



Annex 4 - Drivers and motivations for land-use change in the Danish case

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MOSAIC

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Abstract

This chapter has investigated drivers and motivation of afforestation in Denmark. It is based on literature from the case area, two MSc theses, a qualitative study done in parallel to MOSAIC by colleagues, and a quantitative study inspired by the qualitative. Additionally, interpretations have been related to discussions in the policy lab, especially the event “Skovkonventet 2025” where the ambition of how to reach a policy goal of afforesting 250.000 ha was heavily discussed.

The development in land prices is a main driver identified as both a motivational factor and a barrier: there are many competing land uses, and this drives up land prices. At the same time, private amenity values play an increasing role, and this is found to be capitalised in the land price. Hence it can also act as a lever.

Competing land uses is also reflected in competing incentives (e.g. subsidies for afforestation and for extensive grassland) which compete for the same land. This can act as a barrier for the individual goal – here afforestation.

Turning to the motivations, private amenity values in the form of joy of ownership, nature interests, hunting and own outdoor recreation are found as main motivational factors in both the qualitative and quantitative studies. Potential forest income only play a smaller role. Among the barriers, the need of land for agricultural production is found to be a main barrier, along with the associated opportunity costs. Afforestation in Denmark comes with a permanence restriction. This is also seen as a main barrier among landowners and other stakeholders. Not least in the uncertain world, where both market and policies may change in the future. This latter point is hence investigated further in D3.2.

1 Context and framing of the land-use change

The Danish policy lab (LP) is situated in a context of currently politically driven land-use changes. During centuries, Danish forests were overexploited, resulting in very little forest cover and largely degraded forests (by grazing and overharvesting) by the beginning of the 19th century (Sand-Jensen & Møller, 2017). A forest law was made in 1805 with the aim of protecting and restoring remaining forest. Hence, requirements of permanence were implemented – forests could not any longer be converted to other land-uses. This restriction is still present today. Since 1805, afforestation has taken place, with different policy motivation – in the beginning soil conservation (preventing inland dune creation) and wood production, then from the 1980ies utilisation of less productive soils, and later on motives like outdoor recreation, biodiversity conservation and carbon sequestration as been main drivers. The last 30 years or more, it has been possible to obtain subsidies for afforestation on private land. The entire country is divided into zones where afforestation is wanted or not wanted (e.g. due to landscape conservation). In the autumn 2024, a political deal was established between agricultural NGOs, nature conservation NGOs and the government on reducing GHG and nitrate emissions from agriculture. A key element of this agreement is afforesting 250.000 ha of agricultural land (or 6% of the surface area of Denmark) and setting areas aside for extensive land-use (The Danish

Government, 2024). The afforestation ambition is the key object of interest in WP3. The reason for this is that the goal is so ambitious in terms of size, that it can only be reached if most of the barriers are overcome. The scale of the project is the entire country (approx 43.000 km²)

A part of the political agreement is, that land-use changes is to be decided by local tripartite groups. There are 23 of these – one for each watershed (as N leakage is a main policy objective too). In each group, local stakeholders (the government, municipalities, local farmer organisations, and green NGOs) agree on how to fulfill the goals (primarily assigning potentials for afforestation, reduced N leakage into surface water, sensitive drinking water areas and areas for biodiversity conservation). Further, voluntary incentives are key, i.e. private landowners cannot be forced to change management. Hence, understanding the motivations and drivers for the landowners is key, and is focus of this study.

72,5% of the Danish area is agriculture (as of 2016, Statistics Denmark statistical code AREALAN1) of which the largest share is privately owned. Again, this points at the importance of understanding motivations and drivers as seen by private landowners.

In 2020 there were 7500 full time farmers of which men constitute 94%, 50% are 55 years or more (Pedersen et al., 2022). Hence the key research objectives is to understand private land owner motivation for afforestation - what drivers and barriers affect their choice of afforesting or not.

2 Methodology

In order to understand drivers and motivation of land-use change, we started out with an overview of the literature as also reported in T3.1, combined with a literature search on specific Danish studies looking at land-use change. This search was conducted in both English and Danish.

