Management of pastures – what is affecting the farmers priority?

Skötsel av betesmarker – vad avgör lantbrukarnas prioriteringar?

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Independent project • 30 HEC
Swedish University of Agricultural Sciences, SLU
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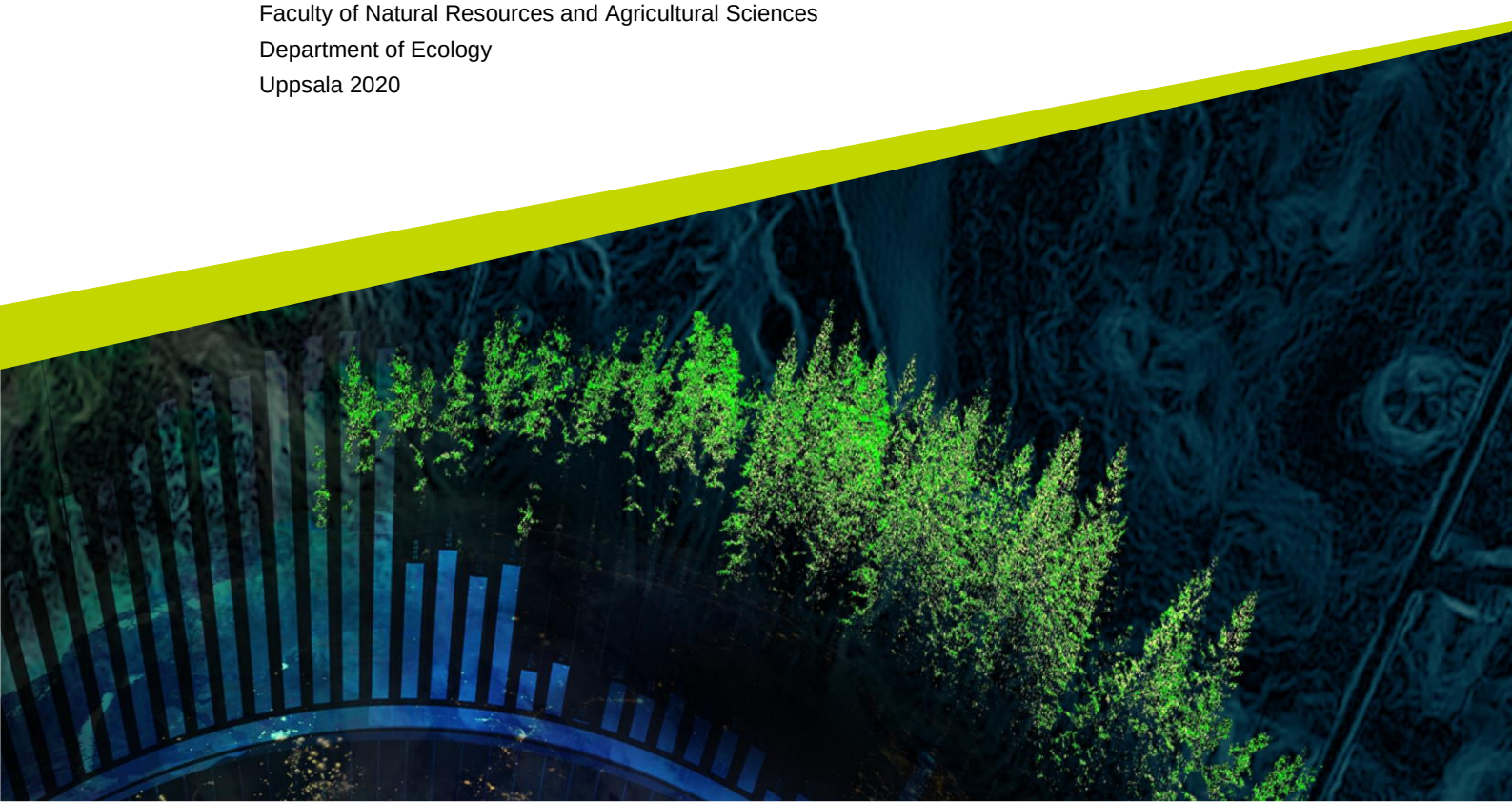
Uppsala 2020



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Credits: 30 HEC
Level: A2E
Course title: Independent project in Biology
Course code: EX0895
Course coordinating dept: Department of Aquatic Sciences and Assessment

Place of publication: Uppsala
Year of publication: 2020

Keywords: Pasture, semi-natural pasture, agri-environmental payments, land leasing, grazing regimes, grazing management

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Abstract

Natural pastures are important for the biological biodiversity. In 2004 we had 520 000 ha of pastures in Sweden, according to the Swedish Board of Agriculture, whereas today we have 461 000 ha (Jordbruksverket, 2019). By studying a questionnaire done by the Swedish Board of Agriculture 2017 and analysing GIS-data from aerial photo interpretation, I have tried to work out what is influencing farmers' choice to let their animal feed in pastures. I have also analysed how intense the grazing is and what type of farmlands that are grazed.

The farmers that participated in the questionnaire preferred to let their animal feed in ley or other temporary grassland rather than natural pastures, if they could choose. Analyses of the number of "livestock units" in relation to ley or other temporary grassland and natural pasture show that very small farms let their animals graze more extensively. Animals on dairy farms graze intensively, and farms with sheep and beef cattle have grazing intermediate between extensively and intensively.

The questionnaire shows that the economy is important for management of pastures. But more things are affecting, like the practical work with pastures, the farmers' age, lack of time and strength. Especially sheep farmers are concerned that the sheep grow less on natural pastures, and they also have problems with parasites, predators and the cost of predator fences.

Analyses of data from the aerial photo interpretation show that about 70% of the natural pastures are grazed. Pastures and meadows in the TUVA databases that overlap with the aerial photo interpretation are grazed by about 90% and those that overlap with pasture in the block database overlap by about 80%. Even in land classified as natural pasture in the TUVA database you can find both natural pastures and arable land, though semi-natural pastures are the most common.

Agricultural subsidies and agri-environmental payments also affect the grazing management. The ability to apply for agricultural subsidies is affected by land leasing. Also, some of the rules for agricultural subsidies and payments affect certain types of farmers, like very small farms. Most farmers that are applying for the agri-environmental subsidies for natural pastures are satisfied with the rules and the configuration of the subsidies and payments. Very small farms and sheep farms in general are less interested to apply for this payment, although their production still contributes to caring for the landscape.

The attitude from the society and authorities towards farmers' work with semi-natural pastures affects the farmers' commitment.

Keywords: Pasture, semi-natural pasture, agri-environmental payments, land leasing, grazing regimes, grazing management

Sammanfattning

Betesmarkerna är viktiga för den biologiska mångfalden. År 2004 hade vi 520 000 ha betesmark i Sverige enligt jordbruksverket, men nu har vi endast 461 000 ha (Jordbruksverket, 2019). Analys av en enkät som Jordbruksverket genomförde 2017 och GIS-analys av data från flygbildstolkning av gräsmarker visar på orsaker till vad som påverkar lantbrukarens val att låta djuren beta betesmark. Jag har också analyserat vad det är för marker som betas och hur hävden är för gräsmarker som flygbildstolkas.

De lantbrukare som har deltagit i enkäten föredrar att låta sina djur beta vall framför betesmark. Analys av antalet djurenheter i förhållande till areal vall och betesmark visar att småbrukare betar sina marker extensivt, mjölkgårdar har intensiv produktion, nöt och fårgårdar ligger däremellan.

Enkäten visar att ekonomin är viktig för skötseln av betesmark, men att fler faktorer påverkar som tex det praktiska arbetet med betesmarker, lantbrukarens ålder, tid och ork. Speciellt fårägare har problem med djurens tillväxt på betesmark och parasiter, rovdjur och rovdjursstängsel.

Analys av flygbildstolkningens resultat visar att ca 70 % av betesmarkerna i landskapsrutorna är hävdade. Av de marker som överlappar med flygbildstolkningen är ca 90 % av betesmarker och slåtterängar i TUVA hävdade och ca 80 % av block bete. Markslaget kultiverad betesmark och åkermark ingår i alla olika inventeringar av betesmark, även om naturbetesmark dominerar i de flesta fallen.

Betesdriften påverkas av jordbrukarstöden, enligt enkäten påverkas möjligheten att söka miljöstöd i stor grad av arrende, det finns även stödregler som missgynnar olika kategorier lantbrukare tex småbrukare. De flesta som har miljöstöd med åtagandeplan är nöjda med stödformen och skötselreglerna. Få småbrukare och endast hälften av fårägarna har miljöstöd med åtagandeplan, trots att många i de kategorierna lantbrukare har landskapsvård som produktionsinriktning.

Samhällets och myndigheters attityd till lantbrukarnas insats med betesmarker påverkar lantbrukarnas vilja och engagemang.

Nyckelord: betesmark, naturbetesmark, miljöersättning, arrende, hävd, skötsel

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1. Introduction

To protect biological diversity and cultural heritage in agricultural land we need to protect the pasture area we already have and also try to increase it (Eide, 2014). According to the Swedish Species Information Centre we need 1,3 million ha pasture to create favourable prerequisites for the redlisted species in agricultural land (Eide, 2014). There are several calculations on the area of pasture in Sweden. We need to know the difference in quality between different types of inventories (table 1).

Table 1. The area of pasture in Sweden according to different types of inventories. Source: The Swedish Tax Agency, 2020; The Swedish Board of Agriculture, 2018; SLU, 2019; The Swedish Board of Agriculture, the block database, 2017; Statistics Sweden, 2019; Eide, 2014; the database TUVA, 2020.

Source	*Area (ha)*	*Forest pasture (ha)*
Real estate registry (2018)	683 000	
NILS (2019) (animal-keeping, uncultivated land)	555 076 (without forest pasture)	33 950
NILS (2019) (animal-keeping, cultivated/manured land)	382 812	
The Swedish National Forest Inventory (2019)	506 000	
The Swedish board of Agriculture the block-database 2017	476 589	
Statistics Sweden (2019)	461 300	
Natura 2000, 17 grassland habitat types (2013)	272 960 (without forest pasture)	74 100
The Meadow- and Pasture Inventory (2020)	256 800 (without forest- and mountain-pasture)	18 090

It is important to know the quality of pastures and meadows if we need to choose in which sites we should prioritize management, as well as to decide which level of agri-environmental payments different areas should receive.

The value and quality of meadows and pastures can increase or decrease depending on the management. Even if trees and bushes have expanded into a pasture, it is possible to restore the grassland values and the biological diversity and cultural heritage (Johansson & Hedin, 1995).

How farmers choose to let their animals graze is crucial. It is important that we know what farmers need and prioritize, so that the agricultural subsidies and agri-environmental payments can be designed to suit the farmers' needs and make grazing on pastures attractive. The farmers' motivation for grazing pastures can be different for different farmers. Some like nature conservation, some are proud of keeping the landscape open and like the appreciation from the public. What most of the farmers have in common is that their work must pay off and be economically sustainable.

The agricultural subsidies do not allow so much variation in management. Maybe we need more possibilities to vary the management and grazing intensity.

- How are the possibilities to apply for all agricultural subsidies?
- Are the rules for the agricultural subsidies formulated to favour the quality of the pasture?
- Is it the person who is doing the most work for keeping the pasture grazed that actually receives the agricultural subsidies?

2. Background

Grazed semi-natural pastures belong to the most species-rich habitats in Sweden. It could be as many as 40 vascular plants in one square meter (Olsson 2008). In this type of habitat there are high biological values and cultural heritage values (Pehrson 1998). The habitat has been created through a long history of grazing, in some areas for several hundred years or longer (Ekstam & Forshed 1996; Welinder, Pedersen & Widgren 1998).

According to the IPBES report on biological diversity and ecosystem services (2019) the global extinction of species is now the highest since the last 10 million years, and 25% of most animal and plant groups are threatened by extinction. With that knowledge is it important for Sweden to preserve our most species-rich habitats. Semi-natural pastures is not only important for biological biodiversity, but also cultural heritage and remnants from many generations are visible in the landscape and contribute to environments and places that are preferred by different species (Olsson 2008).

According to a questionnaire from Västra Götaland people are prepared to pay more to keep pastures open, and people also like to live nearby sparse birch groves (Kumm 2014 and The County Administrative Board in Västra Götaland 2017).

In 1927 the area of pasture was 1 500 000 ha in Sweden (Swedish Statistics 1930), but since then the area has decreased depending on efficiency and structure rationalization of agricultural land (Ekstam & Forshed 2000).

When Sweden joined the EU in 1995, the pasture area was 425 000 ha, and until 2004 the area increased to 523 000 ha of pasture in Sweden. The last 10 years, the area of pasture in Sweden has been around 450 000 ha, and in 2019 the area was 461 000 ha (The Swedish Board of Agriculture 2019).

The global warming is getting more alarming (Lenton et al 2019). The beef meat production generates emissions of greenhouse gases. The beef meat production in Sweden produces the least greenhouse gas emissions in the world, compared to other countries (Bodin 2019, Wikström 2019). To let cattle graze semi-natural pasture would be one way to justify beef production. People need food, and meet production creates greenhouse gases, but the meet production may also contribute to a lot of biological diversity that could justify emissions of greenhouse gases. When beef cattle are grazing in semi-natural pastures it is not competing with other

food production as beans and vegetables because semi-natural pastures are impossible to plough (Ekström 2019).

The Swedish Species Information Centre argues that the area of grazed pasture including forest pasture should increase to 1,3 million ha if the redlisted species in the agricultural landscape will have favourable conditions (Table 2) (Eide 2014). It is also important to preserve the area forest pasture and to preserve the grazing management above all in forest districts, 1 million ha semi-natural pasture is needed to preserve and strength the biodiversity we have today (Ekström 2019).

Table 2. The eighteen EU grassland habitats, of which thirteen depend on management by grazing. The table shows the current area and the area that is needed for every habitat to achieve favourable conservation status, the so called reference area. (Eide 2014)

Grassland habitats		
Name	**Current area (ha)**	**Reference area (ha)**
Atlantic salt meadows (1330)	2 400	7 000
Boreal baltic coastal meadows (1630)	5 900	22 000
Northern Atlantic wet heaths (4010)	260	2 400
European dry heaths (4030)	13 200	39 000
Juniperus communis formations (5130)	4 800	4 800
Rupicolous calcareous or basophilic grasslands (6110)	2 300	2 400
Xeric sand calcareous grasslands (6120)	110	3 300
Semi-natural dry grasslands on calcareous sustrates (6210)	20 950	70 200
Species-rich Nardus grasslands on siliceous substrates (6230)	9 000	49 100
Fennoscandian lowland species-rich dry to mesic grasslands (6270)	144 400	416 500
Nordic alvar (6280)	19 610	23 500
Molinia meadows (6410)	36 620	151 200
Fennoscandian wooded pastures (9070)	74 100	317 000
Habitats not dependent on grazing		
Hydrophilous tall herb fringe communities (6430)	6 350	6 500
Northern boreal alluvial meadows (6450)	2 800	10 100
Lowland hay meadows (6510)	2 600	63 300
Mountain hay meadows (6520)	1 070	15 600
Fennoscandian wooded meadows (6530)	590	16 000
Total	**347 060**	**1 299 900**

3. Purpose

The first purpose with this essay is to do an in-depth analysis of the questionnaire conducted by the Swedish Board of Agriculture in 2017 (Jordbruksverket 2017). Research question one and three (see below) is answered from the questionnaire.

The second purpose is to use GIS-data from the aerial photo interpretation, the TUVA-database, the agriculture block database and a GIS-layer over land-class to answer research question two (Jordbruksverket, 2020).

A further purpose with the essay is to contribute with support to authorities and decision makers working with pastures and agricultural subsidies.

4. Research questions and hypothesis

4.1.1. Research question and hypothesis one

- Which fields are used for grazing?
- What is influencing how farmers choose to let their animals graze?

Hypothesis: The farms' prerequisites (area of pasture, area of ley or other temporary grassland, land consolidation, buildings, forest, geographical location) and the farmers interest, economy, driving forces, etc., determine how and what fields that are grazed.

4.1.2. Research question and hypothesis two

- How much do we know about how large areas that are being grazed or not?
- What kind of values do the areas have?
- Is the quality even within an inventory?
- Is there difference in quality between different inventories?

Hypothesis: The conceptual confusion affects how the area of pasture turns out. Different authorities and institutions have different definitions, and farmers have their definitions.

4.1.3. Research question and hypothesis three

- How is the grazing management affected by agri-environmental payments and other agricultural subsidies?
- How can we improve the management of valuable pastures?

Hypothesis: Agri-environmental payments and other agricultural subsidies are important for the management of grasslands. We can improve the management of pastures and even graze more areas. It is a common assumption that it is lack of grazing animals in Sweden, but we have an underutilized resource in bulls bred on stables.

