 1.443,11	-€ 2.119,60
0,5	-€ 14.044,96	-€ 15.273,28	-€ 32.000,84	-€ 19.043,22	-€ 9.851,80	-€ 12.296,14	-€ 1.727,32	-€ 2.394,29
0,49	-€ 14.758,57	-€ 16.044,02	-€ 32.881,77	-€ 19.920,91	-€ 10.146,17	-€ 12.566,85	-€ 2.011,54	-€ 2.668,98
0,48	-€ 15.472,18	-€ 16.814,76	-€ 33.762,69	-€ 20.798,59	-€ 10.440,55	-€ 12.837,57	-€ 2.295,76	-€ 2.943,67
0,47	-€ 16.185,79	-€ 17.585,50	-€ 34.643,61	-€ 21.676,27	-€ 10.734,92	-€ 13.108,28	-€ 2.579,98	-€ 3.218,36
0,46	-€ 16.899,40	-€ 18.356,24	-€ 35.524,54	-€ 22.553,96	-€ 11.029,29	-€ 13.379,00	-€ 2.864,20	-€ 3.493,05
0,45	-€ 17.613,02	-€ 19.126,98	-€ 36.405,46	-€ 23.431,64	-€ 11.323,66	-€ 13.649,71	-€ 3.148,41	-€ 3.767,74
0,44	-€ 18.326,63	-€ 19.897,72	-€ 37.286,39	-€ 24.309,32	-€ 11.618,03	-€ 13.920,43	-€ 3.432,63	-€ 4.042,43
0,43	-€ 19.040,24	-€ 20.668,47	-€ 38.167,31	-€ 25.187,01	-€ 11.912,40	-€ 14.191,14	-€ 3.716,85	-€ 4.317,12
0,42	-€ 19.753,85	-€ 21.439,21	-€ 39.048,23	-€ 26.064,69	-€ 12.206,77	-€ 14.461,86	-€ 4.001,07	-€ 4.591,81
0,41	-€ 20.467,46	-€ 22.209,95	-€ 39.929,16	-€ 26.942,37	-€ 12.501,14	-€ 14.732,57	-€ 4.285,29	-€ 4.866,50
0,4	-€ 21.181,07	-€ 22.980,69	-€ 40.810,08	-€ 27.820,05	-€ 12.795,51	-€ 15.003,29	-€ 4.569,50	-€ 5.141,19
0,39	-€ 21.894,68	-€ 23.751,43	-€ 41.691,00	-€ 28.697,74	-€ 13.089,88	-€ 15.274,00	-€ 4.853,72	-€ 5.415,88
0,38	-€ 22.608,29	-€ 24.522,17	-€ 42.571,93	-€ 29.575,42	-€ 13.384,25	-€ 15.544,72	-€ 5.137,94	-€ 5.690,57
0,37	-€ 23.321,91	-€ 25.292,91	-€ 43.452,85	-€ 30.453,10	-€ 13.678,62	-€ 15.815,43	-€ 5.422,16	-€ 5.965,26
0,36	-€ 24.035,52	-€ 26.063,65	-€ 44.333,77	-€ 31.330,79	-€ 13.972,99	-€ 16.086,15	-€ 5.706,38	-€ 6.239,95
0,35	-€ 24.749,13	-€ 26.834,39	-€ 45.214,70	-€ 32.208,47	-€ 14.267,36	-€ 16.356,86	-€ 5.990,59	-€ 6.514,64
0,34	-€ 25.462,74	-€ 27.605,14	-€ 46.095,62	-€ 33.086,15	-€ 14.561,73	-€ 16.627,57	-€ 6.274,81	-€ 6.789,33
0,33	-€ 26.176,35	-€ 28.375,88	-€ 46.976,54	-€ 33.963,84	-€ 14.856,10	-€ 16.898,29	-€ 6.559,03	-€ 7.064,02
0,32	-€ 26.889,96	-€ 29.146,62	-€ 47.857,47	-€ 34.841,52	-€ 15.150,47	-€ 17.169,00	-€ 6.843,25	-€ 7.338,71
0,31	-€ 27.603,57	-€ 29.917,36	-€ 48.738,39	-€ 35.719,20	-€ 15.444,84	-€ 17.439,72	-€ 7.127,47	-€ 7.613,40
0,3	-€ 28.317,18	-€ 30.688,10	-€ 49.619,32	-€ 36.596,89	-€ 15.739,22	-€ 17.710,43	-€ 7.411,68	-€ 7.888,09
0,29	-€ 29.030,79	-€ 31.458,84	-€ 50.500,24	-€ 37.474,57	-€ 16.033,59	-€ 17.981,15	-€ 7.695,90	-€ 8.162,78
0,28	-€ 29.744,41	-€ 32.229,58	-€ 51.381,16	-€ 38.352,25	-€ 16.327,96	-€ 18.251,86	-€ 7.980,12	-€ 8.437,47
0,27	-€ 30.458,02	-€ 33.000,32	-€ 52.262,09	-€ 39.229,94	-€ 16.622,33	-€ 18.522,58	-€ 8.264,34	-€ 8.712,16
0,26	-€ 31.171,63	-€ 33.771,06	-€ 53.143,01	-€ 40.107,62	-€ 16.916,70	-€ 18.793,29	-€ 8.548,56	-€ 8.986,85
0,25	-€ 31.885,24	-€ 34.541,80	-€ 54.023,93	-€ 40.985,30	-€ 17.211,07	-€ 19.064,01	-€ 8.832,77	-€ 9.261,54
0,24	-€ 32.598,85	-€ 35.312,55	-€ 54.904,86	-€ 41.862,99	-€ 17.505,44	-€ 19.334,72	-€ 9.116,99	-€ 9.536,23
0,23	-€ 33.312,46	-€ 36.083,29	-€ 55.785,78	-€ 42.740,67	-€ 17.799,81	-€ 19.605,44	-€ 9.401,21	-€ 9.810,92
0,22	-€ 34.026,07	-€ 36.854,03	-€ 56.666,70	-€ 43.618,35	-€ 18.094,18	-€ 19.876,15	-€ 9.685,43	-€ 10.085,61
0,21	-€ 34.739,68	-€ 37.624,77	-€ 57.547,63	-€ 44.496,04	-€ 18.388,55	-€ 20.146,87	-€ 9.969,65	-€ 10.360,30
0,2	-€ 35.453,30	-€ 38.395,51	-€ 58.428,55	-€ 45.373,72	-€ 18.682,92	-€ 20.417,58	-€ 10.253,86	-€ 10.634,99
0,19	-€ 36.166,91	-€ 39.166,25	-€ 59.309,47	-€ 46.251,40	-€ 18.977,29	-€ 20.688,30	-€ 10.538,08	-€ 10.909,68
0,18	-€ 36.880,52	-€ 39.936,99	-€ 60.190,40	-€ 47.129,09	-€ 19.271,66	-€ 20.959,01	-€ 10.822,30	-€ 11.184,37
0,17	-€ 37.594,13	-€ 40.707,73	-€ 61.071,32	-€ 48.006,77	-€ 19.566,03	-€ 21.229,73	-€ 11.106,52	-€ 11.459,06
0,16	-€ 38.307,74	-€ 41.478,47	-€ 61.952,25	-€ 48.884,45	-€ 19.860,40	-€ 21.500,44	-€ 11.390,74	-€ 11.733,75
0,15	-€ 39.021,35	-€ 42.249,22	-€ 62.833,17	-€ 49.762,14	-€ 20.154,77	-€ 21.771,16	-€ 11.674,95	-€ 12.008,44
0,14	-€ 39.734,96	-€ 43.019,96	-€ 63.714,09	-€ 50.639,82	-€ 20.449,14	-€ 22.041,87	-€ 11.959,17	-€ 12.283,13
0,13	-€ 40.448,57	-€ 43.790,70	-€ 64.595,02	-€ 51.517,50	-€ 20.743,51	-€ 22.312,59	-€ 12.243,39	-€ 12.557,82