Parallel to MOSAIC, various other reports have been made investigating the drivers and motivations of afforestation (Broch & Vedel, 2012; Guyard & Lundhede, 2023; Vedel et al., 2015) . In particular Guyard et al 2023 conducted an inductive qualitative study where 19 landowners and forest consultants were interviewed to understand barriers and drivers for afforestation on private agricultural land. Building on this study, a quantitative survey has been carried out, to better understand and quantify the drivers and barriers for afforestation and to allow for generalisations. The details of the survey development is reported in Ryge et al (2025), but brief details given here. The survey was carried out from October to December 2024 and distributed to 6.231 landowners which were randomly selected from The Danish Agricultural Agency's list of all 29.654 CVR-numbers of landowners who in 2022 received the basic income support for sustainability (EU based subsidy). The questionnaire was approved by the ethical committee at Faculty of natural science and Faculty of health before distributing it. The sample consisted of 50% "large landowners" who were defined as landowners getting basic income support for sustainability on more than 50 ha and 50% "small landowners" who were defined as landowners with a registered area below 50 ha. The sample was randomly drawn within the two groups. Gender, and other socio-demographic factors are therefore represented according to the population. While we do not know the true gender distribution in the population (numbers above

are for full-time farmers only), we know it is male dominated. Surveys of the kind used here (choice experiments) often have a slight over-representation of females (often attributed to higher tendency to responding). We don't know if that is also the case here. But we observe a low female proportion. 786 landowners responded to the survey, giving a response rate of 12,6%. The distribution of respondents on socio-demographic factors are presented in Appendix A. Data are pseudo-anonymised and stored on a secure server, hosted by University of Copenhagen and living up to legal requirements of GDPR.

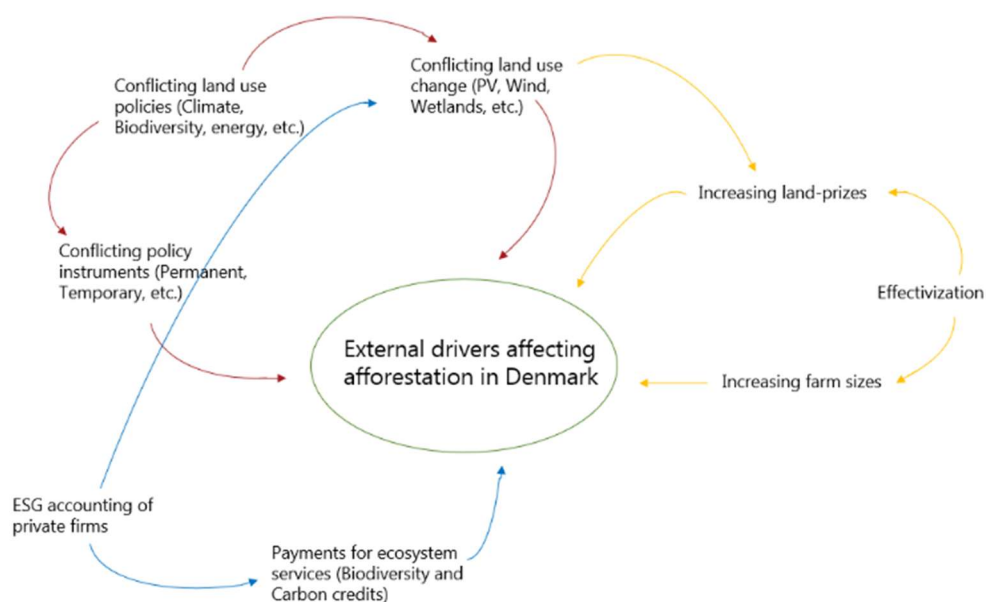
The questionnaire is comprised by three main sections, a section where the respondents are asked a line of questions regarding their property and definition of it in the context of farming, their relation to afforestation, whether they have previously done afforestation on their land and reasons for and against and whether they have plans to do afforestation and reasons for and against. The second section is a choice experiment where different contracts are presented, and the landowners are asked to choose between them or a business-as-usual scenario. The third section contains questions regarding their attitude to different statements and some socio-demographic questions. This report consists of result from the first and last section of the questionnaire. The middle section about the choice experiment relates to the uptake of incentives and will therefore be reported in D3.2.

Additionally, two MSc theses have been directly associated with MOSAIC: Kennedy (2025) conducted an analysis linking which motivational factors different land-use change policies in Denmark addresses. This is based on a document analysis of the policy instruments themselves linking the characteristics of the instrument to motivational factors identified in the literature. Lehner (2025) relied on the quantitative data from Ryge et al (2025) and combined it with qualitative interviews conducted after analysing the quantitative ones. This allowed for an ex-post analysis to supplement the causal interpretation of the results.