5. Definitions

5.1. General definitions of agriculture land

The most common definitions of agriculture land (figure 1) come from the Code of regulations of the Swedish Board of agriculture SJVSFS 2019:80.

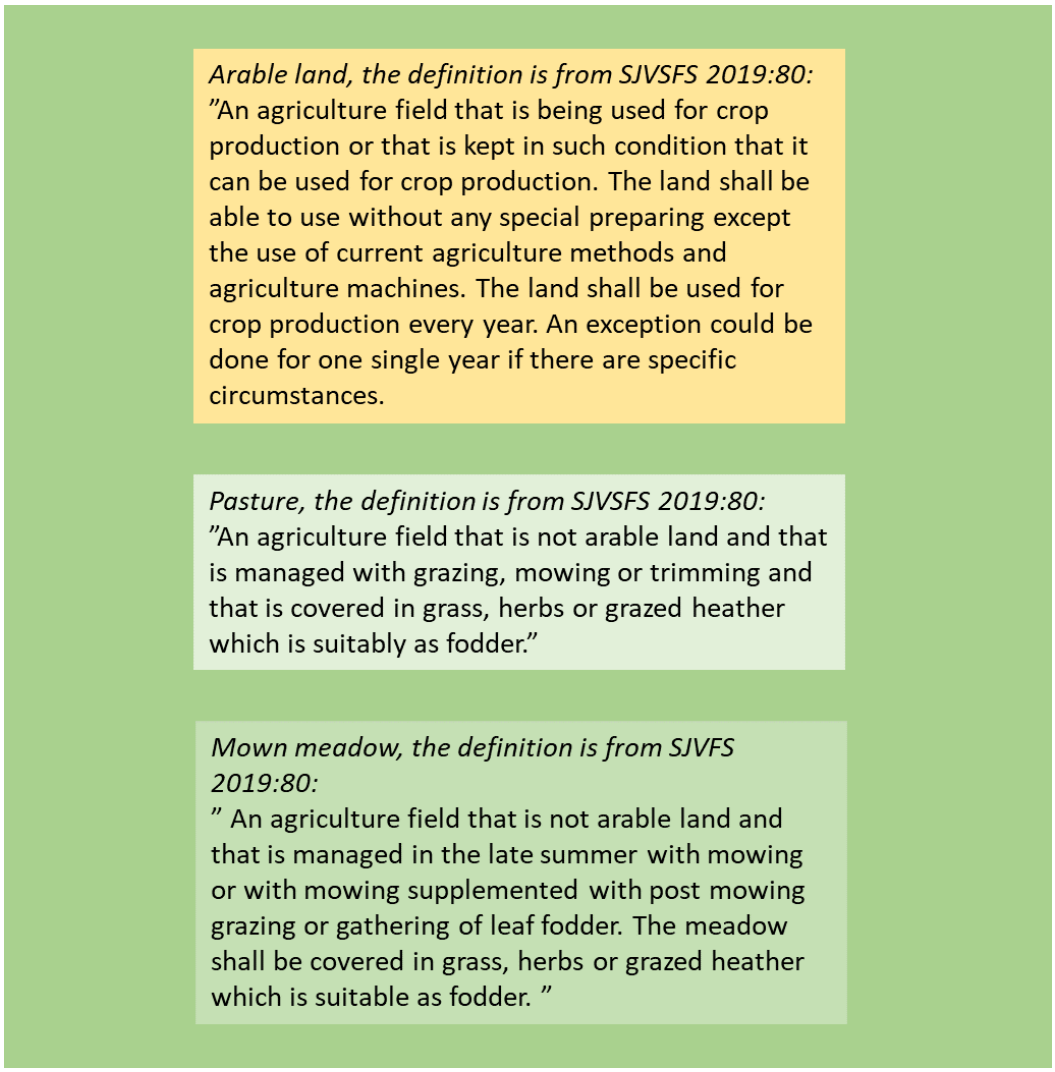

Figure 1.The definitions from the Swedish Board of Agriculture of the most important types of land for agriculture.

5.2. Descriptions of inventories and GIS-layers that are included in the analyses

5.2.1. The agriculture block database

The Swedish Board of Agriculture divides the agriculture land into *agriculture block* (land parcels) depending on what type of agriculture land it is. The block is delimited in a GIS-layer in the *block* database (Land parcel information system, LPIS) of the Swedish Board of Agriculture. The block is the eligible area for agriculture subsidies. (Jordbruksverket 2019)

5.2.2. TUVA – The meadow and pasture inventory

The definition of meadows and pastures in the inventory methods from 2005 is an area that is used for mowing or grazing and that is not suitable to plough and that is not included in crop rotation. It has none or very little impact of manure or other methods to increase the production. The management determines the type of land, meadow or pasture. The areas are at least partly light and open and has been used as fodder land for very long time. The lands' early origin could be fossil farmland or outfield, but today the land is impossible or unsuitable to plough. Land that has been included in the inventory is classified as pasture, mown meadow, "not of interest" (i.e., land that is no longer mown meadow or pasture) and restoration land (land that could be restored to pasture or mown meadow within reasonable time) (Jordbruksverket 2005).

5.2.3. TUVA – with habitat types

The intention is that all land in the TUVA inventory shall have a habitat type. Below is a list of the habitat types in TUVA. (Jordbruksverket 2005).

- **Natura 2000 grassland-type**: habitat type of grassland according to the European network for Natura 2000
- **Other habitat type**: habitat types other than open grasslands (i.e., forests, wetlands, alpine habitats, etc.) within the European Habitat directive.
- **Cultivated grassland**: recently abandoned arable land or cultivated pasture
- **Mosaic**: two or more habitat types in mosaic
- **Development**: land with TUVA potential (Jordbruksverket 2005)

5.2.4. Aerial photo interpretation of grasslands

Every year, aerial photo interpretation is performed within a certain number of landscape squares, as part of the nation-wide monitoring of grasslands. The

distribution of landscape squares within each of the counties depends on at which level each county has chosen to participate. During the last five years, 433 squares have been completed. Every landscape square is three times three km, i.e. 900 ha. The block database, the property map and historical aerial photos is used to support the aerial photo interpretation. Grasslands are defined and classified into one of 29 types of land according to a certain method depending on management and land type (Kindström et al 2019, Lundin et al 2016). The eight most important types of land in this context are defined in the list below. The other 21 land types are grouped in five categories; for more information, see Appendix 1.

- **Pastures (**Terrestrial land with semi-natural pasture or meadow) contains three subgroups:
    - *Managed pasture or meadow: "*Permanent pasture or meadow with grass vegetation that is managed, but not suitable to plough or is not strongly characterised by ploughing or early cultivation."
    - *Unmanaged pasture or meadow:* Permanent pasture or meadow with grass vegetation that is not strongly characterised by ploughing, which is suitable for grazing or mowing but is not managed nowadays. "
    - *Rocky outcrop influenced by grazing*: "Rocky outcrops with a thin soil cover (<10 cm) and that has no grass vegetation but is clearly affected by grazing. Often with a thin/affected ground layer, could have weathering gravel."
- **Arable land** (Arable land**)** contains three subgroups.
    - *Arable land used for arable crops: "*Arable land that is included in the crop rotation, with cultivation of crop/ley, temporary fallow or newly ploughed or newly sowed. Land with commercial cultivation of energy crops (*Salix*), fruit trees or berries on arable land are also included."
    - *Arable land with permanent grazing or mowing: "*Arable land which is suitable for ploughing and crop cultivation, but is nowadays used permanently for grazing or mowing, without ploughing. None or hardly any trees or shrubs taller than 1,3 m."
    - *Unused arable land*: "Arable land that is suitable for ploughing and crop cultivation, but is not used for cultivation, grazing or mowing nowadays. None or hardly any trees or shrubs taller than 1,3 m."
- **Former arable land** (Former arable land) contains two subgroups.
    - *Former arable land with permanent grazing or mowing*:" Previously ploughed land, which is now used for permanent grazing or mowing, but is not any longer suitable for ploughing,

because of overgrowth by trees and bushes or too moist/wet ground. Trees and shrubs cover less than 60%.
    - *Unused former arable land*: Unused land which previously has been used for ploughing and crop cultivation but is not any longer suitable to plough because of overgrowing of trees and bushes or to moist/wet ground. Trees and shrubs cover less than 60%.
- **Constructed land**
- **Other open land**
- **Forest or shrubland**
- **Open wetland**
- **Water**

5.2.5. Land classes with agri-environmental payments

Fields receiving agri-environmental payments with the higher level of compensation do always have a land class. There are six classes. Pastures or meadows with specific values shall have high cultural heritage values connected to the agricultural landscape or high biological values connected to long continuity of mowing or grazing. If the value of the land is connected to the field layer, it must be only very little affected by manure or other methods to increase the production. This is true also if the value is connected to other things than the field layer (SJVSFS 2019:80).

- **General values** is the basic level and has the same definition as pasture (The Swedish Board of Agriculture), though some extra management conditions are included. A field can have general values without land class.

For the following land classes the County Administrative Board decides which pastures or meadows are approved, and all of them should have values that demands special management.

- **Specific values** in sites with biological and/or cultural heritage values.
- **Forest pasture** is a special type of pasture in forest.
- **Mountain pasture** is a special type of pasture around a seasonal mountain holding.
- **Alvar grazing** is pasture at the alvar on Öland and Gotland.
- **Sward/rock mosaic with grazing** is pasture where areas without grass is too large to be approved for single payment scheme (“pro rata” is the administrative term for areas with too little production value for grazing or mowing). Areas without grass in the pasture could be brushwood, rock, culture cairn, permanent water.
- **Areas with sparse grass growth** has too little grass to approve as pasture, but still there are high biological values depending on grazing.

- **Pastures or meadows with restoration** are sites that are being restored to increase their values as pasture or meadow. (Jordbruksverket 2019).
- **Special** = in this essay that will be a collection name for forest-, mountain-, alvar-, swards/rock mosaic and areas with sparse grass growth.

5.2.6. General information about the GIS-layers

The GIS layers with agriculture blocks (land parcels), land class and TUVA vary between years depending on how many farmers that have applied for agricultural subsidies and on how the TUVA inventory progresses. The aerial photo interpretation is the same within the landscape square from year to year, although it is not a complete inventory, but a sample of the landscape.

5.3. Description of the questionnaire that is included in this analysis

One part of this essay is an in-depth analysis of a questionnaire conducted by the Swedish board or agriculture the summer 2017 (Jordbruksverket 2017). The company *Mind Research,* which designed and distributed the questionnarie, has earlier reported the results from the questionnaire. The response rate was 43%, and 1117 farmers answered. About half of the respondents had cattle and the other half had sheep. The questionnaire had 23 questions; two questions were free text response, and on six further questions there was a possibility to answer with free text.

6. Methods

6.1. GIS-analysis

When doing the GIS-analysis I have compared GIS-layers from different inventories. The layers used were:

- *Aerial photo interpretation* over grasslands from five years 2015, 2016, 2017, 2018 and 2019.
- *Agriculture block* from 2017. GIS-layer over all agriculture blocks in the database from The Swedish bBard of Agriculture 2017. (Jordbruksverket 2020).
- *Land class* 2016. GIS-layer over all the agriculture blocks receiving agri-environmental payments in the agriculture block database 2016.
- *TUVA.* GIS-layer from the Meadow and pasture inventory 2017, containing all objects inventoried until 2017 and a GIS-layer with the areas which have a habitat class (Jordbruksverket 2020).

All layers have been intersected to the landscape squares used for the sample-based aerial photo interpretation, so that I would be able to compare areas between the four different layers. The number of landscape squares are 433 and the total area within the squares are 389 421 ha.

Mown meadows were included in the same category as pasture for most layers.

6.2. The questionnaire

6.2.1. The division of the questionnaire

In the questionnaire, 25 of the 1117 respondents answered in the first question that they did not have any animals at all, and they were therefore excluded from the analysis. Further 23 respondents answered that they did not have any animals in question 2 and 3, and they were also excluded. Another respondent was excluded

because an unreasonably large pasture area (3996 ha). In total 49 respondents have been erased, which leaves 1068 respondents.
The questionnaire was designed to represent four production areas (table 3), the animal types cattle and sheep, including the classes small livestock (1-100 cattle or 1-50 sheep) and large livestock (more than 101 cattle or more than 50 sheep) (Jordbruksverket 2017).

Table 3. The production areas represented in the questionnaire and simplified names for these areas.

Production areas	***Simplified names***
Plain districts in Svealand and northern and southern Götaland	Plain
Central districts in Götaland	Central
Forest districts in Götaland and central Sweden	Woodland
Lower and upper parts of Norrland	Norrland

I have chosen to divide the respondents in the same order as the Swedish Board of Agriculture have categorised agriculture holdings in their statistical database. I am interested to see if there are differences between farms depending on what management they have and if the companies' size has any significance when choosing what land to graze.

In statistics from the Swedish Board of Agriculture are they using working standard to divide companies and entrepreneurs. Small farms are defined as companies where the working standard is less than 400 hours/year (Jordbruket I siffror 2020).

In this essay, farms with 1-20 sheep or 1-10 cattle are categorized as small farms. Dairy cows are included in the category dairy farms, even if they just have on dairy cow, it is difficult to set the limit, but I estimate that even just one dairy cow demands almost 400 working hours/year (Jordbruket i siffror, 2020).

The category small farms in this essay includes both small farms with cattle and small farms with sheep. In some analyses the groups have been mixed and in some a separation between cattle and sheep has been made.

When categorising farms according to management, the distribution becomes uneven (table 4). For example, dairy farms are fewer than the categories cattle farms, sheep farms and small farms, which is important to remember when comparing answers between different management types in the questionnaire. The distribution in the questionnaire is uneven, and it is not representative for the total situation in Sweden. Differences in answers between categories might depend on the number of participants in the questionnaire and not the reality.

Table 4. The number of farms in each category.

Farm category	***Number of farms***
Dairy farms	189
Cattle farms	273
Sheep farms	312
Small farms	294
(small farms with cattle)	(73)
(small farms with sheep)	(221)
Total	**1068**

6.2.2. Conversion to livestock unit

To be able to compare the area ley or other temporary grassland and pasture between different categories of farms in relation to the number of grazing animals the type and number of animals have been converted to livestock unit (de) (table 5). The feeding requirements is calculated as proportion of livestock unit/ha. The calculation includes an assumption that a dairy cow eats 10 kg dry matter pasture grass every day and that a normal grazing period is 150 days, which corresponds to 1 livestock unit/ha (Blom, 2009 and Pehrsson, 2001).

For the other types of animals, the feeding requirements are calculated in relation to the need of dairy cows. For the category cattle, have I made an assumption that 50% of the animals in the questionnaire are suckle cows and 50% are heifers. For the category sheep I have used the value for ewe for all sheep in the questionnaire. I have chosen to include all animals presented in the questionnaire, including horses.

The purpose of counting in terms of livestock units is to estimate if there is enough area pasture and ley or other temporary grassland in relation to the number of animals. Glimskär and Spörndly (2018) concluded, in a new investigation on yield and feeding requirements in different types of natural pastures, that fresh, open natural pastures can produce 2 livestock units/ha. I have chosen to count 1 livestock unit /ha, since I do not know what type of pastures the farmers in the questionnaire have.

Tabell 5. The livestock units represented by one animal of each type (Blom, 2009; Pehrsson, 2001).

Type of animal	***Livestock units***
Dairy cows	1.0
Suckling cows	0.9
Heifers	0.75
Ewes	0.3
Horses	0.65

6.3. The pastures for each landowner

In the questionnaire, the respondents have declared the area of pasture they have access to. They have also declared how much of the pasture area they own, in six percentage classes, from 0% to 100%. I have taken class center value for each respondent and multiplied with the area of pasture, which gives the approximate area pasture each respondent owns. I have summed up these values for each category of farmers. This gives an estimation of the area of pasture that is leased or borrowed according to the respondents in the questionnaire.

6.4. The free text of the questionnaire

Many of the respondents have used the possibility to answer with free text. In six of the questions it was possible to answer with free text comments in addition to the pre-printed answers. Two questions were open with the possibility for the farmers to answer anything. Totally it was over 1400 free text comments among all the answers of the questionnaire. Important information of reasons affecting the grazing management appear in the free text. The free text answers confirm that farming is a complex occupation. This includes causes that do not seem to be related directly to the grazing management. I have chosen to analyse the free text, because in those answers there are many reasons for the complexity within farming.

There are some difficulties in analysing the free text quantitatively. To be able to analyse the comments, the answers must be classified. It is difficult to refer to comments without changing the original meaning. Sometimes you may also misinterpret the meaning of the comment. There is also a risk of including subjective personal choices when choosing which comments to use.

Also, the comments are already a sort of bias, because not all farmers have written comments. However, those who have been writing comments often have written a lot of text.

6.5. The representativeness of the questionnaire

To check if the replies of the questionnaire were representative for the Swedish agriculture in general, the replies were compared with statistics from the statistical database of the Swedish Board of Agriculture (Jordbruksverket 2020).