0,12	-€ 41.162,19	-€ 44.561,44	-€ 65.475,94	-€ 52.395,19	-€ 21.037,89	-€ 22.583,30	-€ 12.527,61	-€ 12.832,51
0,11	-€ 41.875,80	-€ 45.332,18	-€ 66.356,86	-€ 53.272,87	-€ 21.332,26	-€ 22.854,02	-€ 12.811,82	-€ 13.107,20
0,1	-€ 42.589,41	-€ 46.102,92	-€ 67.237,79	-€ 54.150,55	-€ 21.626,63	-€ 23.124,73	-€ 13.096,04	-€ 13.381,89
0,09	-€ 43.303,02	-€ 46.873,66	-€ 68.118,71	-€ 55.028,24	-€ 21.921,00	-€ 23.395,45	-€ 13.380,26	-€ 13.656,58
0,08	-€ 44.016,63	-€ 47.644,40	-€ 68.999,63	-€ 55.905,92	-€ 22.215,37	-€ 23.666,16	-€ 13.664,48	-€ 13.931,27
0,07	-€ 44.730,24	-€ 48.415,14	-€ 69.880,56	-€ 56.783,60	-€ 22.509,74	-€ 23.936,88	-€ 13.948,70	-€ 14.205,96
0,06	-€ 45.443,85	-€ 49.185,89	-€ 70.761,48	-€ 57.661,28	-€ 22.804,11	-€ 24.207,59	-€ 14.232,91	-€ 14.480,65
0,05	-€ 46.157,46	-€ 49.956,63	-€ 71.642,40	-€ 58.538,97	-€ 23.098,48	-€ 24.478,31	-€ 14.517,13	-€ 14.755,34
0,04	-€ 46.871,08	-€ 50.727,37	-€ 72.523,33	-€ 59.416,65	-€ 23.392,85	-€ 24.749,02	-€ 14.801,35	-€ 15.030,03
0,03	-€ 47.584,69	-€ 51.498,11	-€ 73.404,25	-€ 60.294,33	-€ 23.687,22	-€ 25.019,74	-€ 15.085,57	-€ 15.304,72
0,02	-€ 48.298,30	-€ 52.268,85	-€ 74.285,17	-€ 61.172,02	-€ 23.981,59	-€ 25.290,45	-€ 15.369,79	-€ 15.579,41
0,01	-€ 49.011,91	-€ 53.039,59	-€ 75.166,10	-€ 62.049,70	-€ 24.275,96	-€ 25.561,16	-€ 15.654,00	-€ 15.854,10
0	-€ 49.725,52	-€ 53.810,33	-€ 76.047,02	-€ 62.927,38	-€ 24.570,33	-€ 25.831,88	-€ 15.938,22	-€ 16.128,79

Yield	Miscanthus 60 € / odt	Miscanthus 70 € / odt	Yield	Flower Bulbs	Yield	Dairy Farming
1	€ 3.261,19	€ 1.281,53	~~1~~	€ 6.891,06	*1*	€ 5.002,24
0,99	€ 3.125,78	€ 1.165,92	~~0,99~~	€ 6.796,65	*0,99*	€ 5.002,24
0,98	€ 2.990,37	€ 1.050,31	~~0,98~~	€ 6.702,23	*0,98*	€ 5.002,24
0,97	€ 2.854,96	€ 934,70	~~0,97~~	€ 6.607,81	*0,97*	€ 5.002,24
0,96	€ 2.719,55	€ 819,09	~~0,96~~	€ 6.513,40	*0,96*	€ 5.002,24
0,95	€ 2.584,15	€ 703,47	~~0,95~~	€ 6.418,98	*0,95*	€ 5.002,24
0,94	€ 2.448,74	€ 587,86	~~0,94~~	€ 6.324,56	*0,94*	€ 5.002,24
0,93	€ 2.313,33	€ 472,25	~~0,93~~	€ 6.230,15	*0,93*	€ 5.002,24
0,92	€ 2.177,92	€ 356,64	~~0,92~~	€ 6.135,73	*0,92*	€ 5.002,24
0,91	€ 2.042,51	€ 241,03	~~0,91~~	€ 6.041,32	*0,91*	€ 5.002,24
0,9	€ 1.907,10	€ 125,41	~~0,9~~	€ 5.946,90	*0,9*	€ 5.002,24
0,89	€ 1.771,70	€ 9,80	~~0,89~~	€ 5.852,48	*0,89*	€ 5.002,24
0,88	€ 1.636,29	-€ 105,81	~~0,88~~	€ 5.758,07	*0,88*	€ 5.002,24
0,87	€ 1.500,88	-€ 221,42	~~0,87~~	€ 5.663,65	*0,87*	€ 5.002,24
0,86	€ 1.365,47	-€ 337,03	~~0,86~~	€ 5.569,23	*0,86*	€ 5.002,24
0,85	€ 1.230,06	-€ 452,65	~~0,85~~	€ 5.474,82	*0,85*	€ 5.002,24
0,84	€ 1.094,65	-€ 568,26	~~0,84~~	€ 5.380,40	*0,84*	€ 5.002,24
0,83	€ 959,24	-€ 683,87	~~0,83~~	€ 5.285,98	*0,83*	€ 5.002,24
0,82	€ 823,84	-€ 799,48	0,82	€ 5.191,57	*0,82*	€ 5.002,24
0,81	€ 688,43	-€ 915,09	0,81	€ 5.097,15	*0,81*	€ 5.002,24
0,8	€ 553,02	-€ 1.030,70	0,8	€ 5.002,73	*0,8*	€ 5.002,24
0,79	€ 417,61	-€ 1.146,32	0,79	€ 4.908,32	0,79	€ 4.935,13
0,78	€ 282,20	-€ 1.261,93	0,78	€ 4.813,90	0,78	€ 4.685,00
0,77	€ 146,79	-€ 1.377,54	0,77	€ 4.719,48	0,77	€ 4.434,86
0,76	€ 11,39	-€ 1.493,15	0,76	€ 4.625,07	0,76	€ 4.184,73
0,75	-€ 124,02	-€ 1.608,76	0,75	€ 4.530,65	0,75	€ 3.934,60
0,74	-€ 259,43	-€ 1.724,38	0,74	€ 4.436,23	0,74	€ 3.684,47
0,73	-€ 394,84	-€ 1.839,99	0,73	€ 4.341,82	0,73	€ 3.434,33
0,72	-€ 530,25	-€ 1.955,60	0,72	€ 4.247,40	0,72	€ 3.184,20
0,71	-€ 665,66	-€ 2.071,21	0,71	€ 4.152,98	0,71	€ 2.934,07
0,7	-€ 801,06	-€ 2.186,82	0,7	€ 4.058,57	0,7	€ 2.683,94
0,69	-€ 936,47	-€ 2.302,44	0,69	€ 3.964,15	0,69	€ 2.433,80
0,68	-€ 1.071,88	-€ 2.418,05	0,68	€ 3.869,73	0,68	€ 2.183,67
0,67	-€ 1.207,29	-€ 2.533,66	0,67	€ 3.775,32	0,67	€ 1.933,54
0,66	-€ 1.342,70	-€ 2.649,27	0,66	€ 3.680,90	0,66	€ 1.683,41
0,65	-€ 1.478,11	-€ 2.764,88	0,65	€ 3.586,48	0,65	€ 1.433,27
0,64	-€ 1.613,52	-€ 2.880,49	0,64	€ 3.492,07	0,64	€ 1.183,14
0,63	-€ 1.748,92	-€ 2.996,11	0,63	€ 3.397,65	0,63	€ 933,01
0,62	-€ 1.884,33	-€ 3.111,72	0,62	€ 3.303,24	0,62	€ 682,88
0,61	-€ 2.019,74	-€ 3.227,33	0,61	€ 3.208,82	0,61	€ 432,74
0,6	-€ 2.155,15	-€ 3.342,94	0,6	€ 3.114,40	0,6	€ 182,61
0,59	-€ 2.290,56	-€ 3.458,55	0,59	€ 3.019,99	0,59	-€ 67,52
0,58	-€ 2.425,97	-€ 3.574,17	0,58	€ 2.925,57	0,58	-€ 317,65