Finally, results from Ryge et al (2025) were presented at a stakeholder workshop and findings were discussed by practitioners. The purpose were two-fold: to provide feedback on whether results reflect practitioners' understanding of the broad picture, and to provide an input for practitioners in their decision making regarding the green three partite, and especially the local negotiation and coordination between landowners that were to be initiated.

3 Structural drivers of land-use change

Land-use changes continuously with societal changes. Figure 1 illustrates some of the main external drivers as identified in the project. The main input for these is a literature review, but also discussions with the policy lab partners.



1. Figure 1 illustrating some of the main external drivers affecting land use change for afforestation in Denmark. Colours of the arrows are only meant to make links more visible.

Following the theoretical von Thünen model, forest is an extensive land-use, and hence afforestation will often take place on land of lower productive value and further away from markets (Rogers et al., 2013). Production should in 2025 be seen as both production potential for agriculture, but also urban development, industrial development, energy infrastructure, etc.

Campbell et al (2014) estimate large welfare economic values of public goods from forests (recreation, biodiversity conservation, water provision). But not all ecosystem services from forests are public – some are also private. For example, Lautrup et. al (2023) show that private forest amenity values influence land prices positively, especially for small properties. Thorsen (2010) show how forest land prices have developed over a 50-year period compared to the production value showing a much higher increase in forest land prices than production value increases can explain, and he uses this to discuss whether amenity values or land price speculation (or both) is the main driver. Hence looking at land price development is a starting point for understanding the structural drivers of afforestation.

Starting at the right side of Figure 1, the yellow arrows indicate aspects related to **land prices**. A key factor here is agricultural production. Seen in a time perspective since the second world war, we have seen an increased intensification, and a trend towards larger farm sizes. This has also

led to increases in land prices. If we zoom in on the more recent development, from 2015-2024, a land price increase of 16% can be observed (Statistics Denmark 2025, LPRIS37). The increase in prices is not solely driven by a demand for agriculture. Figure 2 shows the development in the price index for agricultural properties, and as is seen, it is not showing the same increase as the land prices per se. Hence, other competing interests for land is also driving up the land prices.

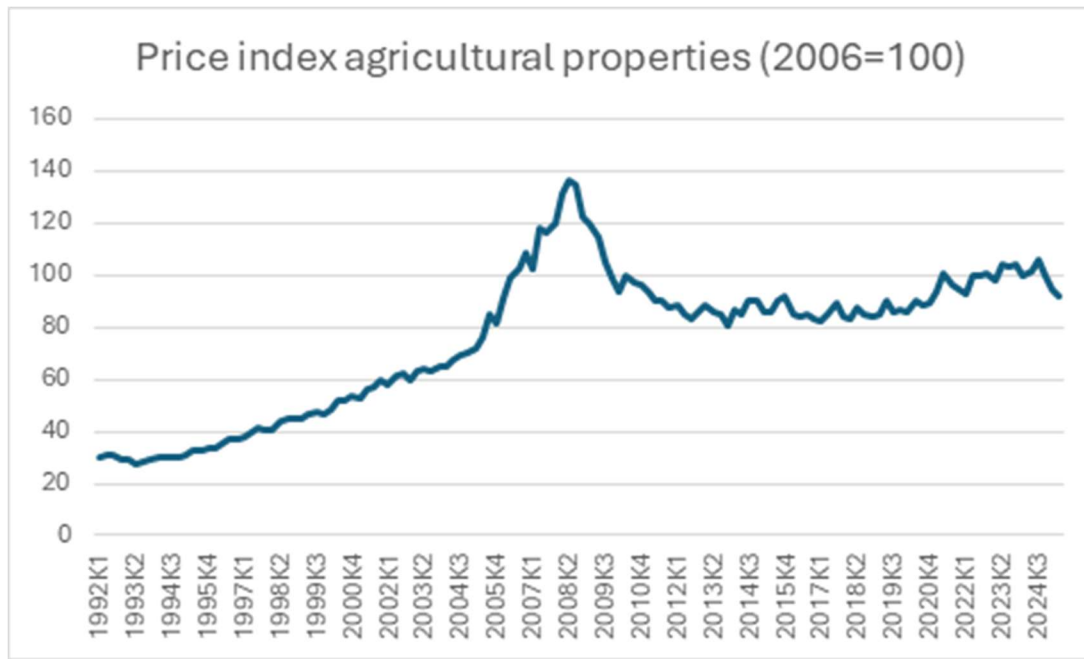


Figure 2 Price index for agriculture in Denmark, 1992-2024 for each quarter (K). This includes both the pure land value and the value of the farm (infrastructure, etc) per se.

