Increasing Afforestation in the Irish Agriculture Sector

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Abstract

Ireland targets to expand forest cover to 18% of total land area by 2050 under the current Forestry Programme. Furthermore, Ireland envisages carbon neutrality in the agriculture, forestry, and land-use (AFOLU) sector by 2050.

The aim of this study is to investigate the impact of increasing annual afforestation rates on Irish agriculture and the possibility of the AFOLU sector becoming carbon neutral by 2050 solely through afforestation. Using the CAPRI model, we analyse the effects of an increase in the forested area on Irish agricultural market balances, prices, and Greenhouse Gas (GHG) emissions. The analysis focusses on the medium-term impacts (2030).

Increasing the annual afforestation rate strongly increases land-use change related carbon sequestration. This can offset significant levels of agricultural GHG emissions for 2030. Land use change for forestry, no longer available for agricultural production systems, leads to a decrease in total agricultural GHG emissions due to indirect production changes.

The findings suggest that the most significant effects occur in the beef sector when partly offsetting agricultural GHG emissions through forestry by 2030. Attaining a path towards a carbon neutral AFOLU sector affects the grass-based sectors mostly, shifting production and potential emissions to other countries with strong grass-based ruminant sectors such as the Mercosur countries.

Keywords Irish Agriculture, Afforestation, Carbon Sequestration, CAPRI model

JEL code C54, Q11, Q15, Q23

1 Introduction

Despite a long-running and relatively generous farm afforestation scheme, Ireland's total forest area cover in 2017 was only 769,395 ha or 11% of the total land area, which is well below the EU-28 average of 38% (Duffy et al., 2019, Eurostat, 2021). The introduction of a farm afforestation scheme in 1989 led to an increase in private farm afforestation, with nearly half (49.2%) of the forest area now in private ownership. Since 1990, 72% of the newly afforested area has been planted by the private sector, of which farmers afforested 81%. As a result, forestry and agriculture are intimately intertwined (DAFM, 2020) However, the rate of afforestation has slowed.

Under the current Forestry Programme and endorsed by the Food Wise 2025 strategy paper, Ireland has a target to expand forest cover to 18% of the land area by 2050 to maintain a sustainable forestry sector (DAFM, 2018, DAFM, 2015). To achieve this target, an annual afforestation target of 16,000 ha per year would be required (Farrelly and Gallagher, 2015). Furthermore, Ireland aims to achieve carbon neutrality in the agriculture and land-use sector, including forestry, by 2050, which does not compromise the national capacity for sustainable food production (DCCAE, 2017, DCCAE, 2013). The recently published Irish Climate Action Plan has outlined the leading role that the agriculture sector is required to take in order for Ireland to achieve the GHG emission targets set out for the non-ETS sector[1] of 30% reduction by 2030, relative to 2005 levels, and a net zero target by 2050. The agricultural sector faces an emission reduction target of 10-15% by 2030, relative to 2030 projections (DCCAE, 2019). In order to achieve these targets, the agriculture sector will need to reduce its total GHG emissions and increase carbon sequestration (DCCAE, 2019). Thereby, the main carbon sequestration strategy is increased afforestation.

Given the recent decline in afforestation from 15,696 ha per year in 2000 to just 4,000 ha per year in 2019 (DAFM, 2020), the present study aims to investigate the impact of an increased annual afforestation rate on Irish agriculture and the potential for the agricultural sector to achieve carbon neutrality by 2050 solely through forestry offsetting emissions from agriculture. Mitigation technologies are not considered in order to assess only the abatement potential existent in the LULUCF (land use, land-use change and forestry) sector. Using the CAPRI model, we simulate the effect of increasing the annual afforestation rate on Irish agricultural market balances, prices, and GHG emissions projected for 2030. This paper presents two scenarios that show the potential impact range of alternative rates of conversion of agricultural land to forestry.

Concluding, the received results will give a first insight into whether the Irish agriculture sector can continue producing efficiently while at the same time meeting the climate targets set under the Irish Climate Action Plan and Forestry Programme.