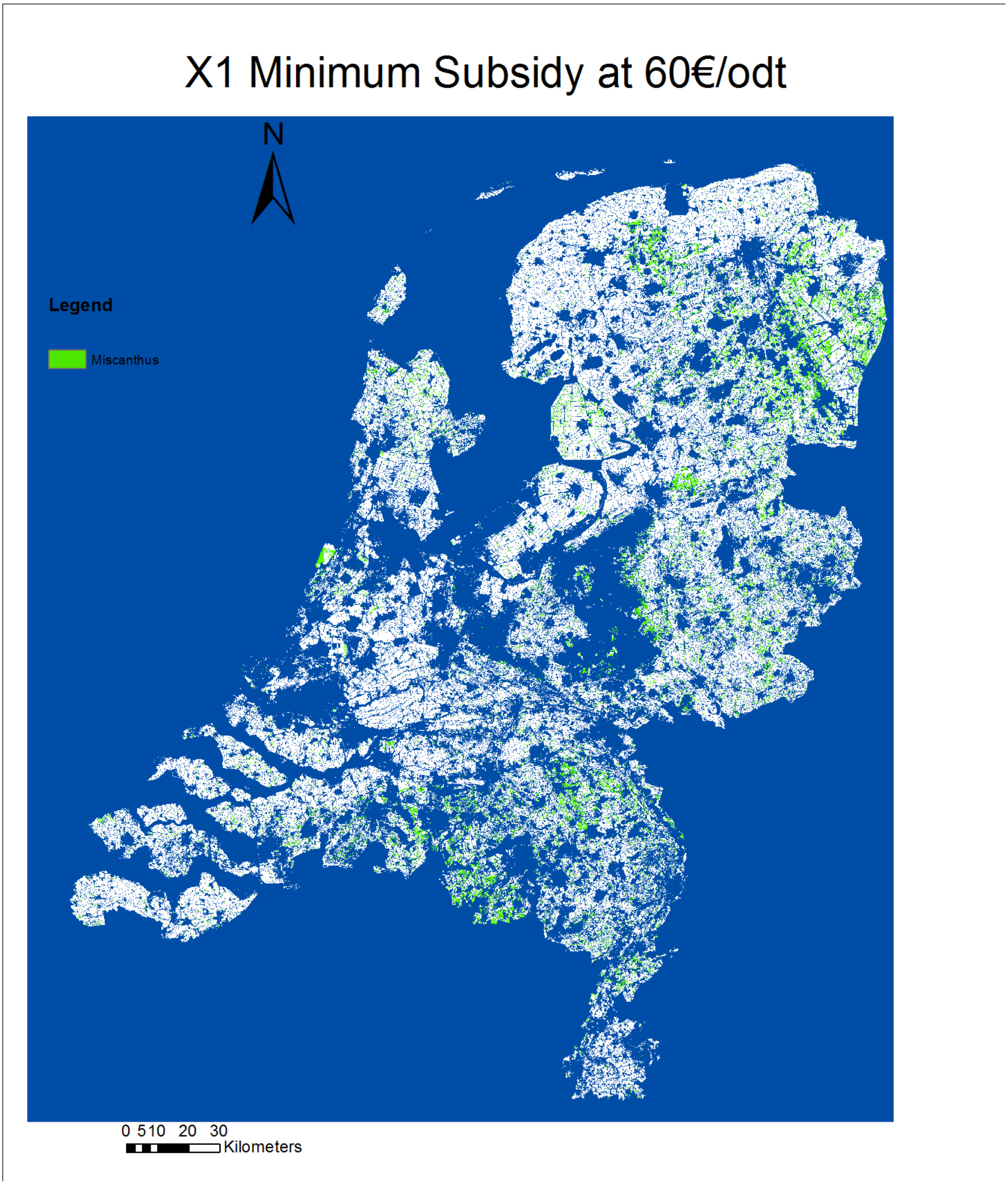
0,57	-€ 2.561,37	-€ 3.689,78	0,57	€ 2.831,15	0,57	-€ 567,79
0,56	-€ 2.696,78	-€ 3.805,39	0,56	€ 2.736,74	0,56	-€ 817,92
0,55	-€ 2.832,19	-€ 3.921,00	0,55	€ 2.642,32	0,55	-€ 1.068,05
0,54	-€ 2.967,60	-€ 4.036,61	0,54	€ 2.547,90	0,54	-€ 1.318,19
0,53	-€ 3.103,01	-€ 4.152,22	0,53	€ 2.453,49	0,53	-€ 1.568,32
0,52	-€ 3.238,42	-€ 4.267,84	0,52	€ 2.359,07	0,52	-€ 1.818,45
0,51	-€ 3.373,82	-€ 4.383,45	0,51	€ 2.264,65	0,51	-€ 2.068,58
0,5	-€ 3.509,23	-€ 4.499,06	0,5	€ 2.170,24	0,5	-€ 2.318,72
0,49	-€ 3.644,64	-€ 4.614,67	0,49	€ 2.075,82	0,49	-€ 2.568,85
0,48	-€ 3.780,05	-€ 4.730,28	0,48	€ 1.981,40	0,48	-€ 2.818,98
0,47	-€ 3.915,46	-€ 4.845,90	0,47	€ 1.886,99	0,47	-€ 3.069,11
0,46	-€ 4.050,87	-€ 4.961,51	0,46	€ 1.792,57	0,46	-€ 3.319,25
0,45	-€ 4.186,27	-€ 5.077,12	0,45	€ 1.698,15	0,45	-€ 3.569,38
0,44	-€ 4.321,68	-€ 5.192,73	0,44	€ 1.603,74	0,44	-€ 3.819,51
0,43	-€ 4.457,09	-€ 5.308,34	0,43	€ 1.509,32	0,43	-€ 4.069,64
0,42	-€ 4.592,50	-€ 5.423,96	0,42	€ 1.414,90	0,42	-€ 4.319,78
0,41	-€ 4.727,91	-€ 5.539,57	0,41	€ 1.320,49	0,41	-€ 4.569,91
0,4	-€ 4.863,32	-€ 5.655,18	0,4	€ 1.226,07	0,4	-€ 4.820,04
0,39	-€ 4.998,73	-€ 5.770,79	0,39	€ 1.131,65	0,39	-€ 5.070,17
0,38	-€ 5.134,13	-€ 5.886,40	0,38	€ 1.037,24	0,38	-€ 5.320,31
0,37	-€ 5.269,54	-€ 6.002,01	0,37	€ 942,82	0,37	-€ 5.570,44
0,36	-€ 5.404,95	-€ 6.117,63	0,36	€ 848,40	0,36	-€ 5.820,57
0,35	-€ 5.540,36	-€ 6.233,24	0,35	€ 753,99	0,35	-€ 6.070,70
0,34	-€ 5.675,77	-€ 6.348,85	0,34	€ 659,57	0,34	-€ 6.320,84
0,33	-€ 5.811,18	-€ 6.464,46	0,33	€ 565,16	0,33	-€ 6.570,97
0,32	-€ 5.946,58	-€ 6.580,07	0,32	€ 470,74	0,32	-€ 6.821,10
0,31	-€ 6.081,99	-€ 6.695,69	0,31	€ 376,32	0,31	-€ 7.071,23
0,3	-€ 6.217,40	-€ 6.811,30	0,3	€ 281,91	0,3	-€ 7.321,37
0,29	-€ 6.352,81	-€ 6.926,91	0,29	€ 187,49	0,29	-€ 7.571,50
0,28	-€ 6.488,22	-€ 7.042,52	0,28	€ 93,07	0,28	-€ 7.821,63
0,27	-€ 6.623,63	-€ 7.158,13	0,27	-€ 1,34	0,27	-€ 8.071,76
0,26	-€ 6.759,03	-€ 7.273,74	0,26	-€ 95,76	0,26	-€ 8.321,90
0,25	-€ 6.894,44	-€ 7.389,36	0,25	-€ 190,18	0,25	-€ 8.572,03
0,24	-€ 7.029,85	-€ 7.504,97	0,24	-€ 284,59	0,24	-€ 8.822,16
0,23	-€ 7.165,26	-€ 7.620,58	0,23	-€ 379,01	0,23	-€ 9.072,29
0,22	-€ 7.300,67	-€ 7.736,19	0,22	-€ 473,43	0,22	-€ 9.322,43
0,21	-€ 7.436,08	-€ 7.851,80	0,21	-€ 567,84	0,21	-€ 9.572,56
0,2	-€ 7.571,48	-€ 7.967,42	0,2	-€ 662,26	0,2	-€ 9.822,69
0,19	-€ 7.706,89	-€ 8.083,03	0,19	-€ 756,68	0,19	-€ 10.072,82
0,18	-€ 7.842,30	-€ 8.198,64	0,18	-€ 851,09	0,18	-€ 10.322,96
0,17	-€ 7.977,71	-€ 8.314,25	0,17	-€ 945,51	0,17	-€ 10.573,09
0,16	-€ 8.113,12	-€ 8.429,86	0,16	-€ 1.039,93	0,16	-€ 10.823,22
0,15	-€ 8.248,53	-€ 8.545,48	0,15	-€ 1.134,34	0,15	-€ 11.073,35
0,14	-€ 8.383,94	-€ 8.661,09	0,14	-€ 1.228,76	0,14	-€ 11.323,49
0,13	-€ 8.519,34	-€ 8.776,70	0,13	-€ 1.323,18	0,13	-€ 11.573,62
0,12	-€ 8.654,75	-€ 8.892,31	0,12	-€ 1.417,59	0,12	-€ 11.823,75