While we do not have the price statistics yet to document it, some stakeholders in the policy lab are saying that they see large increases in land prices after the green tripartite agreement from 2024.

Forest production also provides a financial benefit. Jørgensen et al (2025) have shown soil expectation values for forestry in the range of -40.000 DKK to 500.000 DKK, depending on which afforestation type, soil condition and interest rate we are looking at. This should be combined with capital value of opportunity costs in form of lost agricultural production of 40.000-150.000 DKK (Jørgensen et al., 2025).

Another factor influencing afforestation is **competing land-uses**, c.f. the red arrows in figure 1. In recent years photo-voltaic development has become important, as well as private land conservation. For example, large private foundations are buying up land for nature conservation. This also affects land prices. But it also leads to policy interventions as indicated by the red arrows. Here we see various conflicting instruments and conflicting land-use changes. As Kennedy (2025) shows there are many policies with some degree of overlap, cf. figure 3, and as Jørgensen et al (2025) argue, this also lead to competing policy instruments.

The increasing land-use prices combined with the competing land-use policies and national Danish goals of afforestation (The Danish Government, 2024), provide a large share of uncertainty for landowners and are some of the external drivers that make them reluctant in joining into permanent schemes as afforestation, where there is no irreversibility in terms of land-use change (Bisgaard, 2024; Hansen, 2023). This was also backed up at the stakeholder event February 2025, where a conclusion from a discussion of barriers concluded that the political environment with shifting policies give rise to uncertainty and reluctance to enroll.

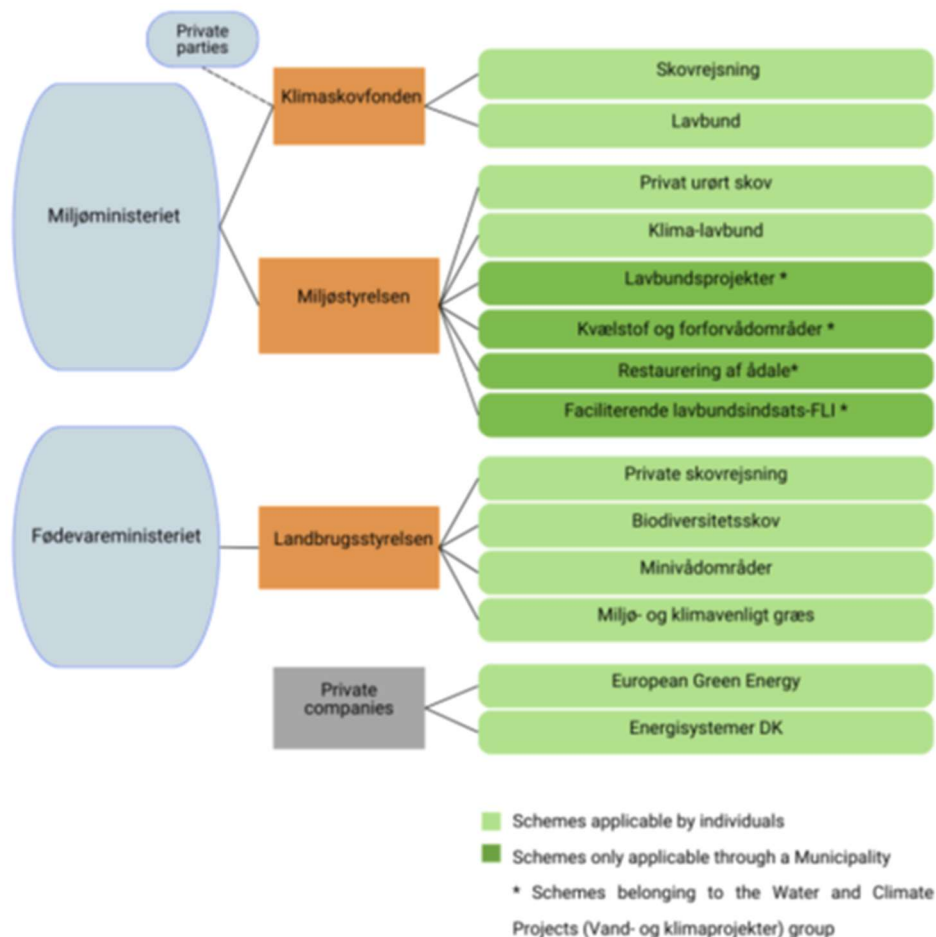


Figure 3 Land-use change related policies are organized under two ministries (environment and food; left part of the figure), a number of implementing institutions (Middle) and specific instruments (green to the right) Source: Kennedy (2025).