2 Irish LULUCF sector

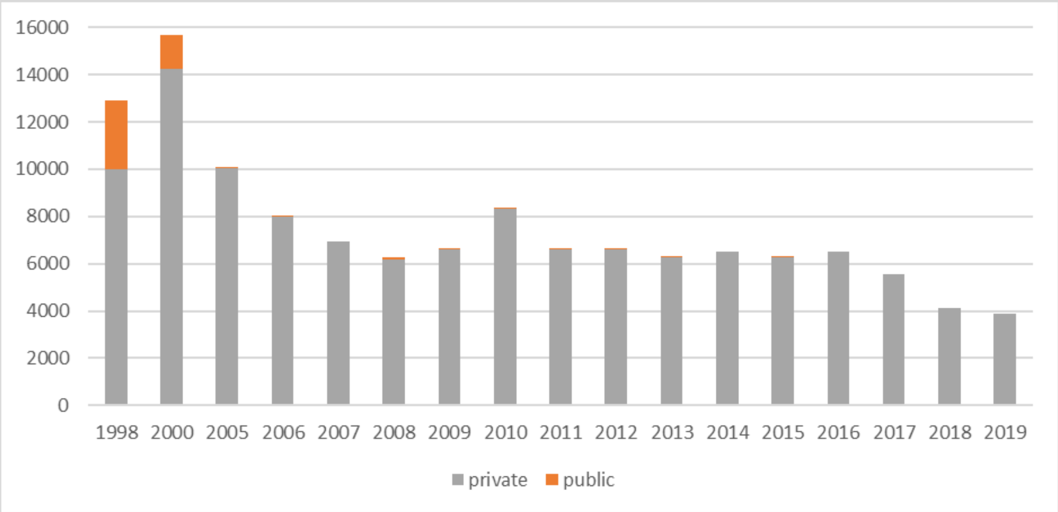
The dominant carbon sinks in Ireland are forests (11% of total land area), grassland (58.5%) and wetlands (16.4%) (Duffy et al., 2019). While total forest area increased by nearly 290,000

[1] The EU Emissions Trading Scheme (EU ETS) launched in 2005 and covers more than 11,000 heavy energy consuming installations in power generation and manufacturing including food processing and manufacturing (EPA, 2019). The non-ETS sector consists of those sectors not included in the EU ETS including agriculture, transportation, households and waste (EPA, 2019).

ha between 1990 and 2017, wetlands (especially peat) have declined by nearly 132,000 ha (-9.7%) and grassland area has declined by 178,000 ha (-4.1%) (Duffy et al., 2019, DAFM, 2018b).

Ireland's total area of forestry covers 769,395 ha (end of 2017), or close to 11% of the total land area, which is well below the EU-28 average of 38% (Duffy et al., 2019, Eurostat, 2018). Nearly half (49.2%) of forests are in private ownership. Since 1990, 72% of the newly afforested area was planted by the private sector, of which 81% was afforested by farmers (DAFM, 2020, Figure 1). To date, the majority of afforestation (67%) has occurred on marginal agricultural land, of this, 56% is marginal grassland (Farrelly and Gallagher, 2015). Over the same period, public afforestation declined to close to zero since 2005 (IFFPA, 2018). As a result, forestry and agriculture are intimately intertwined and compete in the most efficient use of natural resources (DCCAE, 2017, Schulte and Lanigan, 2011).

Figure 1 Public vs private afforestation in Ireland by area planted in hectares (1998-2019)



Source: DAFM (2020), DAFM (2018), IFFPA (2018).

This change from public to private afforestation was largely a result of the introduction of a range of farm afforestation schemes in 1989 that offered planting grants and annual forestry premia to cover forest establishment costs and offset the lost income from agricultural livestock production (Teagasc, 2018). In 2007, farm afforestation was made even more financially attractive given that farmers who planted continued to receive agricultural direct payments on the afforested land (Duesberg et al., 2014, Breen et al., 2010). Now, forestry returns typically exceed those from beef and sheep farming (Ryan and O'Donoghue, 2016, Breen et al., 2010), yet annual afforestation rates continue to fall. Reasons thereby are the obligation to replant after clear-felling, farmers sense of identity and the impact on the land's value.

Under the current Forestry Programme and endorsed by the Food Wise 2025 strategy paper, Ireland has set a target to expand forest cover to 18% of the land area by 2050 (approximately 1.25 M ha) to maintain a sustainable processing sector (DAFM, 2018, DAFM, 2015). To achieve this target, an annual afforestation target of 16,000 ha per year would be required (Farrelly and Gallagher, 2015).

As forest, grassland, and wetlands are the major carbon sinks in Ireland, they play an important role in mitigating climate change by sequestering and storing CO_2 (DAFM, 2018).