0,11	-€ 8.790,16	-€ 9.007,92	0,11	-€ 1.512,01	0,11	-€ 12.073,88
0,1	-€ 8.925,57	-€ 9.123,53	0,1	-€ 1.606,43	0,1	-€ 12.324,02
0,09	-€ 9.060,98	-€ 9.239,15	0,09	-€ 1.700,84	0,09	-€ 12.574,15
0,08	-€ 9.196,39	-€ 9.354,76	0,08	-€ 1.795,26	0,08	-€ 12.824,28
0,07	-€ 9.331,79	-€ 9.470,37	0,07	-€ 1.889,68	0,07	-€ 13.074,41
0,06	-€ 9.467,20	-€ 9.585,98	0,06	-€ 1.984,09	0,06	-€ 13.324,55
0,05	-€ 9.602,61	-€ 9.701,59	0,05	-€ 2.078,51	0,05	-€ 13.574,68
0,04	-€ 9.738,02	-€ 9.817,21	0,04	-€ 2.172,92	0,04	-€ 13.824,81
0,03	-€ 9.873,43	-€ 9.932,82	0,03	-€ 2.267,34	0,03	-€ 14.074,94
0,02	-€ 10.008,84	-€ 10.048,43	0,02	-€ 2.361,76	0,02	-€ 14.325,08
0,01	-€ 10.144,24	-€ 10.164,04	0,01	-€ 2.456,17	0,01	-€ 14.575,21
0	-€ 10.279,65	-€ 10.279,65	0	-€ 2.550,59	0	-€ 14.825,34

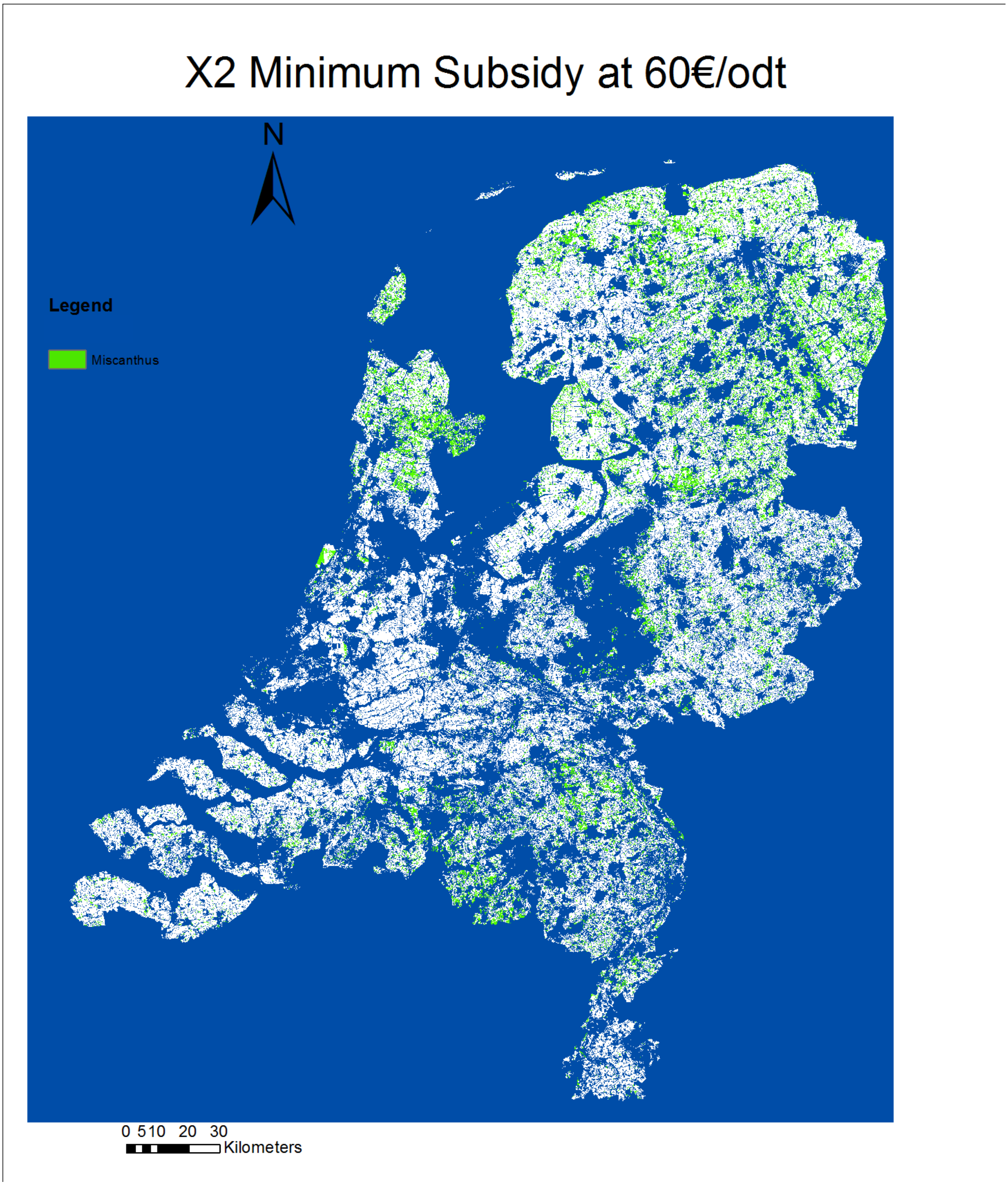
Yield values for flower bulbs in the range of 100 to 83 per cent of maximum yield don’t occur in the Netherlands. Net present values for dairy farming only drop when grass yields are 80 or lower. Values above 80 produce enough feedstock to sustain the cows.