6.5.1. Division of farmers according to what type of animals they have

Table 6. A comparison between the statistical database from the Swedish board of agriculture and the questionnaire. The number of farms distributed according to size and animal type.

Agricultural holdings	***Total number***	***%***	***Number in questionnaire***	***%***	***Per cent of holdings***
The country	42 837	100	1068	100	2.5
Small farms	23 291	54	294	28	1.3
Sheep farms	4 837	11	312	29	6.5
Cattle farms	11 416	27	273	26	2.4
Dairy farms	3 293	8	189	18	5.7

Despite the source of error for where the border between small farms and full-time farms should be drawn (section 6.2.1), it is a rather big differences between the questionnaire and the statistics (table 6). The proportion of small farms is underrepresented in the questionnaire, whereas the proportion of sheep farms is overrepresented. The proportion of cattle farms is the same as in the statistics. The proportion of dairy farms is overrepresented.

If the respondents themselves would have defined their own farm according to the Swedish Board of Agriculture's definition of agricultural holdings, it would have been more reliable when comparing with statistics, for example.

6.5.2. The distribution of agriculture holdings depending on farming type in different regions

I have compared the number of agriculture holdings depending on farming type between different regions (table 7-10). For the production area plain, the proportion

of the four specializations, dairy farms, cattle farms, sheep farms and small farms is correct. In production area Central and Norrland, the proportion of dairy farms, cattle farms, and sheep farms is overrepresented in the questionnaire. For the production area Central the small farms are overrepresented in the questionnaire. In Norrland the proportion of small farms is similar to that within the agriculture statistics. In woodland all the four agriculture categories are underrepresented.

Table 7. Comparison between the statistical database from the Swedish Board of Agriculture and the questionnaire, number of dairy farms in the production areas. Number and %.

	Statistics from the Swedish Board of Agriculture		***Questionnaire***	
	No. of dairy farms	**%**	**No. of dairy farms**	**%**
The country	3 293	100	189	100
Plain	829	25	53	28
Central	429	13	46	24
Woodland	1 409	43	45	24
Norrland	626	19	45	24

Table 8. Comparison between the statistical database from the Swedish Board of Agriculture and the questionnaire, number of cattle farms in different production areas. Number and %.

	Statistics from the Swedish Board of Agriculture		***Questionnaire***	
	No. of cattle or mixed farms	**%**	**No. of cattle farms**	**%**
The country	11 416	100	273	100
Plain	2 504	22	63	23
Central	1 180	10	78	29
Woodland	6 311	55	80	29
Norrland	850	7	52	19

Table 9. Comparison between the statistical database from the Swedish Board of Agriculture and the questionnaire, number of sheep farms in different production areas. Number and %.

	Statistics from the Swedish Board of Agriculture		***Questionnaire***	
	No. of sheep farms	**%**	**No. of sheep farms**	**%**
The country	4 837	100	312	100
Plain	1 246	26	76	24
Central	577	12	74	24
Woodland	2 333	48	90	29
Norrland	681	14	72	23

Table 10. Comparison between the statistical database from the Swedish Board of Agriculture and the questionnaire, number of small farms in different production areas. For the questionnaire, small farms are defined as having at most 20 sheep or 10 cattle, but no dairy cattle. Number and %.

	Statistics from the Swedish Board of Agriculture		***Questionnaire***	
	No. of small farms	**%**	**No. of small farms**	**%**
The country	23 291	100	294	100
Plain	6 601	28	79	27
Central	1 646	7	72	24
Woodland	10 438	45	79	27
Norrland	4 606	20	64	22

6.5.3. The distribution between ley or other temporary grassland and pasture and the total relation between them.

The distribution between ley or other temporary grassland and pasture in production areas has almost the same pattern as for the agriculture holdings (table 11 and 12). The areas are most correct for production area plain. The production area central have larger proportion ley or other temporary grassland and pasture in the

questionnaire than in the statics from the Swedish board of agriculture, the same relation as for agriculture holdings. The production area woodland has to little proportion ley or other temporary grassland and pasture in the questionnaire. Production area Norrland have greater proportion ley or other temporary grassland in the questionnaire compared to the statistics, the proportion pasture is almost correct.

Table 11. Comparison between the statistical database from the Swedish Board of Agriculture and the questionnaire, the area of ley or other temporary grassland in different production areas. Area and %.

	Statistics from the Swedish Board of Agriculture		***Questionnaire***	
	Ley or other temporary grassland (ha)	**%**	**Ley or other temporary grassland (ha)**	**%**
The country	1 035 115	100	43 877	100
Plain	334 939	32	11 802	27
Central	112 747	11	9 262	21
Woodland	402 270	39	11 035	25
Norrland	185 159	18	11 778	27

Table 12. Comparison between the statistical database from the Swedish Board of Agriculture and the questionnaire, the area pasture in different production areas. Area and %.

	Statistics from the Swedish Board of Agriculture		***Questionnaire***	
	Pasture (ha)	**%**	**Pasture (ha)**	**%**
The country	453 168	100	30 743	100
Plain	116 374	26	8193	27
Central	106 321	23	12 287	40
Woodland	197 349	44	7028	23
Norrland	33 124	7	3235	11

Table 13. Comparison between the statistical database from the Swedish Board of Agriculture (the whole country) and the questionnaire, the relation between the area ley or other temporary grassland and pasture. Area and %.

	Ley or other temporary grassland (ha)	***Pasture (ha)***	***Ley or other temporary grassland %***	***Pasture %***
The country, statistics	1 035 115	453 168	70	30
Questionnaire	43 877	30 743	59	41
Proportion in questionnaire	4.2	6.8		

In total, 4.2% of the country's area of ley or other temporary grassland is represented in the questionnaire, and 6.8% of the country's pasture area is represented (table 13). The proportion of pasture in relation to ley or other temporary grassland is larger in the questionnaire than in reality (table 13).

6.5.4. Grazing animals in Sweden in relation to the questionnaire

Table 14. Comparison between the statistical database from the Swedish Board of Agriculture and the questionnaire, the relation between the number of grazing animals and type of animal. Number and %. "Other cattle" includes suckle cows, heifers, bulls and steers.

	No. in country	***%***	***No. in questionnaire***	***%***	***Prop. (%) in questionnaire***
Totally	1 686 154		82 687		4.9
Horses	355 500	21	1 261	2	0.4
Dairy cows	322 010	19	17 438	21	5.4
Other cattle	707 176	42	33 266	40	4.7
Ewes, rams	301 468	18	30 722	37	10.0

In the questionnaire, horses are underrepresented. The proportion of dairy cows and other cattle in the questionnaire corresponds with the statistics, but the proportion of ewes and rams is overrepresented in the questionnaire (table 14).

6.5.5. A summary of the questionnaire's representativeness

The questionnaire represents 2.5% of the Swedish farms (table 6). The questionnaire represents 1.3% of the small farms, 6.5% of the sheep farms, 2.4% of the cattle farms and 5.7% of the dairy farms.

4.2% of the Swedish area of ley or other temporary grassland and 6.8 % of the Swedish area of pasture (table 13) is represented.

4.9% of the grazing animals in Sweden (table 14) is represented in the questionnaire. Among the Swedish grazing animals, the questionnaire represents 0.4% of the horses, 5.4% of the dairy cows, 4.7% of other cattle and 10% of sheep.

Agriculture farms based on horses or goats are not represented at all in the questionnaire. Different crops cultivated for fodder as for example cereals and leguminous plants is not represented in the questionnaire.

When comparing the questionnaire with statistics from the Swedish Board of Agriculture is it:

- Too few agriculture companies in relation to the area of ley or other temporary grassland and pasture.
- Too few small farms in relation to the other types of farms.
- Too many sheep farms in relation to the other types of farms and to many sheep in relation to the other animal types and in relation to the number of sheep farms.
- The number of cattle farms is correct in relation to the other types of farms, the number of cattle is correct in relation to the number cattle farms and grazing animals.
- Too many dairy farms in relation to the other types of farms, the number of dairy cows is correct in relation to the number of grazing animals in the questionnaire.
- No horse farms and too few horses in relation to the other types of grazing animals.
- No goat farms and no goats are included at all.
- Too many grazing animals is represented in the questionnaire in relation to the number of farms.
- Too many sheep and too few horses are represented in the questionnaire, in relation to the other types of animals and number of farms.

7. Results

7.1. The representativeness of the questionnaire

Since the number of respondents in the questionnaire is not completely representative in comparison to the proportion of various farm types in general, it will affect the results. There is a risk to draw incorrect conclusions from the questionnaire. It is important to remember that the results depend on the respondents in the questionnaire and not on the real situation for farms in Sweden.

7.2. Hypothesis one

Hypothesis: The farms' preconditions (area of pasture, area of cultivated grassland, land consolidation, buildings, forest, geographical location) and the farmers interest, economy, driving forces and other factors determine how and what fields and pastures are grazed.

7.2.1. Question 1. Which grasslands are used for grazing?

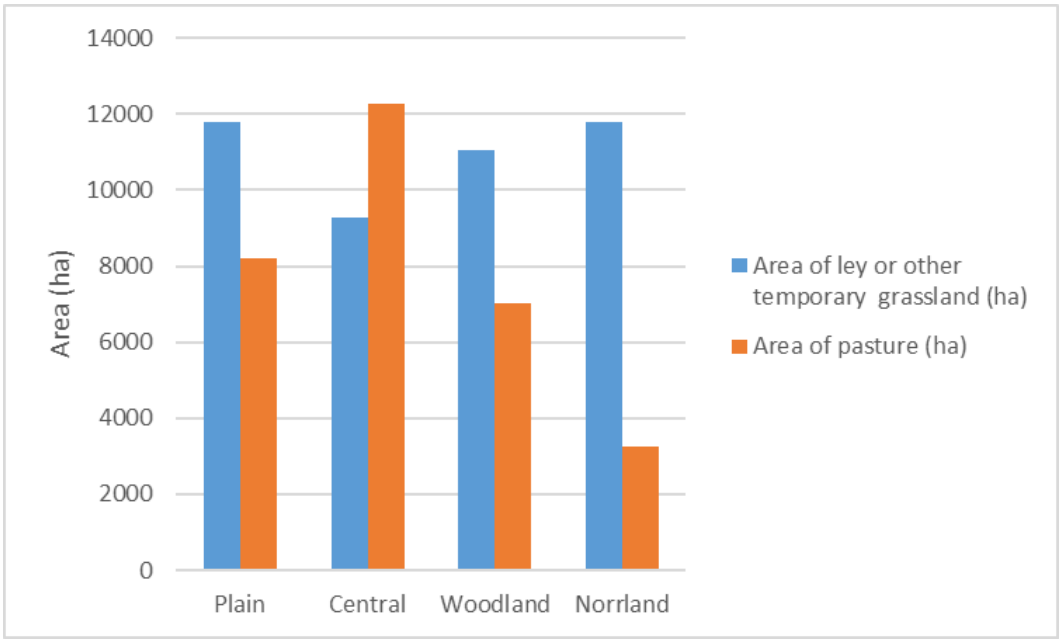

Figure 2. The relation between area of ley or other temporary grassland and pasture in different production areas according to the questionnaire.

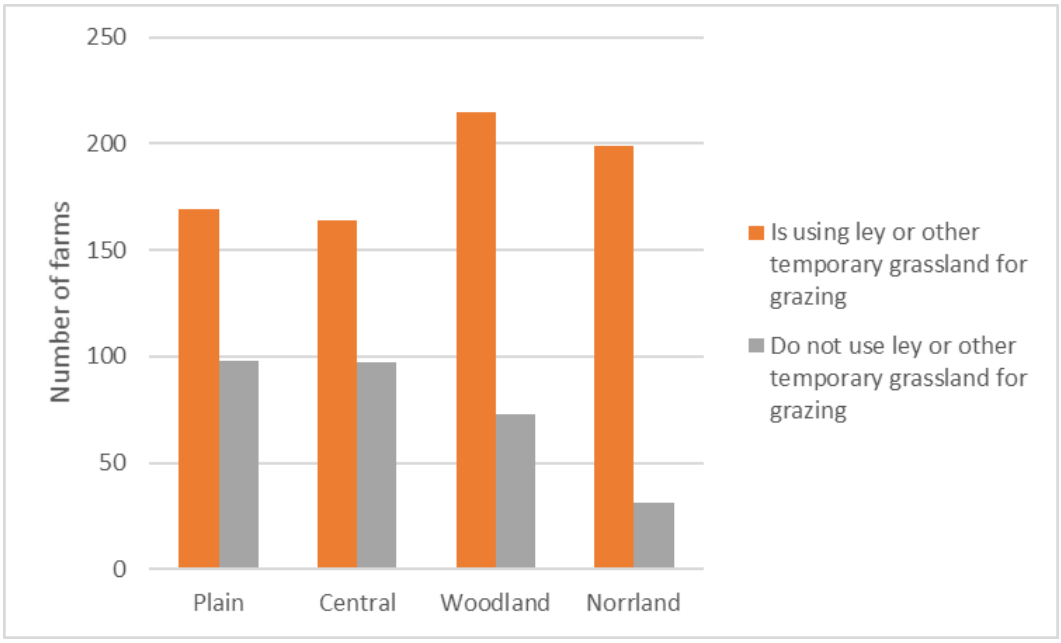

Figure 3. In the questionnaire one question was: "Do you use ley or other temporary grassland for letting your heifers, steers and suckle cows respective ewes and rams graze?" Yes or No. Heifers and young cattle in dairy farms are represented in the question, but not dairy cows.

To answer this question, the separation into four production areas was convenient. It clearly shows that the farms and the preconditions affect which grasslands are being grazed (figure 2 and 3).

Respondents from the central area together have larger area of pasture than of ley or other temporary grassland. Öland, Gotland and the south-east coast with large areas of pasture, for example alvar, is included in the central area. In the central area, the animals are also grazing ley or other temporary grassland, despite that the area of pasture is larger than the area of ley or other temporary grassland for the respondents.

From the respondents in the other areas, the area of ley or other temporary grassland is larger than of pasture. In Norrland it is a significant difference, and the respondents altogether have four times the area of ley or other temporary grassland compared with pasture. When comparing figure 2 with figure 3 it is correct that more ley or other temporary grassland is grazed if the area of ley or other temporary grassland is larger than the area of pasture.

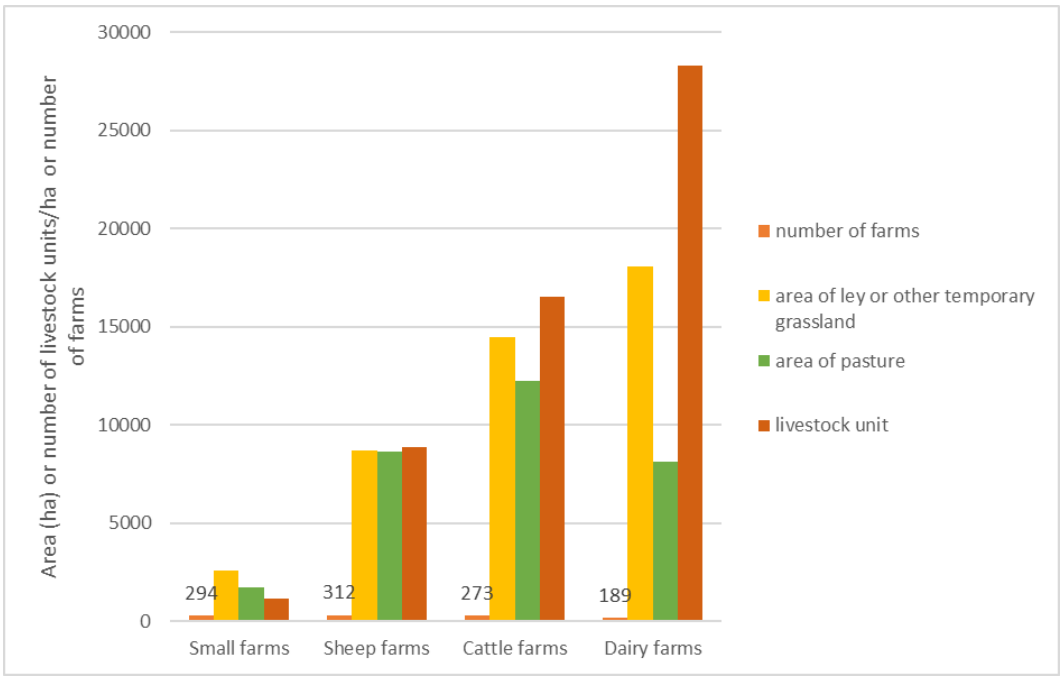

Figure 4. The relation between the number of livestock units and the area of ley or other temporary grassland and pasture for the respondents, categorised after farming type. Horses at the farms are included.