The last set of arrows in the figure comes from an increasing **ESG reporting requirement** for private companies, including farms. As climate change is becoming more visible, many companies do not only comply with required regulations but want to show that they take a larger responsibility. Afforestation is one of the few ways where CO₂ can be removed from the atmosphere, and at the same time provide various co-benefits (ESABCC, 2025). Hence it is attractive for CO₂ emitters - both farmers emitting greenhouse gasses from other parts of production, and for other actors (such as industries with hard-to-abate emissions) wanting to show contribution. This is the basis of the Climate Forest Fund (see WP2 of the project) but also

of a number of other actors selling voluntary carbon credits. Despite an emerging market for voluntary carbon credits, the current possibilities for companies to benefit from amenity values as carbon or biodiversity from afforestation are limited and unsecure and might prevent companies from investing. This was backed up at the stakeholder event February 2025, where stakeholders reported that an external barrier for doing afforestation as a company was the lack of structural incentives for companies to fund such activities since possibilities to report of synergy-effects from afforestation are lacking.

4 Motivations influencing land-use decision making

The actors analysed in the Danish PL are land owners as the land use changes analysed are planned to be implemented by voluntary agreements with individual landowners.

Figure 4 provide an overview of the external drivers as describe above and the motivations and values. A key driver for the land-use change in focus, afforestation, is the external policies and policy instruments, and their alignment or lack of so with personal values and motivations is key (cf Kennedy, 2025). Likewise, climate change is increasingly being observed and hence a direct driver for action. Social surroundings also play a role. The motivation and values of farmers is in the figure split in two – one called farm optimisation, and one called personal values. The personal values are largely relational values, but may hold both instrumental and intrinsic values as well. The points mentioned under farm optimization is to a larger degree instrumental values. This points at all three types of values being present for the individual farmer. In the following, we will elaborate on the motivations and values.