Visual Representations of the Different Subsidy Options

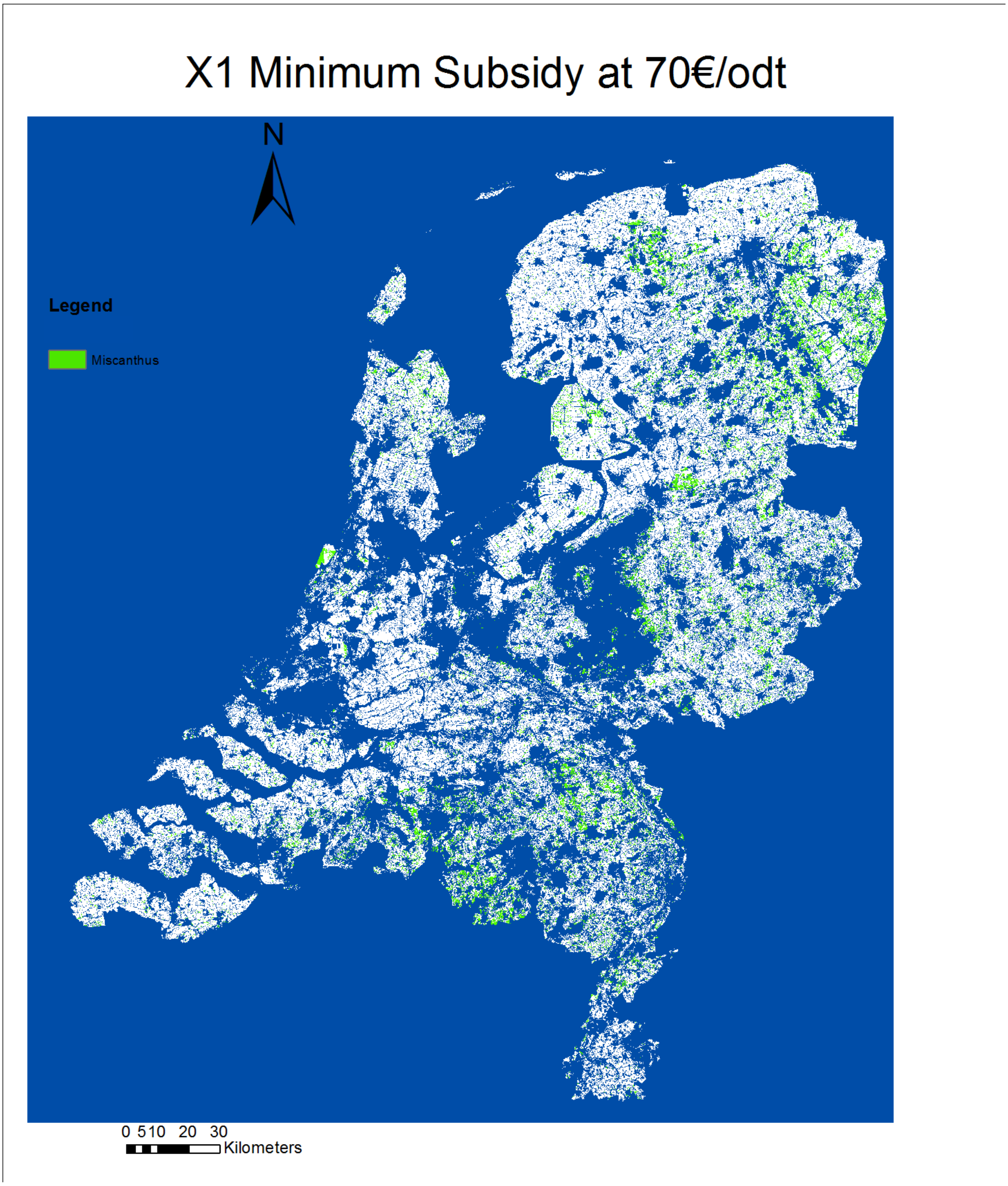
x1 60



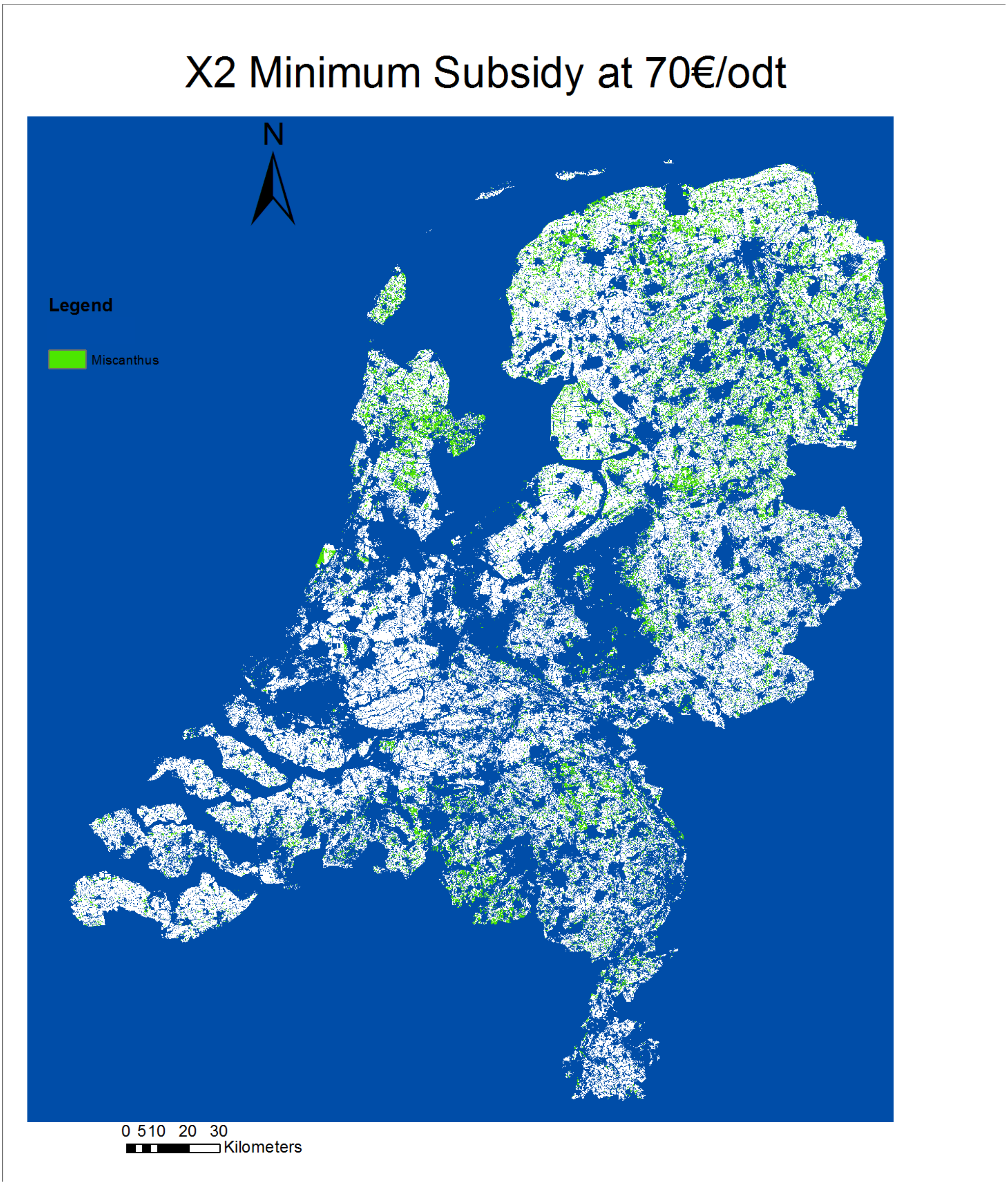
x2 60


X2 Minimum Subsidy at 60€/odt
N
Legend
Miscanthus
0 5 10 20 30
Kilometers

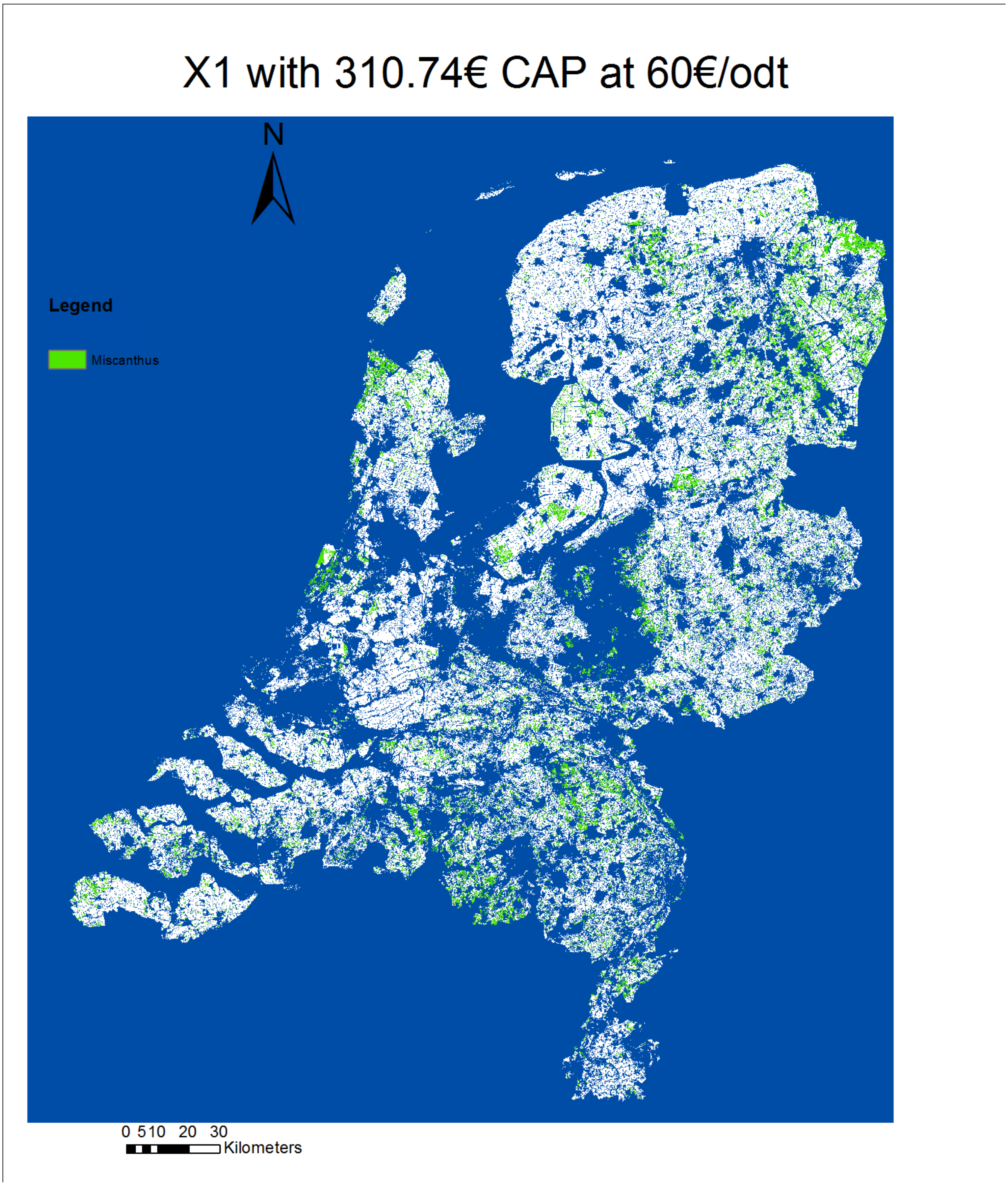
x1 70