At sheep farms, the respondents have almost as many livestock units as they have hectares of ley or other temporary grassland and pasture (figure 4). At cattle farms is it 1.1 livestock unit/ha ley or other temporary grassland and 1.4 livestock unit/ha pasture (figure 4).

At small farms the area ley or other temporary grassland is twice as large as the number of livestock units and the area of pasture is 1.5 times as great (figure 4).

At dairy farms there is a lack of land in relation to the number of livestock units, if you assume that 1 livestock unit is sufficient for each hectare of land. There are almost 3.5 times as many livestock units as hectares of pasture and 1.5 times as many livestock units as there are hectares of ley or other temporary grassland (figure 4).

7.2.2. Question 2. What influences how farmers choose to let their animals graze?

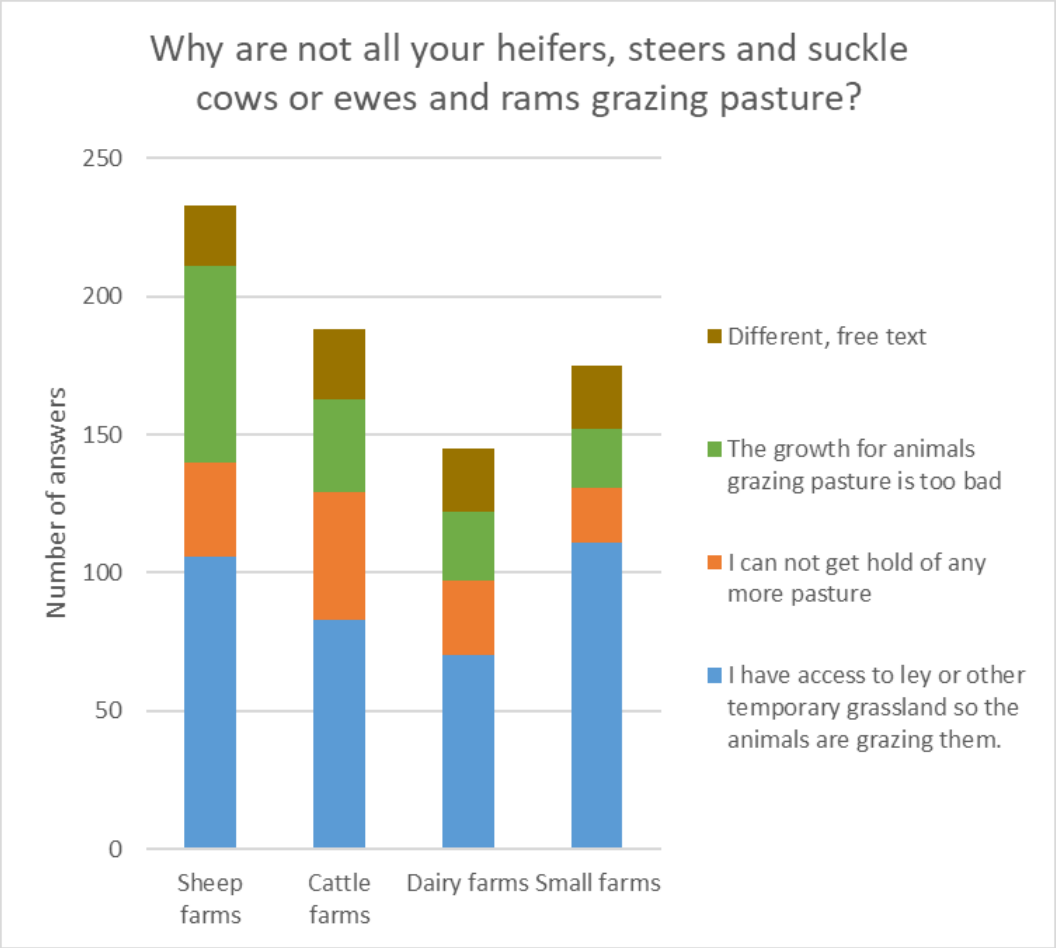

Figure 5. A question in the questionnaire was:" Why are not all your heifers, steers and suckle cows or ewes and rams grazing pasture?" Heifers and young cattle at the dairy farms are represented in the question, but not dairy cows. There were more answer alternatives for the question, but I have chosen to only present those alternatives that most farmers were answering.

Those who answered the questionnaire often chose to let their animals graze ley or other temporary grassland. Among the respondents of small farms, is it almost one third that prefer grazing on ley or other temporary grassland instead of pasture for their animals (figure 5). Among the respondents of sheep farms, is it a quarter that think the growth of the animals is too bad on pasture. Some of the respondents can not get hold of any more pasture. The questionnaire was designed so that it was possible to choose all answer alternatives or none.

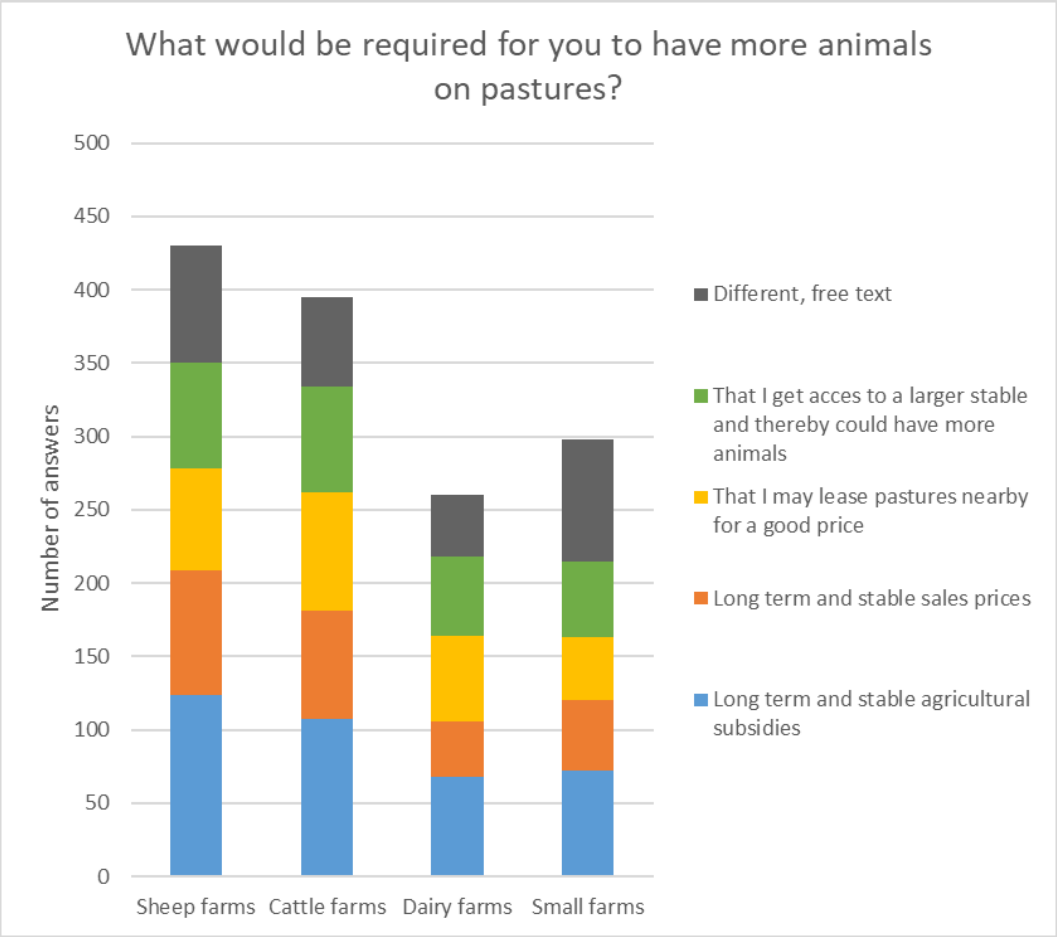

Figure 6. A question in the questionnaire was: "What would be required for you to have more animals on pasture?" There were more answer alternatives for the question, but I have chosen to only present those alternatives most farmers were answering.

For all four categories of farmers answering the questionnaire, economy and buildings are important (figure 6). Land leasing is also an important question for many. Also, many of the respondents have answered with free text. It is no big differences between farm categories. The questionnaire was designed so it was possible to choose all answer alternatives or none.

Table 15. The relation between farm category and the number of respondents mentioning too little time or no energy to graze pastures, in comments from the free text.

	Too little time or no energy to graze
Small farms with sheep	6
Small farms with cattle	3
Sheep farms	7
Cattle farms	6
Dairy farms	4

In the questionnaire, many have written in the free text that they do not have the time or energy to let their animals graze on pastures. Table 15 shows the distribution of comments on the subject between different farm categories.

Table 16. The relation between category of farm and the number of respondents mentioning the importance of age in comments in the free text.

	Age
Small farms with sheep	11
Small farms with cattle	1
Sheep farms	9
Cattle farms	10
Dairy farms	4

Many answering the questionnaires free text think they are too old or have mentioned that they are pensioners. Table 16 shows the distribution of comments on the subject between different farm categories.

Table 17. Number of farmers mentioning fencing, wild animals or parasites in the free text in relation to farmer category.

	Fence	***Predators***	***Wild boar/ geese/deer***	***Parasites***
Small farms with sheep	7	10	-	3
Small farms with cattle	-	2	1	-
Sheep farms	22	16	2	21
Cattle farms	7	-	3	-
Dairy farms	7	5	7	2

Sheep farms are standing out, since they have more problems with parasites in the pasture (table 17). Respondents with sheep farms also mention predators and costs of fences more frequently. Often there are comments on predator fences – which are expensive, hard to set up, maintenance or not entitled to subsidies from the County Administrative Board.

7.2.3. Comments on possible sources of error in relation to the questionnaire

- The small farms are underrepresented in the questionnaire, which affects figure 5-6 and table 15-17.
- The sheep farms are overrepresented, which affects the result in table 17.
- There are too many dairy farms in the questionnaire, which affects primary figure 5 and 6.
- There are too many dairy farms in relation to the number of other farms, but the number of dairy cows is correct compared to the number of grazing animals in the questionnaire. This affects figure 4, and the livestock density is even more dense and dairy farms larger and have more animals on the farms in general.

7.3. Hypothesis two

Hypothesis: Confusion of concepts affects the estimates of the pasture area. Different authorities, institutions and farmers have different definitions.

7.3.1. Question 1. How much do we know about how large areas that are being grazed or not?

Figure 7 shows an example map of a landscape square, with the GIS-layers from the inventories on top of each other. The green areas are grasslands inventoried in the aerial photo interpretation. The diagonally striped areas are agriculture blocks. The purple areas are objects from the TUVA database with Natura 2000 grassland-type. The green spotted areas are TUVA objects without Natura 2000. The blue spotted areas are land class/agri-environmental payments.

In this landscape square it is possible to see how different inventories and classifications are overlapping or not overlapping each other. Along the upper edge, in the middle of the line, there is an area with block and land class, but which is not inventoried in the aerial photo interpretation. In the right side of the map, there are TUVA fields which do not have block nor have been aerial photo interpreted. Most of the TUVA areas in this landscape square have Natura 2000 class and land class. The map shows that there are aerial photo interpreted grasslands that do not overlap with block.

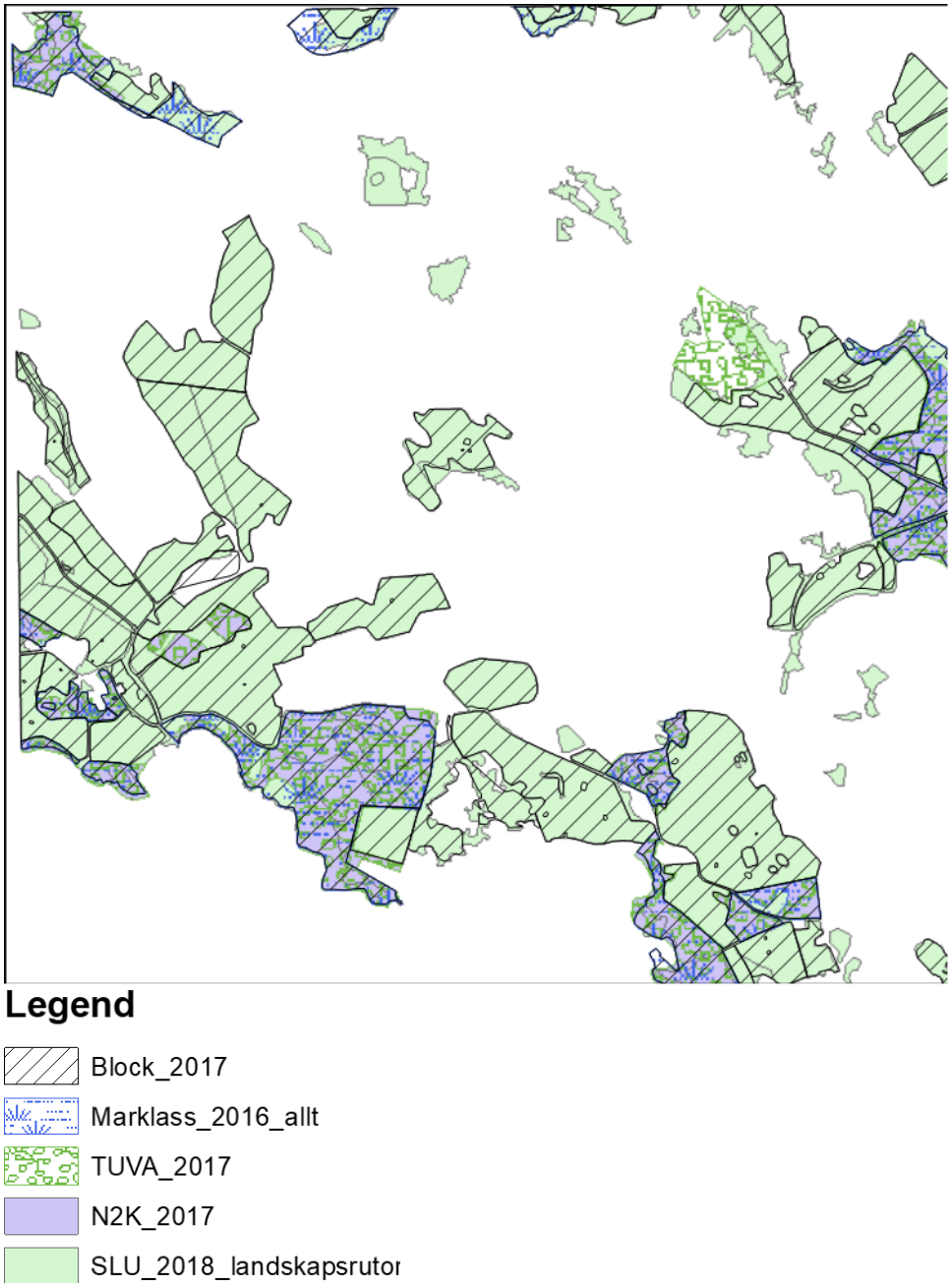

Figure 7. An example map of a landscape square, with the various GIS-layers on top of each other. The diagonally striped areas are agriculture blocks. The blue spotted areas are land class/agri-environmental payments. The green spotted areas are TUVA without Natura 2000. The purple areas are TUVA with Natura 2000 habitat. The green areas are grasslands inventoried in the aerial photo interpretation.

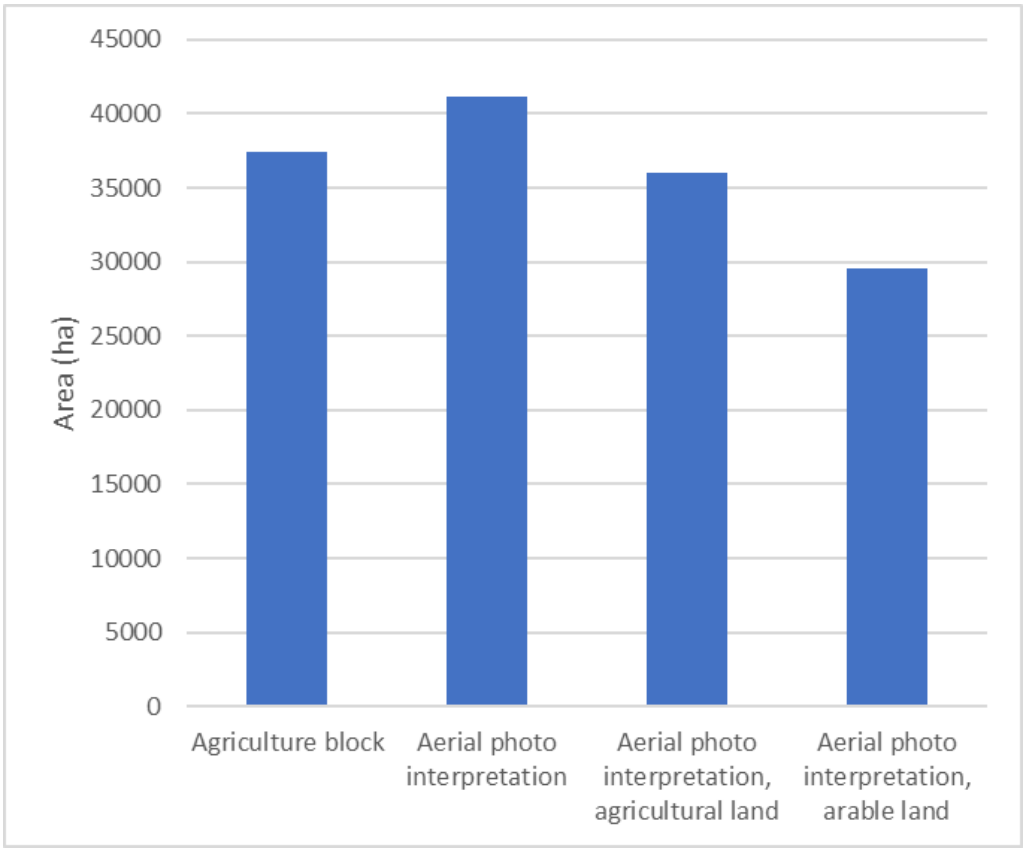

Figure 8. The total areas of different types of land within the landscape squares.