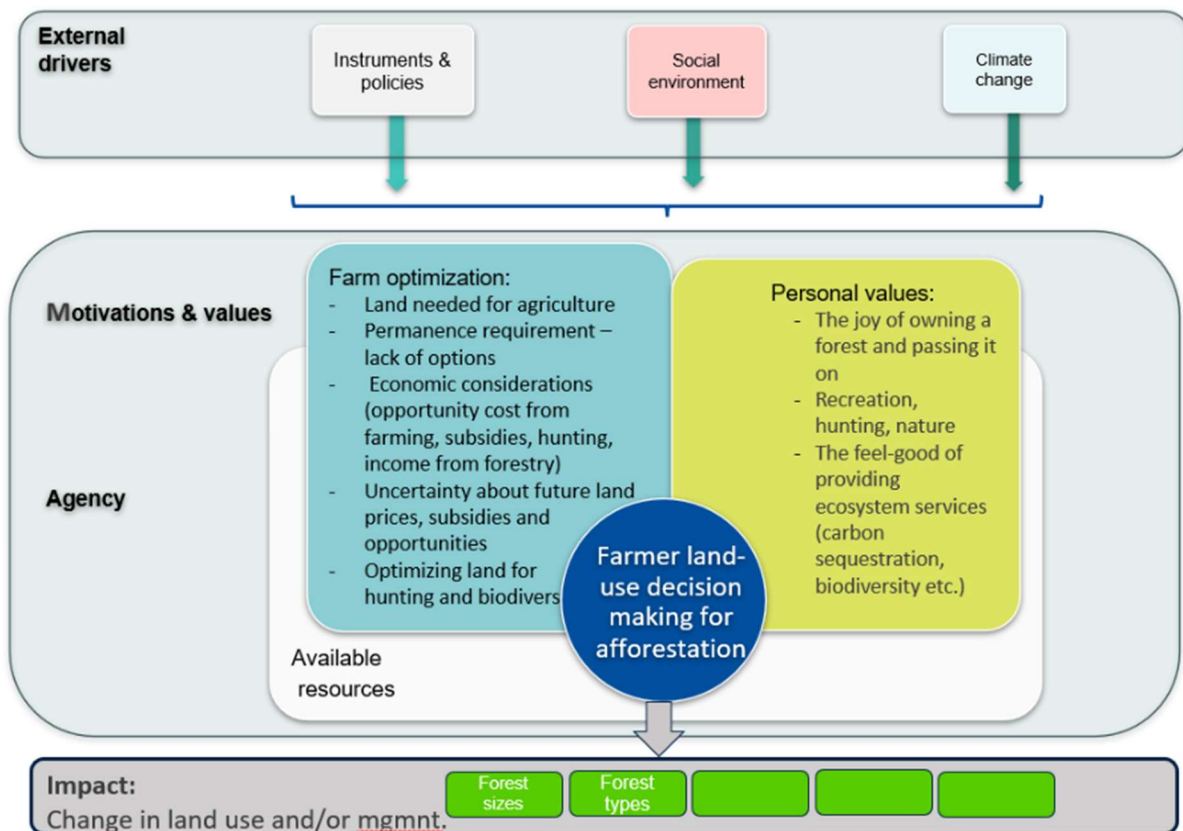


Figure 4 Motivational drivers and barriers for afforestation in Denmark

In the **qualitative study** from 2024 Guyard et. al. found that the main drivers for landowners to do afforestation on their property were the joy of owning a forest, private recreational values and hunting. Common for the interviews was, that the respondents emphasised on the amenity

values and that the values tied to the forest as a production system, producing timber, were not a main driver for doing afforestation. In the study they also investigated barriers for afforestation on private land and here the landowners mentioned the length of the process for applying for the afforestation schemes as a financial barrier. Such a barrier is supported by the MSc thesis associated to the project by Kennedy (2025) emphasizing that the smoothness of policy instruments applications is a main factor for action following on motivation. Other barriers mentioned by Guyard et al (2024) were restrictions in the contracts, restricting certain forest types and structures, but also the aforementioned permanence restriction – that forest land cannot be converted, i.e. there is no option of cancelling the contracts.

The **quantitative results** of drivers and barriers are somewhat in line with what was found in the qualitative study. Of the total 786 landowners 41% had some interest in doing afforestation on their land and correspondingly 59% said that they had no interest in doing afforestation on their land. The landowners were asked about their main reasons for and against afforestation. Each respondent who had confirmed interest in afforestation could choose three main drivers. The drivers which most respondents chose as was the joy of owning a forest, the value of passing on something positive for next generations, the value of increasing biodiversity on their property and hunting. Other drivers which were mentioned but by a smaller share of the landowners were the value of carbon sequestration/carbon credits, wood production and recreational values besides hunting. The drivers which only a small share of the landowners chose were groundwater protection and protection of water ways.

The main barriers which were chosen amongst the landowners who said that they were not interested in afforestation in their property were that the land were needed for agricultural purposes, land restrictions which will be put on the land, when enrolling in a subsidy scheme, and the limited income from afforestation. This was backed up at the stakeholder event in February 2025 where a discussion concerning barriers circled around the Danish Forestry act and its restrictions. Of other factors affecting the motivation, Lehner (2025) finds the importance of what neighbours think about your management an important issue, and it was mentioned as a potential barrier.

Looking at the heterogeneity in motivations among farmers, we do see a **large heterogeneity** reflected in both the qualitative and quantitative parts, but it is difficult to associate it with specific characteristics. Broch et al (2013) have investigated heterogeneity related to spatial location and the provision potential of the ecosystem services, such as groundwater interest, species richness, human population density, forest cover in the area and hunting. They find that human population density affects willingness to afforest negatively. A similar result is found in Lehner (2025) who point at the problem raised by farmers who have done afforestation in densely populated areas – that they don't like people walking in the forest (public access is allowed if the area is larger than 5 ha). On the other hand, possibilities of hunting affect the likelihood of doing afforestation positively – i.e. supporting the conclusion we also have in the study of Ryge et al. Sociodemographic heterogeneity is less studied. In our quantitative study, as a result of the random sampling with only a small share of female participants, we did not have enough information to see statistically significant differences between male and female perceived drivers and barriers.

When comparing the drivers for landowners who have already made afforestation and the ones who say they are potentially interested we find that biodiversity and climate sequestration/carbon credits have been increasing drivers. This is in line with two of the three motivations for the green tripartite agreement (water quality, climate and biodiversity) which was in its last part of negotiation at the time of the survey, but not yet agreed on. This indicates some alignment between private land owner motivation and policy. And may also indicate a trend in these. In an older study, Boon et al (2004) did not find climate and biodiversity as the main motivations for owning a forest. Of course there could be a difference between the motivation for forest owners and for those wanting to establish forests (afforestation). Yet, it may be an indication of a change. The awareness of the climate debate has been raised in the Policy lab as a possible explanation.