X1 Minimum Subsidy at 70€/odt
N
Legend
Miscanthus
0 5 10 20 30
Kilometers

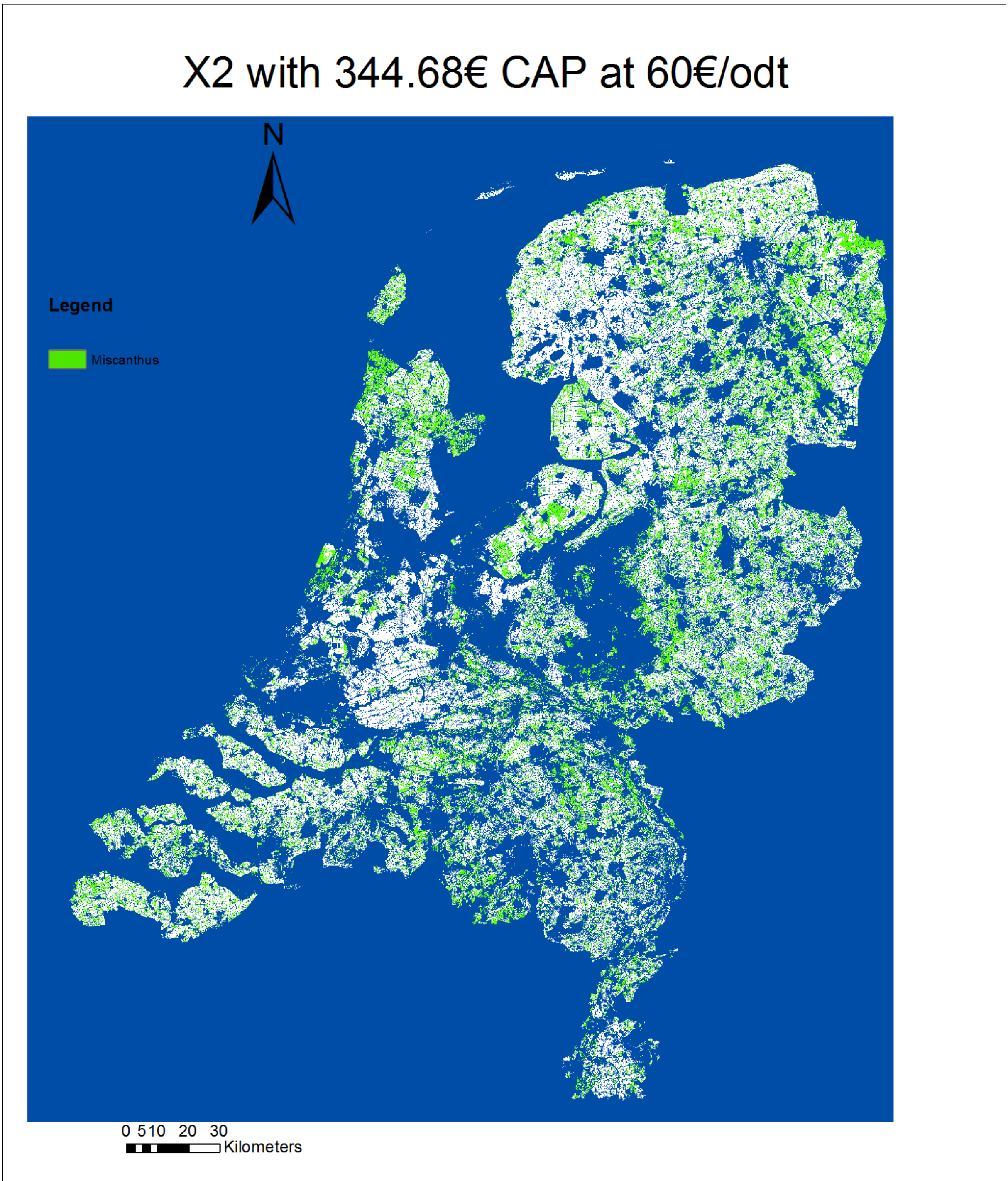
x2 70


X2 Minimum Subsidy at 70€/odt
N
Legend
Miscanthus
0 5 10 20 30
Kilometers

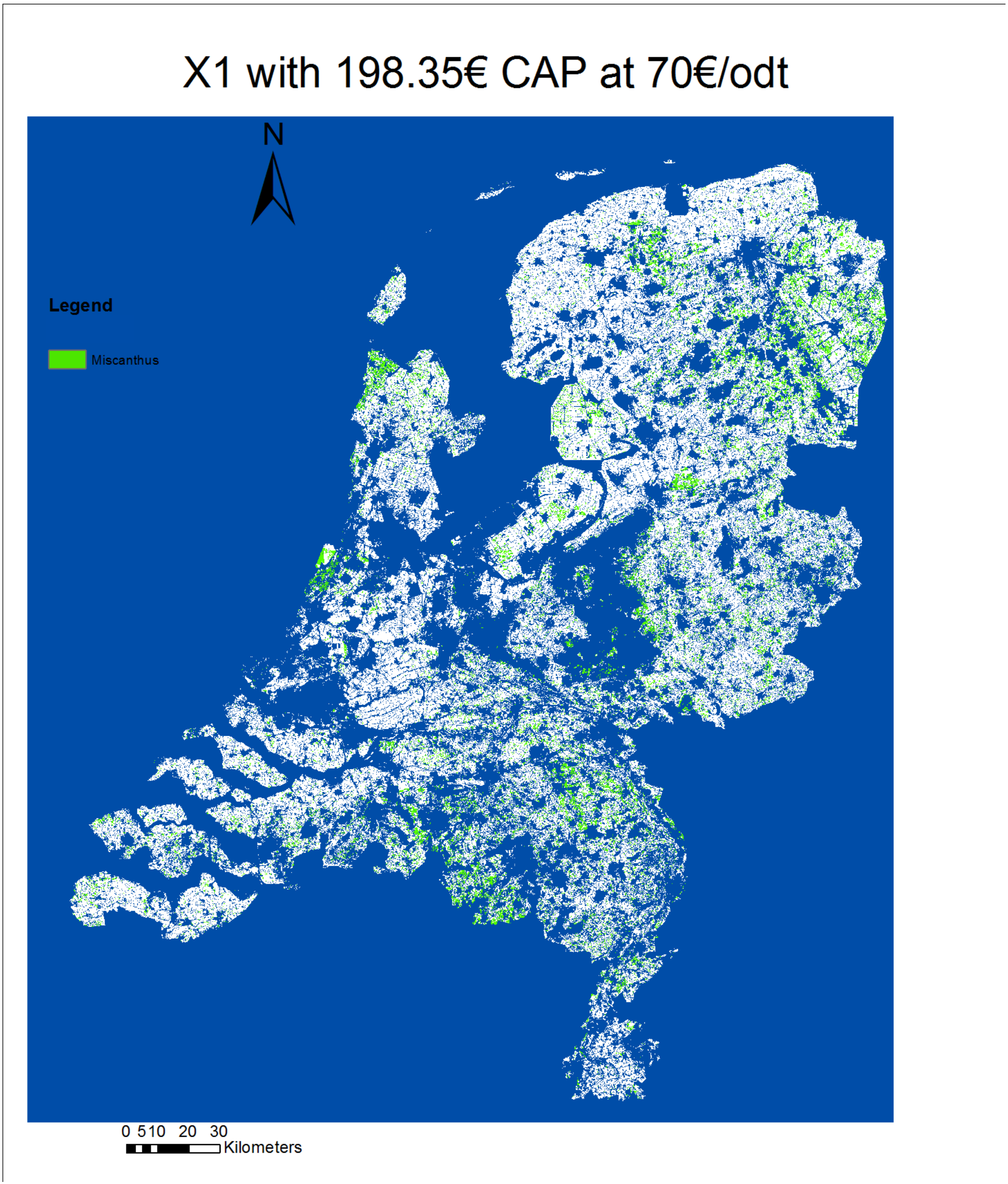
x1 60 CAP


X1 with 310.74€ CAP at 60€/odt