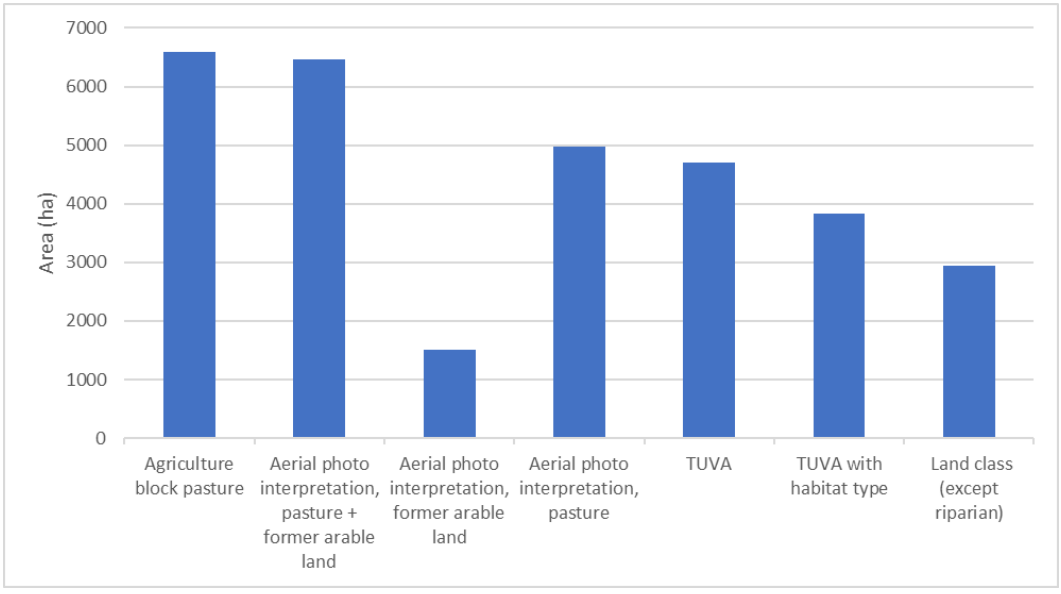

Figure 9. The total areas of different types of land within the landscape squares.

The GIS analysis gives the different inventories areas within the landscape squares. These landscape squares are part of a nation-wide statistical sample randomly distributed over Sweden's land area (figure 8 and 9). The map (figure 7) explains why there are differences in the areas. The different inventories have different aims.

Table 18. The area (ha) and percent of managed and unmanaged pasture according to the aerial photo interpretation.

Type of land	***Managed***	***%***	***Unmanaged***	***%***
Pasture	4041	81	927	19
Former arable land	595	40	899	60
Total area	4636	72	1826	28

A further in-depth analysis of the aerial photo interpretation was done in the analysis of the grazed areas. According to data from the aerial photo interpretation (table 18), is it almost 30% of the pasture area that is not being managed by grazing. Comparing the percentage, is it more former arable land that is not being grazed than for pasture. If the areas are compared instead, the area of non-grazed pasture is almost as large as the non-grazed former arable land.

Table 19. The relation between managing and unmanaging in different inventories where the area and percent overlaps with pasture from the aerial photo interpretation.

Pasture	***Area managed***	***Area unmanaged***	***% unmanaged***	***% managed***
Aerial photo interpretation	4041	927	19	81
Agricultural block	3392	337	9	91
Land class (except riparian)	1682	56	3	97
TUVA (all classes)	2073	209	9	91

When comparing the aerial photo interpretation of pasture areas that overlap with other inventories, is it possible to estimate the managed areas in other inventories. Pastures with agriculture block, land class or TUVA are grazed to more than 90% (table 19).

Table 20. The relation between managed and unmanaged areas in different inventories that overlap in former arable land from the aerial photo interpretation.

Former arable land	***Area managed***	***Area unmanaged***	***% unmanaged***	***% managed***
Aerial photo interpretation	595	899	60	40
Agricultural block	461	193	30	70
Land class (except riparian)	139	9	6	94
TUVA (all classes)	118	14	11	89

Among areas that overlap with former arable land in the aerial photo interpretation, is it between 6-60% that is not managed (table 20).

7.3.2. Question 2: What kind of values do the areas have?

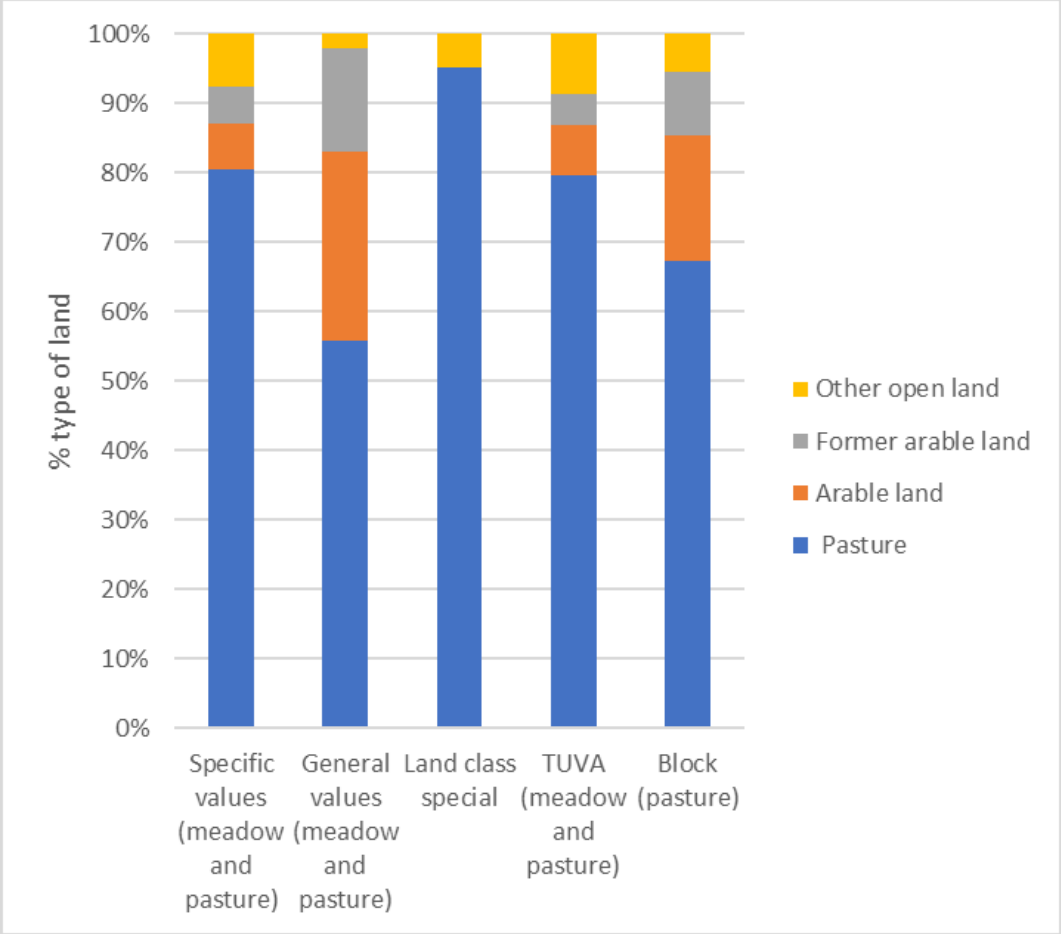

Figure 10. The relation between type of land in the aerial photo interpretation for the different inventories. Specific values and land class special are the higher levels of agri-environmental payments, and general values is the lower level. TUVA only contains pastures and meadows.

Within the land class special, is there no arable land or former arable land (figure 10). The largest proportion of arable land and former arable land is within general values, thereafter block pasture. The second smallest proportion of arable land and former arable land is within specific values and TUVA. The relation between pasture, former arable land and arable land is similar within specific values and TUVA.

Conclusion (figure 10).

If one uses the proportion of pasture, arable land and former arable land as a measure of the land values and assumes that pasture has higher values than previously ploughed land (arable land and former arable land), this can be used for a classification of value.

- What is classified as pasture in different datasets contains 10-45% former arable land or arable land, i.e. land that was previously ploughed. Land class special is an exception.
- The largest proportion of pasture is found in the land class "**special**", which is alvar grazing, mountain pasture, forested pasture, areas with sparse grass growth and sward/rock mosaic – fields that simply cannot be ploughed.
- The largest proportion of previously ploughed land are found in land class for **general values**. Pasture in the block database has a smaller proportion of arable land and former arable land.
- TUVA land and land class with **specific values** have very similar relationships between pasture, former arable land and arable land. In TUVA the proportion of pasture is higher than in pasture from the block database.

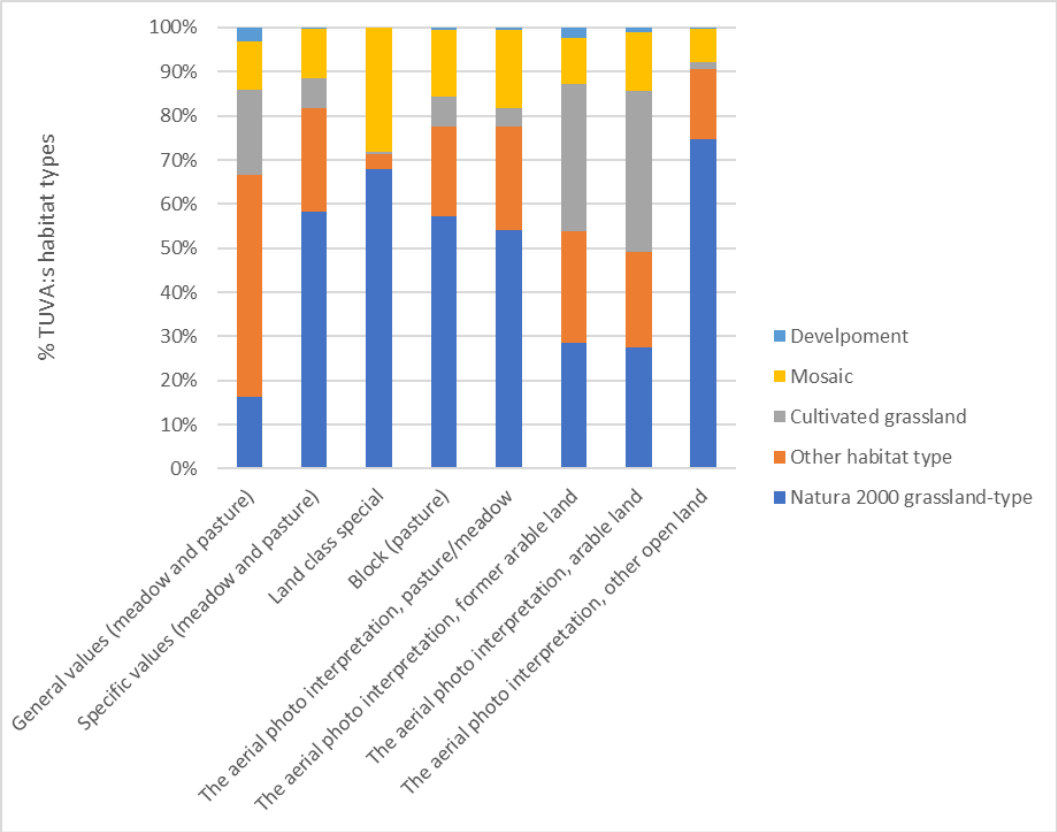

Figure 11. The distribution of TUVA:s habitat types within different inventories.

General values have the least proportion Natura 2000 grassland-type, less than land class **special** and **specific values** (figure 11). Areas which are arable land and former arable land have the second least proportion Natura 2000 grassland-type. Land class **special** have the largest proportion Natura 2000 grassland-type and mosaic, and that land class have almost none cultivated grassland or other habitat types. The largest proportion cultivated grassland is in areas that are or have been arable land and **general values**.

Conclusions about land classes within TUVA (Figure 11).

- Also land included in TUVA objects can be arable land according to the classification in the aerial photo interpretation.
- The proportion of Natura 2000 grassland-type is smallest for land with payment for **general values**.
- The proportion of cultivated grassland/pasture is largest for former arable land and arable land.

- The relation between habitat types within TUVA objects is similar in land class with **specific values**, pasture according to the block database and pasture according to the aerial photo interpretation.

Conclusion

If you assume that TUVA represents the finest pastures in Sweden, in that case there are more categories of pasture with a similar proportion of pasture compared to arable land and former arable land. Above all, land class **special** and **specific values**. It is also surprising that pastures in the block database seem to have a higher proportion of pasture land than land class with **general values**.

7.3.3. Question 3 and 4. Is the quality even within an inventory, and is there difference in quality between different inventories?

Within the land class special is the quality of the type of land most even. Almost all land is pasture or other open land according to the aerial photo interpretation (figure 10). When comparing land class special with TUVA:s habitat types the result is the same, most area have Natura 2000 grassland-type or mosaic (figure 11).

Within **general values** the variation is the largest, as over 50% is pasture and the rest is arable land or former arable land according to the aerial photo interpretation (figure 10). The variation is also large when comparing TUVA:s habitat types within **general values** (figure 11).

Within TUVA and **specific values**, there is about 80% pasture and 10% arable land and former arable land and 10% other open land according to the aerial photo interpretation (figure 10).

Specific values and block pasture have almost the same distribution of TUVA:s habitat types, as over 50% is Natura 2000 grassland-type and over 10% is mosaic and the rest is cultivated grassland (figure 11).

Within block pasture is about 65% pasture, 20% arable land, former arable land and the rest is other open land (figure 10).

The most interesting quality difference is that **general values** have a larger proportion arable land than block pasture (figure 10). **General values** also have the least proportion Natura 2000 grassland-type of all in the comparison (figure 11).

7.4. Hypothesis three

Hypothesis: Agri-environmental payments and other agricultural subsidies are important for the management of grasslands. We can improve the management of pastures and even graze more areas. It is an assumption that it is lack of grazing animals in Sweden, but we have an untapped resource in bulls bred on stables, which are exempted from the general requirements in Sweden that all cattle should be allowed to graze.

7.4.1. Question 1. How is the grazing management affected by agri-environmental payments and other agricultural subsidies?