In the current study (Ruge et al., 2025) no clear difference can be seen in the identified barriers between those who have done afforestation and those who are potentially interested.

Turning to the **afforestation subsidy scheme** and its link with motivational factors, Kennedy (2025) rate 5 different motivational factors depending on how well the scheme fulfil them. Four of these, risk attitude, self-efficacy, social norm and the potential for regretting entering the scheme rate negative, meaning that these factors affect the willingness to enrol negatively, and only one, pro-environmental attitude rate positive for the scheme from the Danish Climate Forest Fund, meaning that this factor motivates people to enrol. This positive relationship, aligns with the findings mentioned above in Ryge et al (2025) of the main motivations for afforestation. That the potential for regret is negative supports the finding from the other studies that the forest permanence requirement is a main barrier. Lack of self-efficacy may have to do with forestry requiring a different set of skills than agriculture – an aspect also mentioned in Broch and Vedel (2012). That social norms weigh negative is also indicated by Lehner, but interestingly it is not mentioned in any other studies. Kennedy also assess the ministerial subsidy for afforestation (cf Figure 4) and find somewhat better alignment with the motivational factors. This is surprising, given that the Danish Climate Forest Fund aims for exactly aligning better with the motivational factors. Kennedy also compare the support of different motivational factors of other subsidy schemes, see figure 4. As is seen, many score negative on the 5 criteria she assesses. Afforestation is somewhat in the middle, indicating that some of the schemes aligns better with motivational factors, and others worse.

Scheme	Risk Attitude (RA)	Pro-Env. Attitude (PEA)	Self-Efficacy (SE)	Social Norm (SN)	Potential for Regret (PFR)
1. Skovrejsning	-5.5	1.5	-5.5	-3.5	-5
2. Lavbund	1.5	1.5	1.5	3.5	2
3. Privat urørt skov	-5.5	1	-5	-5.5	-5
4. Lavbundsprojekter	-6	1.5	-7	-4.5	-6
5. Kvælstof og forforvådområder	-6	1.5	-7	-4.5	-6
6. Restaurering af ådale	-5	1.5	-6	-3.5	-6
7. Faciliterende lavbundsindsats-FLI	2	1.5	2	2.5	2
8. Klima-lavbund	-2.5	1.5	-3.5	-2	-1.5
9. Private skovrejsning	2.5	1.5	1.5	3	1.5
10. Biodiversitetsskov	-3.5	1.5	-6	-4.5	-6.5
11. Minivådområder	-1.5	1.5	-2.5	-2.5	-2
12. Miljø- og klimavenligt græs	-2.5	1.5	-3.5	-2	0
13. EU Green Energy	0.5	1.5	1.5	2	0
14. Energisystemer DK	-3	1	-2	-2	-3

Figure 4 Scheme characteristics and how they affect different motivational factors. The two related to afforestation is number 1 and number 0. Colours indicate alignment (green) or disalignment (red). Source: Kennedy (2025).

Risk and uncertainty play a large role in all the sources of data we have investigated. Kennedy (2025) rates it negative, Jørgensen et al (2025) and Ryge et al (2025) mentions uncertainty of future policies as an important barrier and also earlier studies such as Thorsen (1999) mentions it as a potential barrier of conservation or land use change uncertainty, though looking at it more broadly as market uncertainty. Because of the limitations in changing land-use once The fact that afforestation is done, irreversible, it is perceived as ility comes in as a main barrier. This will be investigated in relation to incentive design in deliverable 3.2

The focus in this report has been on doing afforestation per se. But obviously, these different values and motivations play a role for **which kind of afforestation** is being made – how large a forest is being established, which type of forest etc.

5 Reflections

5.1 Methodological reflection

Motivations and barriers has in the Danish case been analysed qualitatively by a number of studies already when MOSAIC started, and supplemented by Master theses. This caused that the **emphasis could be more on the quantitative side**. The quantitative study has confirmed the qualitative findings, but has further allowed to assess the question of how widespread given opinions are, and how important they are relative to each other (see Ryge et al., 2025 for details).

The quantitative part is based on a **stated preference study**, where respondents consider what they may do in the future. Whether they will in fact do it at the end of the day is not given. Therefore, in the next part of WP3, we will also look retrospectively at similar incentive schemes to assess to which degree it carries over to concrete land-use changes.