N
Legend
Miscanthus
0 5 10 20 30
Kilometers

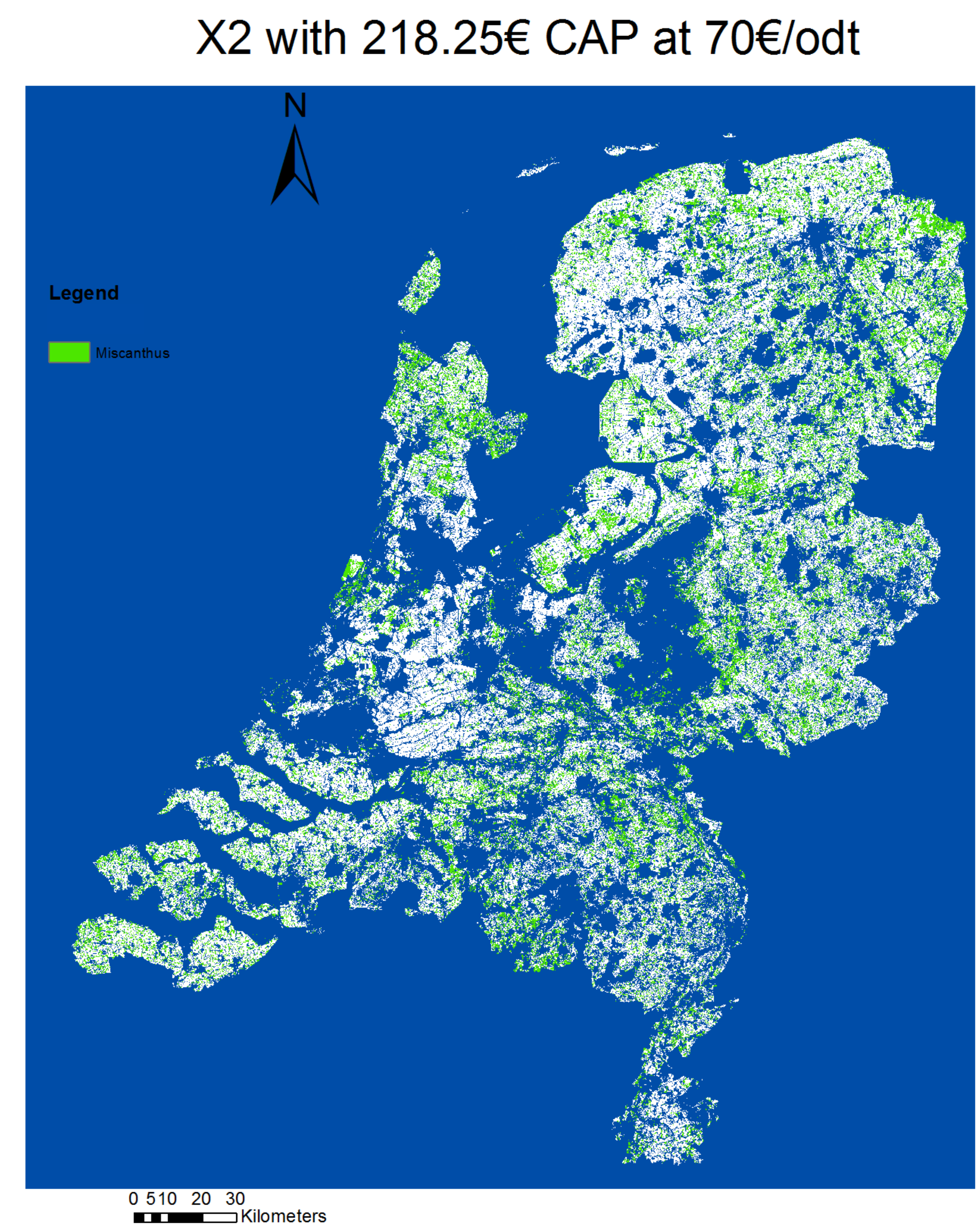
x2 60 CAP


X2 with 344.68€ CAP at 60€/odt
N
Legend
Miscanthus
0 5 10 20 30
Kilometers

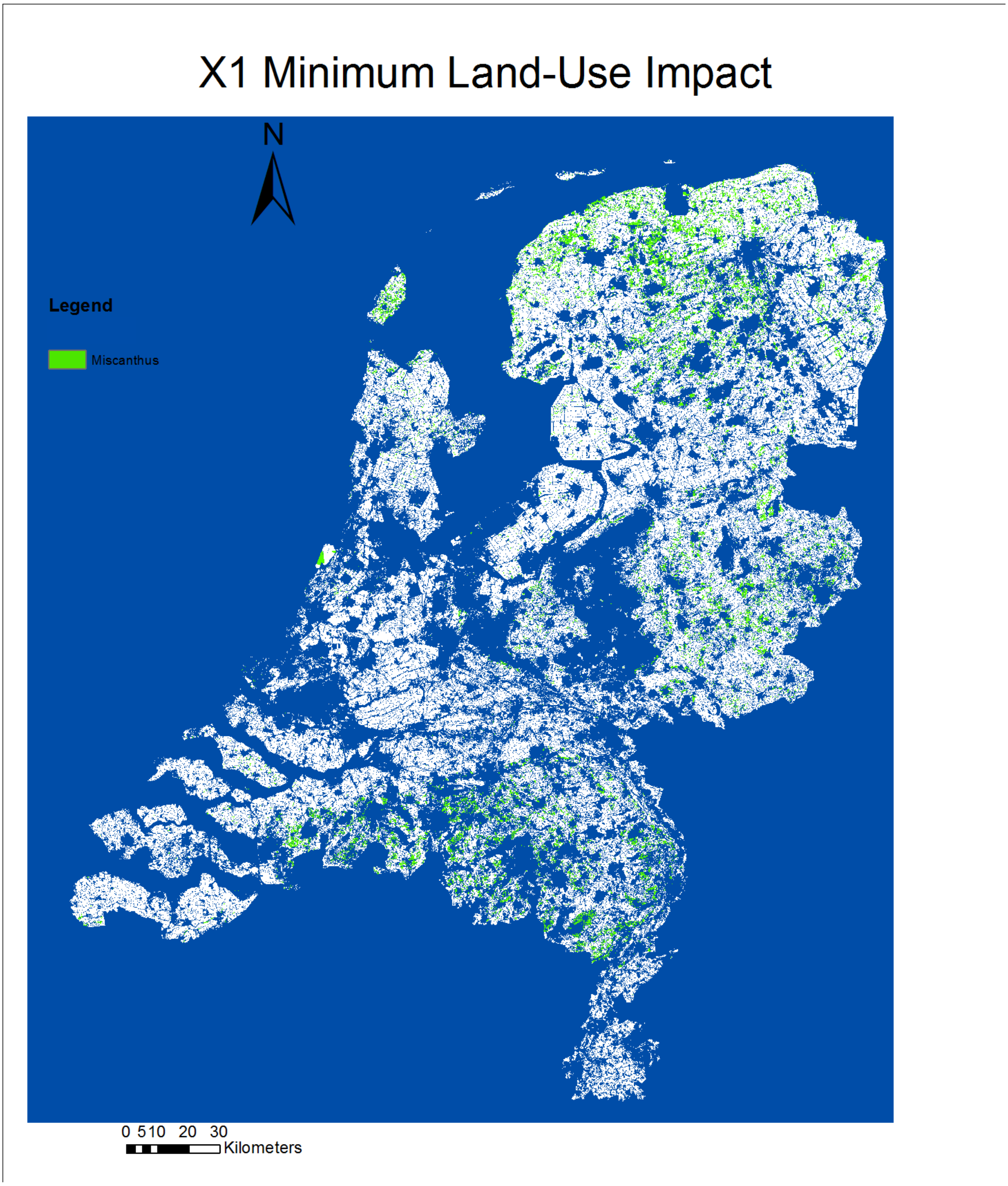
x1 70 CAP


X1 with 198.35€ CAP at 70€/odt
N
Legend
Miscanthus