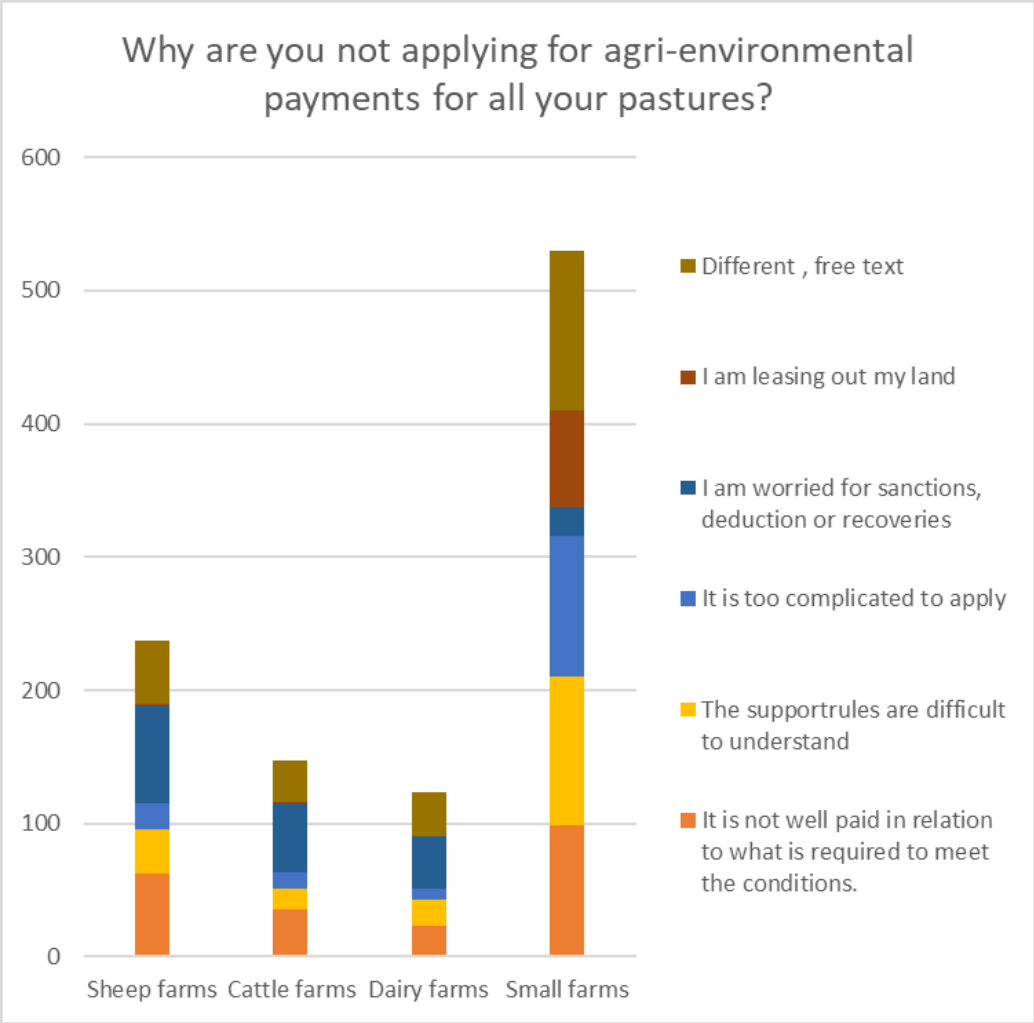

Figure 12. A question in the questionnaire was: "Why are you not applying for agri-environmental payments for all your pastures?" There were more answer alternatives for the question, and I have chosen to only present those alternatives that most farmers answered.

A question in the questionnaire was: “Why are you not applying for agri-environmental payments for all your pastures?” (figure 12). This question was only meant for those *not* applying for agri-environmental payments for *all* of their land.

More than double the respondents with small farms answered this question compared to the other categories of farms. The small farms answered with free text twice as much as other categories of farms. Small farms have answered that they are leasing out more pasture than the other categories of farms in the questionnaire. The respondents with small farms that have responded that the support scheme is too complicated and that the compensation is too low in relation to the work effort.

Sheep farms, cattle farms and dairy farms were more concerned over sanctions and deductions than the small farms.

Table 21. The total area of pasture for each category of farms in the questionnaire.

	Total area (ha)	***%***
Small farms	1 741	6
Sheep farms	8 632	28
Cattle farms	12 226	40
Dairy farms	8 144	26
Total	30 743	100

Table 22. Area and % own ownership pasture calculated on class center value for each category farmer in the questionnaire. Area leased or borrowed was calculated on class center value for each category of farm in the questionnaire.

	Own ownership (ha)	***%***	***Leased or borrowed (ha)***	***%***
Small farms	1091	63	650	37
Sheep farms	3858	45	4774	55
Cattle farms	5095	42	7131	58
Dairy farms	3937	48	4207	52
Total	13 981	45	16 762	55

The total area of pasture in the questionnaire is 30 743 ha, and on average 13 981 ha of that is owned by the farmers themselves (table 21 and 22). Over half of the area pasture is leased or borrowed (table 22).

Table 23. Leasing and ownership of pasture. The number of farmers which owns and leases pasture. A comparison between categories of farmers.

	Farmers that own all pastures	***Farmers that lease a part of the pastures***	***Farmers that lease all the pastures***	***Total number who have answered the question***
Small farms	52	170	21	243
Sheep farms	28	231	27	286
Cattle farms	19	194	22	235
Dairy farms	17	135	16	168
Total	**116**	**730**	**86**	**932**

Table 24. Leasing and ownership of pasture in %, a comparison between categories of farmers.

	Farmers that own all pastures (%)	***Farmers that lease a part of the pastures (%)***	***Farmers that lease all the pastures (%)***
Small farms	**21**	**70**	**9**
Sheep farms	10	81	9
Cattle farms	8	83	9
Dairy farms	10	80	10
Total of sheep, cattle and dairy farms	**9**	**81**	**10**
Total of all categories	**12**	**78**	**10**

It is 932 farmers that have pasture and also have answered the question about leasing land. It is only 12% that own all the pasture they have access to. 10% leases all the all the pasture they have access to. 78% of the farmers are leasing pasture (table 23 and 24).

The leasing question have also been mentioned in the questionnaires free text. I have counted the comments on landownership and land leasing which mention why one is not applying for agri-environmental payments on all the pastures one has access to (table 25). Often have the respondent expressed it like ”the landowner is applying for agricultural subsidies” or ”is not owning the land”. I have interpreted the comments that it is implicitly that the farmer is not able to apply for subsidies on that land.

Table 25. In the free text farmers have written comments on why they are not applying for agri-environmental payments on all the pastures they have access to.

	The landowner is applying for subsidies/is not owning the land
Small farms with cattle	1
Small farms with sheep	10
Sheep farms	21
Cattle farms	13
Dairy farms	12
Total	**57**

I have put together comments from the questionnaire's free text which are relevant to understand the problem with leasing and land ownership (figure 13).

Problems with land leasing

- It is difficult to get long term contract on leased land.
- Short-term, oral-agreements make it difficult to apply for agricultural subsidies with 5-years lease.
- It is difficult to apply for agricultural subsidies on leased land because the land leasing could be terminated.
- The landowner applies for the subsidies.
- It is expensive to build fences. Who shall pay for the fence costs?
- It is hard to agree on management with the landowner.
- Many (landowners) want to have paid, but none would like to put up fences, hardly even assist with water.

What the farmers wishes

- It would be better if the agriculture subsidies is paid for "grazing animals", so the subsidies gets to the animal holder and not the landowner.
- Better cooperation between farmer and landowner.
- More cooperation between more landowners so it would be possible to let larger groups of animals graze a large contiguous area.
- Give support for grazing and not to mow areas.
- Land belonging to other people and that is put in fallow should be available for grazing animals.

Figure 13. Comments from the free text regarding land leasing.

Farmers from all categories experience difficulties in applying for agri-environmental payments because of land ownership (table 25).

Figure 13 shows some of the comments dealing with land leasing and land ownership. The farmers specify both problems and suggest solutions.

Commitment plans

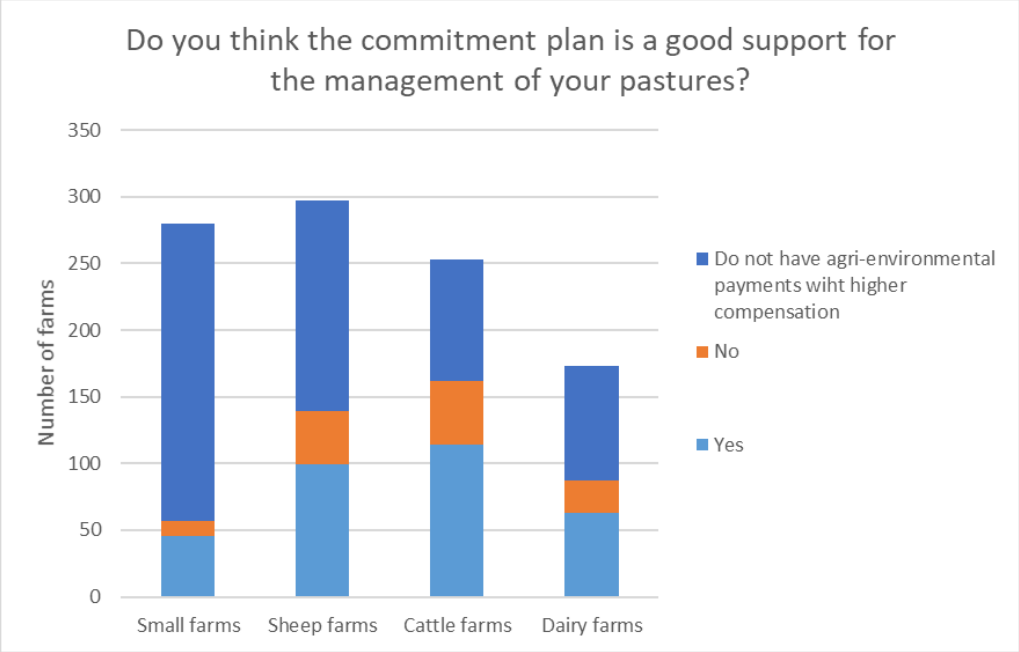

Figure 14. Those farmers that have agri-environmental payments with the higher level of compensation had to answer the question:"Do you think the commitment plan is a good support for the management of your pastures?". In the figure those without agri-environmental payments with the higher level of compensation are also presented.

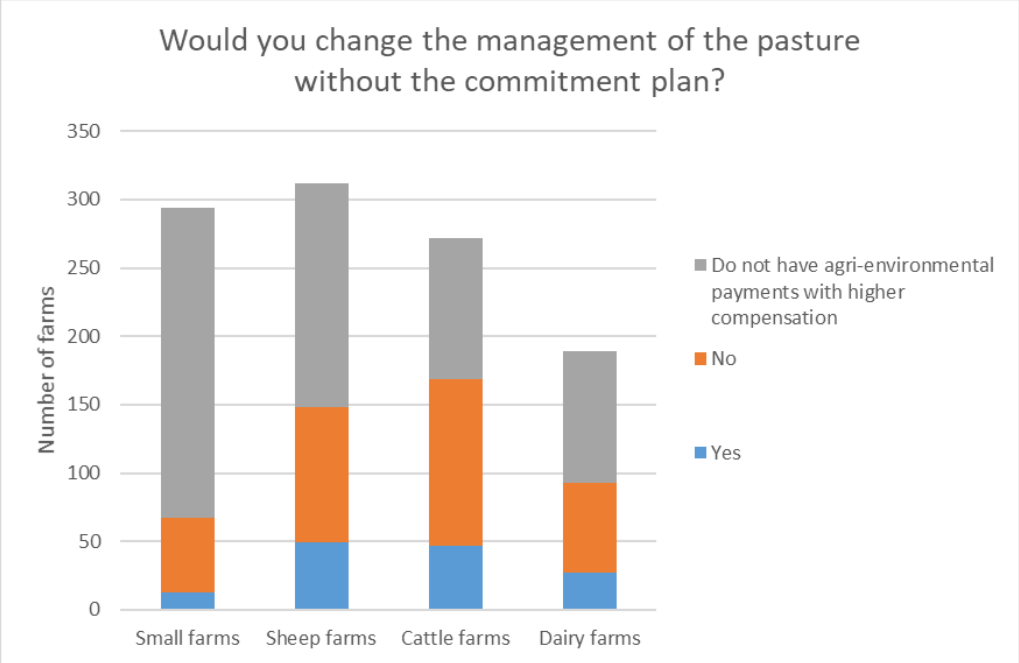

Figure 15. Those farmers that have agri-environmental payments with the higher level of compensation had to answer the question: "Would you change the management of the pasture without having the commitment plan?" In the figure those without agri-environmental payments with the higher level of compensation are also presented.

Questions about the commitment plan should just be answered by those applying for the agri-environmental payments with the higher level of compensation, but those without commitment plans are also presented (figure 14 and 15). 55% of the respondents in the questionnaire do not apply for agri-environmental payments with the higher level of compensation. It is mostly small farms and sheep farms that do not apply for agri-environmental payments with the higher level of compensation.

Of those applying for agri-environmental payments with the higher level of compensation 60% think that the commitment plan is a good support for management of the pasture. 70% are satisfied with the management rules (figure 14 and 15). All categories of farmers think that the commitment plan is a good support for the management and are also satisfied with the rules.

7.4.2. How can we improve the management of valuable pastures?

The direction of production

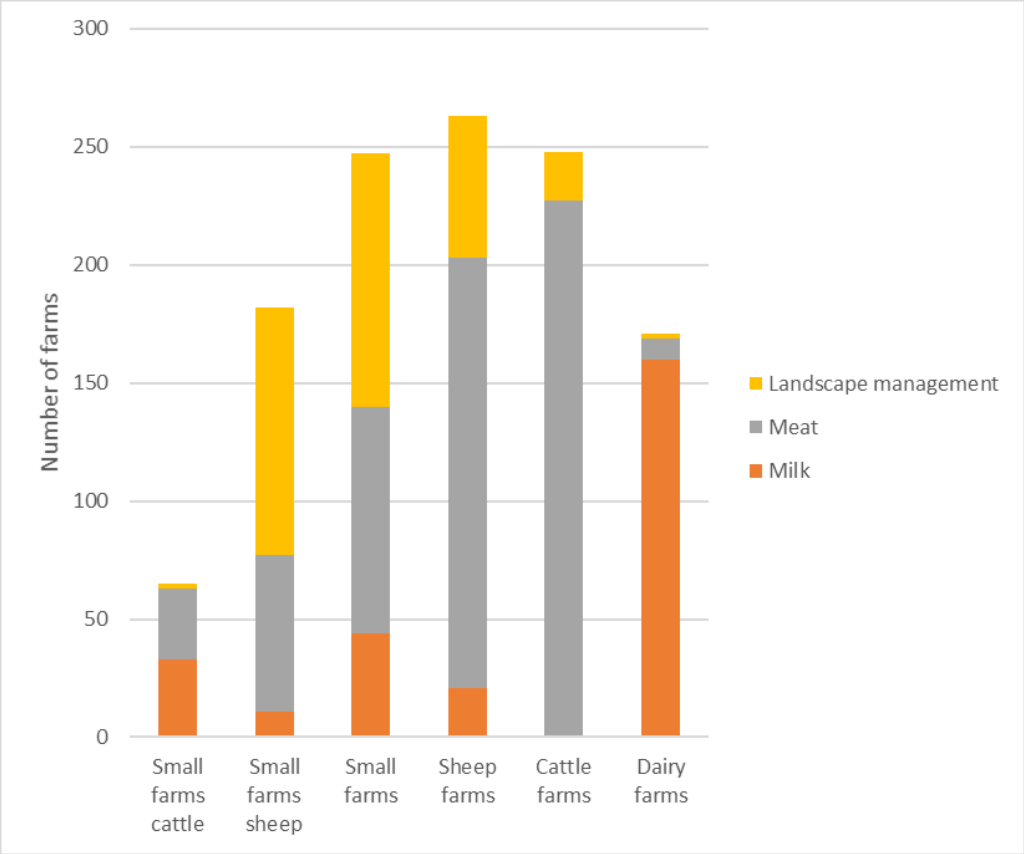

Figure 16. The relation between the direction of production and category of farms among the respondents.

The first question in the questionnaire was: ”Which is your main direction of production?” There were five different answering alternatives: Milk, Meat, Landscape management, Other (state what) and “I no longer have any animals”.

Landscape management as direction of production is most important among small farms with sheep and other sheep farms (figure 16). Small farms may also have animals for milk and meat production. Among the farms with sheep and cattle meat production dominates, and milk production dominates at dairy farms.

Rules for agriculture subsidies

Table 26. The number of farmers in the questionnaire who have access to 4 ha of agricultural land or less.

Area cultivated grassland and pasture (ha)	***Number of farmers***
0-1	7
1-2	26
2-3	12
3-4	22
Total	67

In the questionnaire respondents have written in the free text that the 4 ha rules to be allowed to apply for single payments’ scheme is a problem. Table 26 shows respondents who have 4 ha of cultivated grassland and pasture or less, in total 67.

General comments about agriculture from the questionnaire's free text.

I will finish the result part with some comments from the questionnaire's free text which I consider important, because they summarize many of the questionnaire's comments and my overall impression from the free text comments. I focus on comments on farming.

In general

- It is nice when the public is giving positive encouragement when the animals are grazing!

Requests to the authorities

- Pay out the agricultural subsidies on time.
- Offer more field advice.
- Evaluate and respect the farmer's knowledge.
- Consultation between farmers and government is best.
- Encourage more and give positive feedback.
- More dialogue and inspiration from the Swedish board of agriculture.
- Better consensus between the employees at the County board of administration.
- Less haves and rules.
- Higher compensation for natural pasture land, they are poorer in nutrition and give lower slaughter weight, it is limited how much you get support feed. The meat will be finer, but it is still poorly paid from the slaughterhouse.
- That the county board of administration and the Swedish board of agriculture inform the public about the importance of grazing animals in the landscape.
- Assign the county board of administration to find out how much pasture land needs to be grazed and bring together landowners and animal farmers.
- Provide higher compensation to the farmer, the bureaucracy costs too much

Figure 17. General comments from the questionnaire's free text.