5.2 Major drivers and motivation influencing land-use decisions

Land price development is a main driver for land-use: it can both act as a barrier and a lever for afforestation. Historically we have seen increasing land prices, also for forest land, which cannot be explained by production. Instead amenity values are suggested in the literature to play a large role. This is confirmed by the studies conducted here in MOSAIC on the motivational factors – hunting, own outdoor recreation, biodiversity and the intangible “joy of ownership” are considered the main motivational factors in both the qualitative and the quantitative studies. Through discussions in the Policy Lab, it has also been suggested that a wish to take personal responsibility for public goods like biodiversity and climate may play a role.

The main barrier identified is the need of land for **other purposes**. Second, the restriction that **afforestation is a permanent land-use change** is identified as a main barrier. Last, in population dense areas, the access of the general public is raised as a concern by many.

5.3 Case specific characteristics that may influence decision making

The drivers and motivations for the afforestation analysed in the Danish PL are, like in any case, specific to the setting.

First of all, it is a **national policy**. And it is centered around a narrative of green transition, where all sectors have to contribute. This is a rhetoric that has been articulated in the **climate debate** for at least 10 years: we do not reach the national policy ambitions without. This need, is similar in other EU countries, but our (subjective) impression is, that the debate is more advanced in Denmark – the Danish agricultural sector has realized that they play an important role. A driver of this is, that the emission heavy industry in Denmark is relatively small and the agricultural emissions relatively big – compared to many other European countries. As emissions continue to reduce throughout Europe, emissions from agriculture will play an increasing relative role. Hence, there is much to learn from the Danish case.

Another characteristic that play an important role are **the many small hobby/parttime farmers and few large farmers**- who then manage large parts of the area. This uneven distribution is also

seen in other European countries, but the fact that the small farmers are not dependent on the farm income is more pronounced in some countries than others. This means that designing incentives may target one group more than another. Many of the learning points may be easier adoptable in countries that are also facing this divide between “horsification” and “intensification” like in Belgium. Yet – the development towards few larger farms is seen Europe wide.

Finally, a characteristics of the Danish agricultural landscape is, that it is to a large extend, the **landowner who manages the land**. This is as opposed to the many countries where the farmer rents the land.

5.4 Possible policy options

The Danish afforestation policy goal is ambitious – if it is to be reached, it requires that a lot of landowners enter. While compensation that covers the marginal opportunity costs seems feasible, the need for agricultural land is an issue.

We see farms getting bigger and bigger in order to be competitive. Hence, allocating land, even small shares, is not only a question of marginal costs, but on the whole economy of a farm. Hence it is not surprising that the need of land for agriculture is a main barrier. At the same time, we see smaller farms, especially closer to cities, being bought by hobby-farmers. These properties are bought for private amenity values, and hence it is not surprising that afforestation seems a better option on these farms. However, small forests fulfil the goals of the policy less: despite the target being a measure in hectares, the underlying ecosystem services targeted are biodiversity, carbon sequestration and water quality. Biodiversity requires larger coherent areas. You don’t get that with a few hectares here and there. Public access is only allowed if the forest is above 5 ha, again: size matters, and public access may not be attractive for a small farm – not least if it is a property that serves more as an extended garden close to a larger city. Carbon sequestration is easier in an afforestation mosaic – but makes it administratively more expensive. And likewise with water, where the precise location matters. Hence the motivations of private land owners may conflict with the underlying goals which will **require larger coherent areas**.

However, it is important **to align the policies with these motivations** if the afforestation goal is to be reached by the use of voluntary incentives. Hence, designing policy instruments that takes this into consideration is key. And will be the topic of D3.2.

Appendix

Appendix 1: Distribution of answers to the quantitative survey

	Share of respondents who have answered the questions
Sex	
Men	83.0
Women	4.6
Other	0.3
No answer	12.1
Age	
20-39 years	4.3
40-59 years	31.7
60-79 years	49.4
80+ years	14.4
No answer	0.3
Household income	
0-24,9 t DKK	6.9
25-49,9 t DKK	20.6
50-69,9 t DKK	16.4
70-89,9 t DKK	11.4
90-99,9 tDKK	3.3
More then 100 tDKK	14.2
No answer	27.2
Regions	
Hovedstaden	6.1
Midtjylland	26.2
Nordjylland	16.0
Sjælland	14.4
Syddanmark	24.6
No answer	12.6

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