0 510 20 30
Kilometers

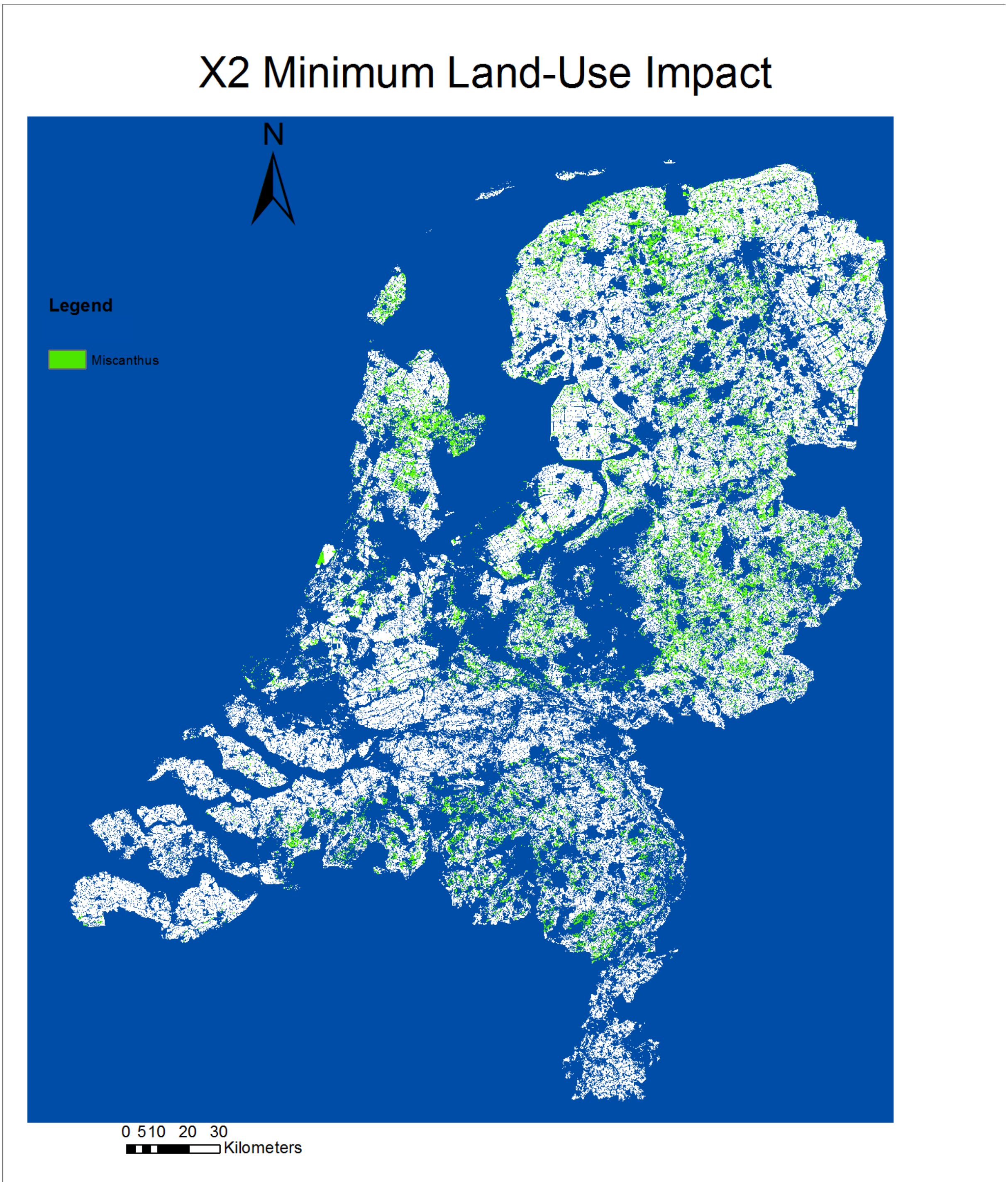
x2 70 CAP


X2 with 218.25€ CAP at 70€/odt
N
Legend
Miscanthus
0 510 20 30
Kilometers

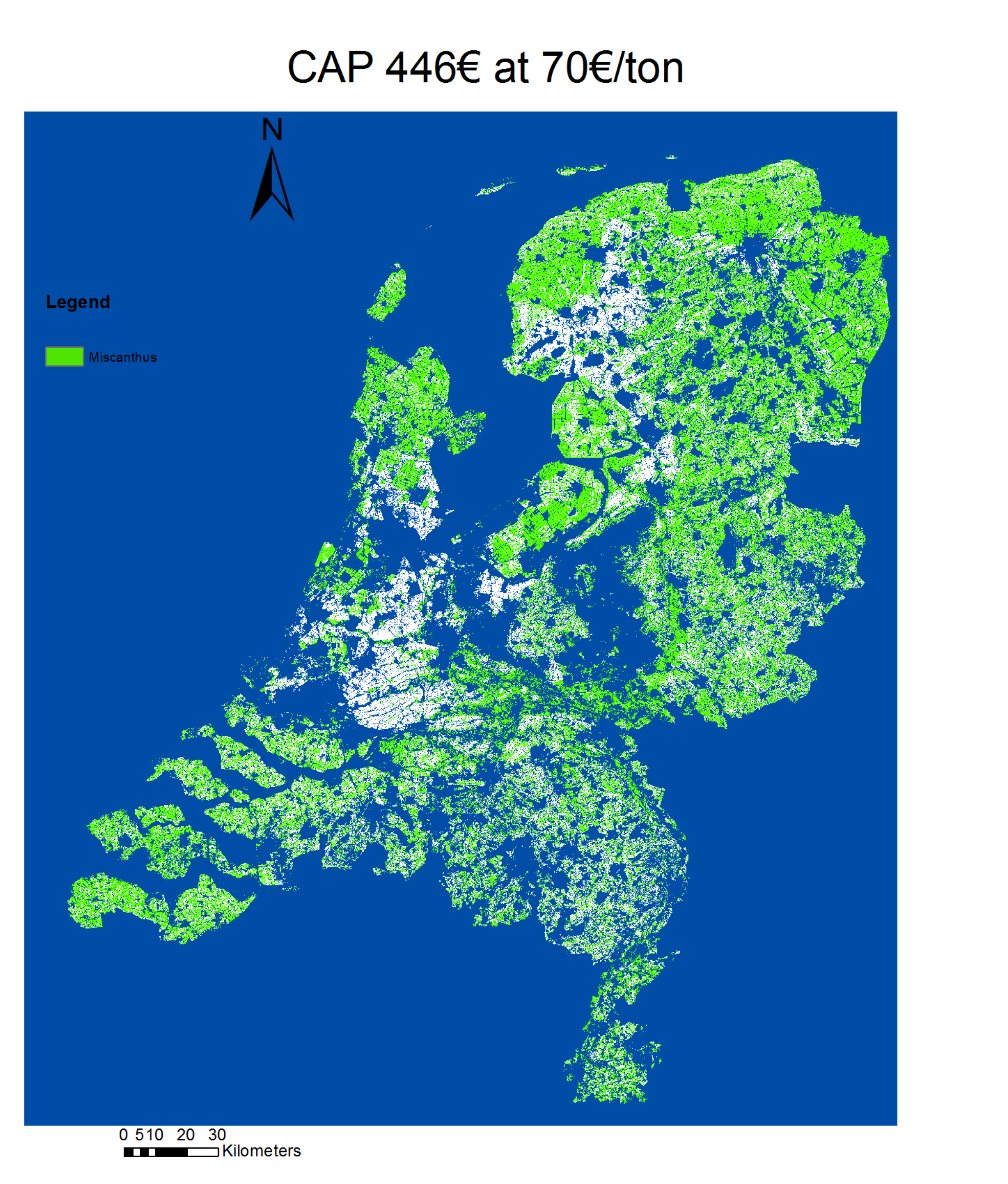
MIMP x1 60 and MIMP x1 70



MIMP x2 60 and MIMP x2 70



446 CAP 60



446 CAP 70