There seems to be a desire for more mutual communication between farmers, authorities and the public. It also seems that the farmers want more positive meetings and more collaboration, besides better finances and predictability.

7.4.3. Comments on possible sources of error in relation to the questionnaire

Small farmers are underrepresented in the questionnaire. In the questions asked in this part of the essay, small farms are standing out. Maybe the differences between small farms and other categories of farms would be even larger if the respondent basis was more representative of how common the categories of farms are in Sweden in general.

The number of dairy farms and sheep farms are overrepresented in the questionnaire, which affects the answers as well.

The land leasing analyses is not based on exact numbers but class centre values. It would have been better to have exact number, and it would also have been interesting to know from how many landowners each farmer is leasing land.

The analyses of the free text are difficult, se comments in 6.4.

8. Discussion

8.1. The questionnaire

The ultimate solution would be if the questionnaire would have represented a certain per cent of all categories of agricultural enterprises, as well as the area of leys, pastures and grazing animals. However, to achieve this is probably difficult, because there are many parameters to take into account.

One reason for the lack of balance between categories of farms, types of grazers and land areas may be that the small farms are underrepresented. If more small farms had been represented in the questionnaire, the number of agricultural enterprises would have been higher, but not so much the number of animals or the area of ley or pasture. Then the figures would be slightly more even.

For six of the questions in the questionnaire, the farmers could choose to answer with free text. There were several fixed alternatives in the checklist, but in addition to that, many have written their own answers and given alternatives not included among the original alternatives. I don't know if there was a pilot study before the questionnaire was sent out, but perhaps that had been justified, since these new alternatives could have been identified and included in the predetermined alternatives. This would have made the questionnaire easier to analyse, and all respondents would have had more alternatives to choose from.

In the questionnaire, the respondents could choose to answer as many alternatives as they wanted. To understand what alternative is the most important when analysing the questionnaire, a scale from "I agree completely" to "I do not at all agree" could have been included, with a request to the respondents to answer all alternatives.

Of the farmers that received the questionnaire, more than 65% did not reply. It would be interesting to know why so many did not reply. Is it those who are not interested in using pastures for grazing, or is it those that do not have grazing animals? In either case, it would have been interesting to get more of the answers from that group. As a complement to the questionnaire, an analysis of the dropout rate would be useful.

8.1.1. Further studies

With the conclusions from this questionnaire, it would be interesting to send out more questionnaires. Based on this analysis, I have learnt that you need to know what information you need, what questions you want answered and how to use them, before you design a questionnaire. You need to formulate the problem and make an outline (Jakobsson & Westergren, 2005).

I would like to make two questionnaires, with these topics:

- Land ownership and leasing conditions for pastures
- Farmers' incentives and driving forces in relation to grazing

This is how I would like to approach it:

- Formulate the problem and making an outline
- Formulate what farmers I want the questionnaire to represent and strive to achieve a sample that is representative for that group
- Decide which questions I want an answer for
- Distribute the questionnaire online, so that the respondent must answer all questions to complete it
- Maximum 10 questions, so that the questionnaire can be completed quickly by the respondents
- Present the possible answers according to a scale from "agree completely" to "do not agree at all"
- Perform a pilot study and evaluate it before the final questionnaire is started
- Conclude with a free-text question that does not have to be analysed in combination with the other replies. Many interesting comments can come in this way.

8.2. Hypothesis 1

Hypothesis: The prerequisites of the farm (area of pastures, area of ley, leasing of land, spatial arrangement of agricultural land, farmland buildings, forestry incomes) and the interest, economy and driving forces of the farmer determine what land is grazed and how.

8.2.1. Question 1. What land is used for grazing?

Ley or other temporary grassland

If you compare Figure 2, which shows the area of ley or other temporary grassland and pasture for different agricultural production areas, with Figure 3, where the participants in the questionnaire have answered the question if they use ley or other temporary grassland for grazing, it is a clear pattern that the more ley or other

temporary grassland there is in the farm area, the more common it is that the animals graze on the ley or other temporary grassland. In the mosaic production area (Table 3), the area of pasture is larger than the area of ley or other temporary grassland, but anyway the farmers prefer to graze the ley or other temporary grassland, despite that the east coast, Öland and Gotland have alvar land and large areas of continuous pastures.

In Figure 5, which shows answers to the question ”Why don’t your grazing animals graze pastures?”, it can be seen that for each category of farmers, almost half of them reply ”Since I have access to grazing ley or other temporary grasslands, the animals graze there”.

Animal units per area

Figure 4 shows the relationship between area ley or other temporary grasslands and pasture and the number of animal units. For sheep farms, it is a 1:1:1 relation between the number of animal units, area of ley or other temporary grasslands and area of pastures, which means that it for each animal unit is 1 hectare of ley or other temporary grassland and 1 hectare of pasture. For each animal unit in cattle farms, there is 0.7 ha of pastures and 0.9 ha of ley or other temporary grassland, which means that there is 1.1 animal units per ha ley or other temporary grassland and 1.4 animal units per ha pasture. The proportions within the farm need to add together, and the number of animals must be adapted to the available area of land, so that there is enough winter and summer fodder.

The small farms have considerably more land in relation to the number of animals, and for each animal unit, they have 1.5 ha of pasture and 2.3 ha of ley or other temporary grassland (Figure 4). For many of the farmers, landscape care (”landskapsvård”) is the main driving force (Figure 16), which includes to keep the land open and to avoid overgrowth and succession to forest. There, the number of animals is not adapted to maximizing the use of fodder resources, but on the contrary, to use the minimum number of animals required to keep the landscape open.

In the dairy farms, there are much more animals than the available amount of fodder, 1.6 animal units per ha ley or other temporary grassland and 3.5 animal units per ha pasture, and for each animal unit there is 0.6 ha of ley or other temporary grassland and 0.3 ha of pasture (Figure 4). Many of the dairy farms in the questionnaire are big, with many animals at one farm, which leads to that the agricultural land close to the farm is insufficient. This means that more land has to be used at longer distance from the farm, which makes the animal feeding procedures more complicated, especially for grazing in pastures. For a dairy cow to produce maximally, it needs a mixture of hay from ley, cereals and protein-rich fodder (Gustafsson et al, 2013). The results show that the dairy farms either grow cereals or other fodder crops than ley, or buy fodder, or a combination of the two.

From the results of the questionnaire it is difficult to see how much other fodder the animals use.

8.2.2. Question 2. What influences how the farmers choose to use their animals for grazing?

The economy is important for all categories of farmers, also the small farmers (Figure 6). They want long-term and stable agricultural payment and sale prices.

They have indicated that they want to rent more pasture at a reasonable price (Figure 6). As the question is asked in the questionnaire, it is difficult to know if the land leasing price is too high now or if they do not get access to the land.

Access to larger stables is also an important issue (Figure 6). It is a little difficult to understand the purpose of the question, who's responsibility is it to fix larger stables? Is it basically about the economy of the farm being too poor for the farmer to be able to make such investments?

If one is to draw some conclusions about different production directions, sheep and cattle farms graze the largest total area of pasture. In the questionnaire, there are 312 respondents that I have classified as sheep farms and 273 as cattle farms. Together, they graze two-thirds of the pasture according to the questionnaire (Figure 4).

Cattle farms is the category of farmers who have the most difficulty in obtaining more pasture (Figure 5).

Sheep owners distinguish themselves from others in the questionnaire. Most sheep owners think that the animal's lower growth in pasture is a reason for not grazing pasture (Figure 5). It is also mostly the sheep owners who have written about parasite problems in pasture in the free text (Table 16). In total, 43 farmers mention fencing in the free text, of which 29 have sheep. Wild animals also cause some concerns for farmers, as 33 farmers mention predators, wolf, bear or lynx, of which 26 farmers have sheep. Seventeen of those who mention predators also mention predator fences that are both expensive and difficult to set up.

Small farmers (294 replies) graze the largest area of pasture per animal unit, 1.5 ha, but the total area is 6% of the pasture area included in the questionnaire (Table 21).

The dairy producers in the questionnaire are 189 and graze just under a third of the pasture included in the questionnaire, and each animal unit grazes 0.3 ha of pasture.

In total 35 farmers (Table 16) consider that they are too old to take on large projects such as restoration and fencing new pastures. Statistics from the Swedish Board of Agriculture show that 30% of agricultural holders are over 65 years of age (Jordbruksverket, 2019), and 26 farmers indicate that time and energy is a reason why no more pasture is grazed (Table 15).

8.2.3. Conclusions about hypothesis 1

My hope was that I would get clear answers to my questions and the hypothesis. What I have come to realize is that there are no clear patterns among those who answered the questionnaire. In a way, it supports my hypothesis that *the farm's conditions – area of pasture, area of ley or other temporary grasslands, spatial arrangement of agricultural land, buildings, forest, geographical location and the farmer's interest, finances, driving forces and ideology - are what influence which fields the farmer chooses to graze.*

Several studies show that the variation between farmers and farms is large. In an article by Cederberg et al. (2018), did farmers who participated in workshops on natural pasture calculations point out that there is a large variation between costs and yields between farms and pastures. It is believed that it is more important to understand and elucidate the variation than to make calculations with larger datasets, as it will not reduce the variation in the results.

In a report from WWF, "Naturbetesbönder 2017" by Jennersten (2017), 11 farmers who manage seminatural pastures with grazing were interviewed. What is common to the interviewees is that it is landscape and nature conservation that are their driving force and not economy. Although the driving force is the same for all 11 farms, production and income look completely different for each place - the conditions of each farm and farmer are different.

According to Ahnström (2009), there are many factors that influence farmers' decisions such as social norms, finances, farm history, heirs etc., which in turn affects the relationship with nature and agri-environmental payments.

This is in line with my results from the questionnaire which do not show any clear patterns in relation to the questions asked.

Nitsch (2009) also shows that there are many factors besides rules and money that affect the farmer's business, especially qualitative values such as freedom, proximity to animals and nature, stewardship and social relations. In one of the in-depth interviews in Nitsch's (2009) questionnaire, a farmer says "There is not one farm or pasture in Sweden which is similar to the other".

8.3. Hypothesis 2

Hypothesis: The conceptual confusion affects how the area of pasture turns out. Different authorities and institutions have different definitions, and farmers have their definitions.

8.3.1. How much do we know about how large areas are grazed or not grazed?

Conclusions about grazing management (table 18-20)

- According to data from the aerial photo interpretation, 30% of the pastures are not any longer managed by grazing
- Out of this area, it is mostly the former arable land that has been left without management, which is the case for all datasets.

The Swedish Board of Agriculture has used the National Forest Inventory to analyze the change in land use since the late 1980s. Based on this, 67% (about 330,000 ha) of what was pasture in the late 1980s is still pasture, and the rest has been converted into forest or arable land. Of the area that was arable land, 3% (100,000 ha) have changed to pasture land. This means that the total area of pasture is unchanged, but that the average quality of the pasture has deteriorated. In some pastures that have never been ploughed or fertilized, grazing has ceased, followed by overgrowth with trees or planting of forest trees (Wallander et al. 2019).

Even though the decrease in grazing seems to continue, it is good that former arable land is abandoned more often than pasture land.

8.3.2. Conclusions about hypothesis 2

When talking about pastures, I think many see a variety of seminatural pasture, with uneven ground, stones, trees, shrubs and maybe some pond or landscape elements and a wide variety of plants. But that's not how all pastures look.

My results show that the different categories of pasture contain previously ploughed fields in varying proportions. That is surprising when comparing with the definitions for the different inventories, see chapter 5. According to the definitions should none of the inventories contain arable land or former arable land.

My hypothesis is that pastures are defined differently by authorities and institutions. I have made a figure of how I perceive the concept of pasture (figure 18) and a compilation of different definitions when talking about pasture land (Figure 19). With this I want to show that it is difficult to find out the actual area of seminatural pasture in Sweden. Aerial photo interpretation might distinguish that type, but that inventory is not comprehensive but based on sampling, and it is also a bit unclear if land that has been ploughed can be included.

I also want to show how I perceive different definitions (Figure 18). Seminatural pasture is defined based on the soil's characteristics and farming history, but the flora need not be rich. There are more types of values included that do not need to be associated with species, e.g. cultural values, landscape elements and buildings.

Natura 2000 grassland-type, unlike the concept of seminatural pasture, are mostly defined based on flora values and vegetation type, though the area must not

be affected by fertilization or extensive ploughing and harrowing (Gardfjell & Hagner 2017).

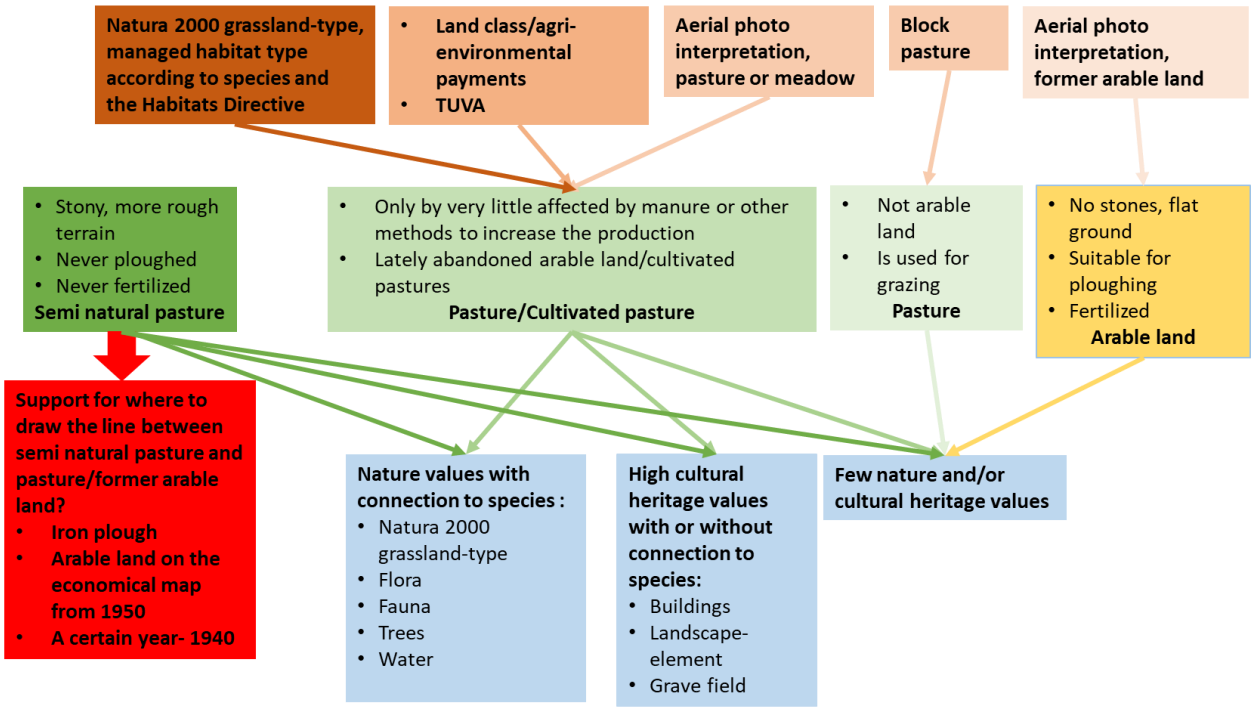

Figure 18. The type of land and minimum requirements for the different inventories. No inventory is focused on just seminatural pastures.

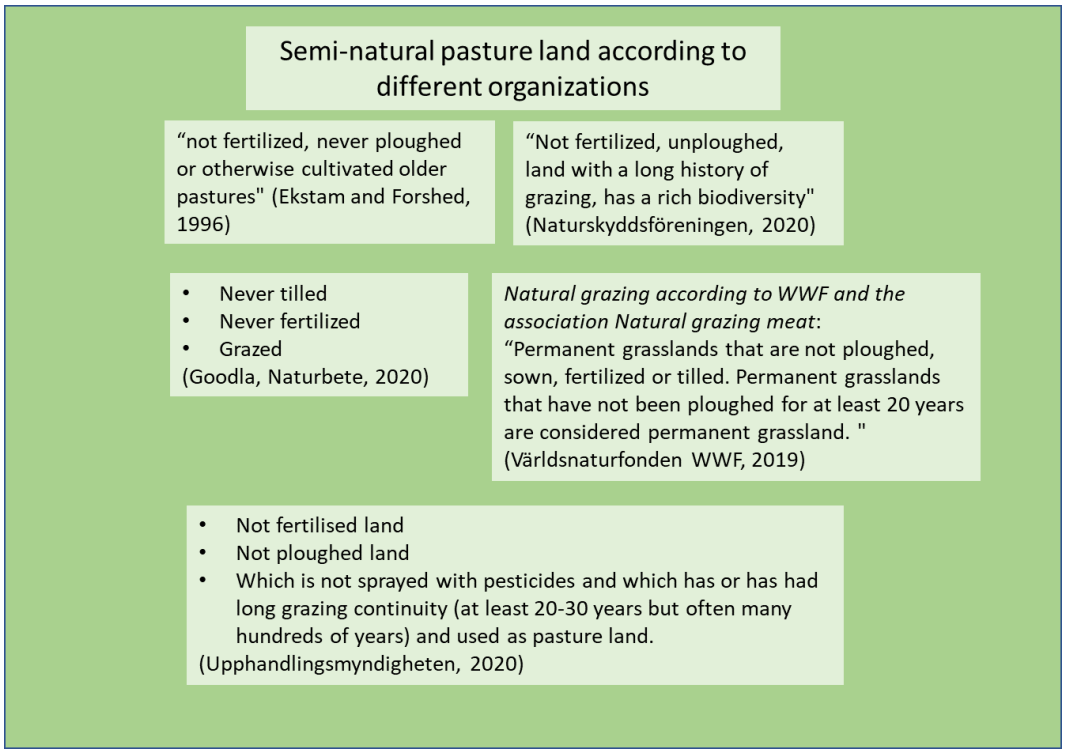

Figure 19. A collection of definitions used for various types of pastures.

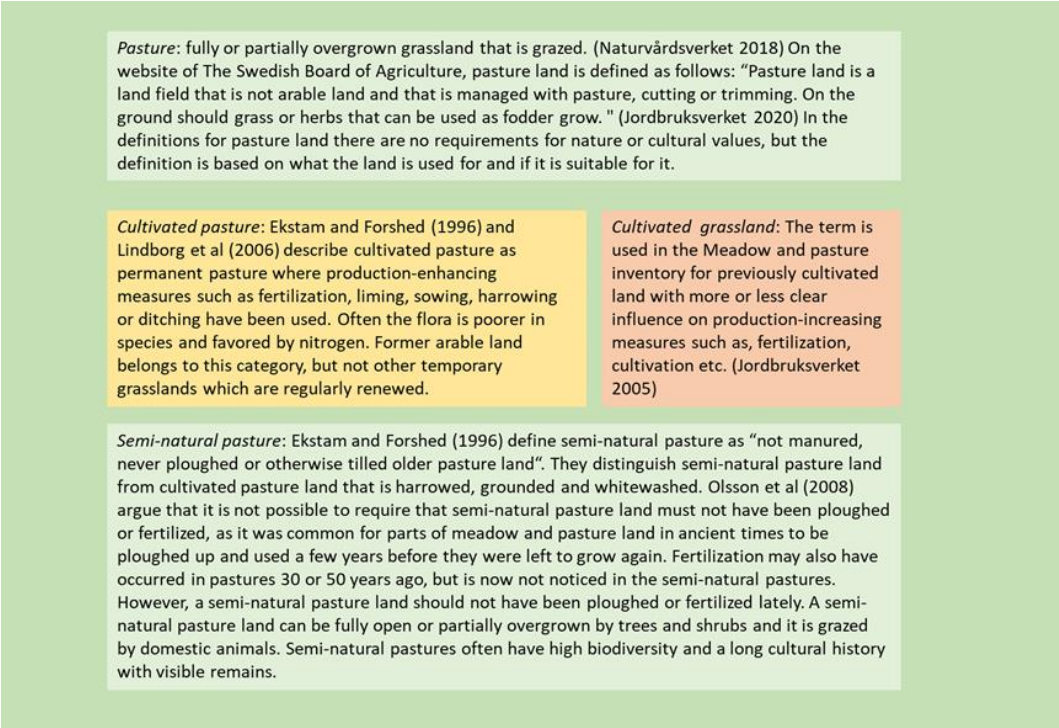

Figure 20. Definitions of seminatural pasture according to different documents and authorities.

The Swedish Board of Agriculture and the Swedish Environmental Protection Agency have no formal definition of seminatural pasture that they use in the work with farmers and support systems. The Swedish Board of Agriculture has a pasture definition where the boundary between arable field and pasture is primarily about the management method, not the conditions of the land (SJVFS 2017: 34).

For the boundary between seminatural pasture and other types of pasture, more criteria are needed, and a seminatural pasture has so many more structures that a pasture on former arable land does not have. For many farmers, it can be considered to be arable land even if you do not plough it. But also, the opposite, when the managing intention for the arable land is changed to grazing, the land type could be changed in the block database despite that the land is the same.

It is interesting that many organizations and authorities have definitions for seminatural pasture, which for example is used for various products (Figure 20). There is a need to know if a land is seminatural pasture. If products are marketed as a product of seminatural pasture, you need to have good criteria for which lands are seminatural pasture.

It is not possible to automatically assume that either pasture according to the block database, land class with agri-environmental payment or objects in the TUVA database are all seminatural pastures.

8.4. Hypothesis 3

Hypothesis: Agri-environmental payments and agricultural support are important for the management of pastures. We can improve the management of pastures and also use much more land for grazing. There is much discussion about the lack of grazing animals, but at the same time we have an unused resource in bulls raised on stables.

8.4.1. Question 1. How is grazing management influenced by agri-environmental payments and other support to farming?

More than twice as many respondents with small farms compared to the other categories of farms have answered the question of why they are not applying for agri-environmental payment for all their land (Figure 12). Most of the answers are that the rules are difficult to understand, that it is complicated to apply and that it is too little paid in relation to what is required to fulfill the conditions. It is common to hire a consultant to make the EU application, but if you have too little land area it probably does not pay enough, and some may not want to make the application themselves.

Many of the respondents with small farms have written free text in the questionnaire. What is surprising is that so many small farms are leasing out the land (Figure 12), which may be because they have their own animals on the ley or other temporary grassland and leasing out the pasture. Among full-time farmers, they are more worried about control (Figure 12). I think that they more often apply and depend more on the money, so controls with possible sanctions are more of a concern.

Leasing of land

A prerequisite for being able to apply for agri-environmental payment for a pasture is that you have access to the land for at least 5 years. The results of the questionnaire show that a large part of the pastures is leased or borrowed, and that almost all farmers lease land (Table 22-24).

This, I think, is a major obstacle to both the farmer's economy and the opportunity to graze more land. Boke Olén, Brady and Larsson (2020) discuss what is needed for more pasture to be managed, and the conclusion is that profitability is important and that agri-environmental payment should be directed to the most valuable land. I think it is more complicated than just raising the payment, and it is also important that the money ends up with the person doing the job, regardless of who owns the land. If the farmer does not get a long-term contract on the pasture and does not dare to enter into a five-year commitment, it will not help to increase the payment.

Many farmers wish that the payment would go to the animal owner, and this would be a convenient way to get around the problem with who owns the land. Cederberg, Henriksson and Rosenqvist (2018), discuss different types of payment and argue that some of the current Agricultural subsidies in some cases counteract each other, and it is also important to look closely at the effects of a payment, so that support to animal owners also is linked to the area of pasture. Otherwise it may be that the density of animals increases instead of the area of pasture.

The free text of the questionnaire shows that some farmers do not even want to discuss the issue of land leasing and Agricultural subsidies with the landowner, so it seems to be a difficult and sensitive issue (Figure 13). Many have also written that there are discussions with the landowner about the management and the fencing on land owned by others. In many commitment plans, there is a requirement that successional trees and shrubs be cleared or trees removed, and it has been commented that this makes it difficult if the landowner does not agree to that.

One of the in-depth interviewed farmers in Nitsche's study (2009) argues that the payment must be area-based in connection to the animals. If the payment is raised based only on area, there is the risk that landowners raise the rent, and if you instead give an animal-based payment, it benefits the farmers and there is a risk that

the farms in plain districts with better production conditions outcompete farmers in forest-dominated districts.

One solution to this problem of payment is the certification of meat from seminatural pasture and the new procurement criteria for meat from seminatural pasture. This can lead to that the public sector can choose that type of meat, which may increase demand. Hopefully, the farmer gets better paid for certified seminatural pastures, which could be a solution to get around the problems with land leasing and agri-environmental payments. Farmers also demand better profitability and better payment for their products, a combination of higher agri-environmental payment and higher kilo price for meat from natural pasture is perhaps a solution? Certification of seminatural pasture for meat means that it becomes even more important what we define as seminatural pasture.

Commitment plan for agri-environmental payment

About 70% of respondents that apply for agri-environmental payment answered that the commitment plan provides good support for the management of pastures land and would continue with the same management even without it (Figure 14-15). Most small farms and sheep farms do not have agri-environmental payment with the higher level of compensation. This could be because they have too little land for it to be economically sustainable, and in order to be able to apply for Single Payment Scheme you must have at least 4 hectares of agricultural land.

8.4.2. Question 2. How can we improve the management of pastures with high natural values?

Small farms

It is mainly sheep-owning small farms who have landscape values as their main production focus (Figure 16). At the same time, small farms let the animals graze on ley or other temporary grassland (Figure 4-5). There are also many small farms who do not apply for agri-environmental payment (Figure 14-15). Those who focus on landscape values let the animals graze on ley or other temporary grassland and do not apply for agri-environmental payment. How does this fit together? In the free text there are comments that can partly answer the question. In order to receive Single Payment Scheme, you must use at least 4 hectares of agricultural land, which disadvantages small active farms with less area than 4 hectares. Of the participants in the questionnaire, 67 have a maximum of 4 ha of pasture and ley or other temporary grassland altogether (Table 26). The support systems would need to be adapted more to small users, and also the application process would need to be simplified so that it pays to apply for payment even for those with less area. The small farms in the questionnaire only have about 6% of the pastures included in the questionnaire (Table 21). But the small farms are under-represented in the sample

of the questionnaire, so the actual proportion of pasture they graze in Sweden is probably larger.

As the category of small farms has a larger area of pasture per animal unit (Figure 4), the grazing impact is different and more extensive, which can favour certain wild plant and animal species, and it in any case contributes to variation in management. It could also be that small farmers graze small pastures that full-time farmers are not interested in, or fields that are remote or inconveniently located. If you look at the example landscape square (Figure 7), there are small solitary grasslands that are identified by the aerial photo interpretation, but which are not included in any other datasets and which are also not included in the block database of the Swedish Board of Agriculture. These could be the land which is managed by small farms without Agricultural subsidies. So even though the total area of pasture grazed by small farms is small, their quality or geographical location can be important!

Appreciate and encourage grazing of seminatural pastures

Farmers want more positive feedback and appreciation for their efforts, both from the public and the authorities (Figure 17). Farmers want authorities to inform the public about the importance of grazing animals in the landscape. Stenseke (2017) states that people want meadows and pastures to be preserved and want to contribute to preserve these lands, but do not know how to do it in concrete terms.

Many farmers also want more advice and inspiration, especially from field visits. A report from the Swedish Board of Agriculture also highlights the need for information, advice and skills development to develop and preserve the cultural landscape's natural and cultural values (Wallander et al. 2019).

Farmers also want more dialogue and consultation with all types of staff, advisors and inspectors. Farmers want the consensus between the county administrative staff to be better, that supervisors and advisers, all hold the same line. Furthermore, it is wished that the County Administrative Board could find pastures that need grazing and bring together landowners and animal owners (Figure 17).

My own view of the comments from the questionnaire is that farmers not only want more compensation, but also recognition and appreciation for making an important contribution to the environment when grazing pastures.

Conclusions, summarized in three points

- The profitability for grazing pastures needs to be improved. It is not as simple as just raising the level of agri-environmental payments, it is also important that the money reaches the right target group, the farmers who are responsible for the care of the animals all year round. Farmers prefer to be payed for the food they produce. One way forward is to combine

agri-environmental payment with certification of meat production from seminatural grazing, if this opportunity exists.

- Encourage and appreciate farmers that let their animals graze seminatural pastures.
- Favour small farms. Adapt the Agricultural subsidies so that also small farms can apply Single Payment Scheme, and simplify the applications so that it is more profitable to apply for small farms, for example by lowering the area limit (for Single Payment Scheme) to 2 hectares and perhaps offer free support for application for farmers with small farms.

8.4.3. Conclusions about hypothesis 3

Grazing is affected by the agricultural payment and subsidies, but also the authorities' and society's attitudes to agricultural use of pastures. The importance of appreciating the farmers' efforts and valuing and encouraging the efforts for nature conservation should not be underestimated (Figure 17). You need to be more clear about what benefits biological diversity and ecosystem services and what is less suitable for the climate and animal welfare.

This analysis shows that some pastures are not managed by grazing (Table 18-20). In addition, there seems to be more pastures than are included in the block database of the Swedish Board of Agriculture (Figure 7). How can we use them for grazing? If we can make use of all animals that are adapted to feed by grazing grasslands, then we would have enough grazing animals in Sweden already today. At present, bulls are exempted from the requirement that all cattle must graze during some period during the year (Djurskyddsförordningen 2019:66). If the bulls were released for grazing (as bulls or steers), the number of grazing cattle in Sweden would be twice as high as today (Table 27), at the same time as there would be much benefits for animal welfare and biological diversity. One possibility is also that females are favoured at insemination, to get more heifers to graze rather than bulls (Marby, 2009).

Table 27. Number of grazing animals in Sweden 2019 in total and presented as livestock units according to Blom (2009) and Perhson (2001). I have assumed that the livestock units are the same for bulls as for steers and heifers. Similarly, I have used the same livestock units for rams as for ewes. Calves under 1 year and lambs were not included in this calculation.

Animal type	***Number of animals 2019***	***Livestock unit (DE) per hectar***	***No. of animals presented as DE***
Dairy cows	305 570	1	305 570
Suckling cows	210 086	0,9	189 077
Heifers, steers, bulls	500 009	0,75	375 006
Calves under 1 year	450 630	-	-
Ewes, rams	279 888	0,3	83 966
Lambs	269 002	-	-
Horses (year 2016)	101 247	0,65	65 810
Total			**1 019 429**

Theoretically, one livestock unit may graze 1 ha of pasture (Table 5). If you count bulls that also could be used for grazing, then the total number of livestock units corresponds to just over a million hectares of pasture. This is also equal to the total area that Swedish Species Information Centre considers necessary for long-term conservation of species in grasslands (Table 1).

Studies show that if there is good access to seminatural pastures with environmental payment for **specific values**, bulls that are castrated (i.e. steers) and fed on natural pastures during two seasons are more profitable than intensive production of bulls on stables (Hessle et al. 2009).

There are many opportunities for preserving pastures in Sweden, but some changes in the support systems and production methods are required.

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Acknowledgements

A great thanks to my supervisors Anders Glimskär and Matthew Hiron. You are as a personal trainer in essay writing. When I get stuck, you support me and challenge me to ask more questions and seek other answers!

Thanks to Merit Kindström for GIS material!

Thanks to Jan Hultgren and Linda Keeling for valuable comments on how I can get structure.

And last but not least, thank you to my family that tolerate in my ups and downs during the essay writing!

Appendix 1

- **Pastures or meadows** contain three subgroups:
- **Arable land** contains three subgroups.
- **Former arable land** contains two subgroups.
- **Constructed or artificial land**
- **Other terrestrial open land**
- **Land with closed forest, active forestry or shrubland**
- **Semiaquatic wetland without closed forest**
- **Aquatic land with permanent water**

Table Land types in the SLU grassland monitoring programme and the aerial photo interpretation For further explanation, see Glimskär & Skånes (2015).

Main land type	**Code**	**Land subtype**	**Groups**
Seminatural pasture or meadow	11	Managed pasture or meadow	Pasture
	12	Unmanaged pasture or meadow	Pasture
	13	Rocky outcrop influenced by grazing	Pasture
Arable land and former arable land	21	Arable land used for arable crops or ley	Arable land
	22	Arable land with permanent grazing or mowing	Arable land
	23	Unused arable land	Arable land
	24	Former arable land with permanent grazing or mowing	Former arable land
	25	Unused former arable land	Former arable land
Constructed or artificial land	31	Agricultural area (except arable land)	Constructed land
	32	Transportation area	
	33	Residential or commersial area	

	34	Industrial area	
	35	Recreational area	
Other terrestrial land with human or natural disturbance	41	Natural rocky outcrop	Other open land
	42	Terrestrial land influenced by harsh climate or natural disturbance	
	43	Terrestrial land influenced by other land use or human disturbance	
Land with closed forest, active forestry or shrubland	51	Terrestrial land influenced by forestry	Forest or shrubland
	52	Terrestrial closed forest without forestry	
	53	Terrestrial land with successional forest or shrubland	
	54	Semiaquatic land influenced by forestry	
	55	Semiaquatic closed forest without forestry	
	56	Semiaquatic land with successional forest or shrubland	
Semiaquatic land without closed forest	61	Peat-forming land (mire) not by shore	Open wetland
	62	Peat-forming land (mire) by shore	
	63	Other semiaquatic land not by shore	
	64	Other semiaquatic land by shore	
	65	Semiaquatic land influenced by other land use or human disturbance	
Aquatic area	71	Aquatic area not in mire	Water
	72	Aquatic area within mire mosaic	