Sequestration is the net removal of CO_2 from the atmosphere and storage in biomass (DAFM, 2018). The national forest estate is an important and expanding sink for carbon, at 312 Mt CO_2eq. Based on the National Forest Inventory (NFI) data, Ireland's forests have removed an average of 3.8 Mt CO_2eq per year from the atmosphere over the period 2007 to 2016. This is equivalent to almost 6% of the total Irish GHG emissions. Forestry as a means of carbon storage has played an important role in Ireland achieving its Kyoto target under the first commitment period of 2008-2012. (DAFM, 2018)

Up to 2018, forestry and agriculture were reported separately, and the offsetting of GHG emissions by afforestation was not credited to the agricultural sector (Lanigan and Donnellan, 2018). Under the new Effort Sharing Regulation (Regulation (EU) 2018/842) from 2018, the level of flexibilities of offsetting agricultural GHG emissions by afforestation has been increased for those EU Member States such as Ireland who face two specific difficulties in reaching targets by reducing agricultural emission alone: 1) the ratio of Ireland's non- ETS emissions to ETS emissions is higher than in most Member States and 2) the high proportion of total Irish GHG emissions that are produced by the agricultural sector. (Lanigan and Donnellan, 2018, DCCAE, 2017) Ireland can therefore now include carbon sequestration of LULUCF as flexible mechanisms to offset agricultural GHG emissions. This opens a future pathway through which Irish agriculture can contribute to mitigating Ireland's GHG emissions. (Schulte and Lanigan, 2011, Lanigan and Donnellan, 2018, DCCAE, 2017)

3 Methodology – CAPRI

CAPRI is a large-scale, comparative-static, agricultural sector model (Fellmann et al., 2018). The model consists of two interacting modules: a supply module and a market module. The supply module comprises independent aggregate optimisation models representing agricultural activities (28 crop and 13 animal activities) in all NUTS 2 regions within the EU. The market module consists of a spatial, global multi-commodity model for 47 primary and processed agricultural products, covering 77 countries in 40 trade blocks. The two modules are linked through an iterative procedure (cf. Perez Dominguez et al., 2009, Britz and Witzke, 2015).

The modelling system can endogenously calculate activity-based agricultural emission inventories as it incorporates detailed information on nutrient flows and yield per agricultural activity and region (Van Doorslaer et al., 2015). Generally, a Tier 2 approach following the IPCC guidelines (IPCC, 2014) is used for calculating the activity based agricultural GHG emission inventories where information is available. Hence, CAPRI can define GHG emission effects of agriculture in response to changes in the policy or market environment (Van Doorslaer et al., 2015).

For each Member State, behavioural functions for agricultural land supply and the conversion between arable land and grassland allows land to shift between arable land and grassland depending on the returns to land. Aside from arable and grassland, the land not currently farmed is allocated to the various other land use classes such as forest, wetlands, artificial land and residual land and included in the model according to a 6x6 land transition probabilities matrix.

3.1 Agriculture in the EU-27 in 2030

Being a comparative static model, CAPRI requires a projected equilibrium state of the agricultural sector regarding supply, demand, production, yields and prices in order to perform scenarios in the projection year 2030. Hence, the model generates a baseline that constitutes the reference scenario against which the two afforestation scenarios are compared.

In the reference scenario, trends regarding supply, demand, production, yields and prices are assumed to develop further, as seen in the past. The afforestation rate for the EU member states follows the trends experienced in the past. For Ireland, this rate will lead to a forestry area of around 12% by 2030 and corresponding carbon sequestration. In the reference scenario, no afforestation target is set for the EU-27.

Regarding policy assumptions which are incorporated through exogenous variables, the reference scenario includes a detailed policy representation of the EU agriculture sector, including agricultural and trade policies approved up to 2015. The measures of the Common Agricultural Policy (CAP) are covered, including measures of the latest 2014-2020 reform (direct support measures implemented at Member State or regional level and the abolition/expiry of the milk and sugar quota systems). The CAPRI reference scenario does not anticipate any potential WTO agreement in the future, and no assumptions are made concerning bilateral trade agreements that are currently under negotiation. Brexit is included in a way that the United Kingdom is no longer considered to be part of the EU, but free trade between the EU and the United Kingdom is still applied.

Specifically, for Ireland, the strong growth trends in the dairy cow sector regarding dairy cow numbers and yield have been incorporated into the reference scenario's calibration. This ensures that the projected level of dairy activity for the year 2030 reflects the developments in the sector post milk quota abolition.

3.2 Simulated Scenarios

For 2030, the scenarios defined aim to increase the rate of afforestation in the Irish agricultural sector. Afforestation scenarios have been based on the COFORD projections on agricultural land availability for afforestation (COFORD, 2016). The simulated afforestation scenarios rely on the same assumptions as in the reference scenario, i.e. the assumptions regarding macroeconomic drivers, CAP, market and trade policy. Different to the reference scenario, the two defined scenarios aim to increase the afforestation rate by the year 2030 and reduce agricultural GHG emissions through carbon sequestration. Therefore, the two scenarios describe possible future developments regarding the carbon sequestration potential of agricultural GHG emissions in Ireland, covering the possible impact range as comprehensively as possible. Both scenarios have no mitigation target set, and no additional subsidies are implemented.

Under scenario one "National Forest", the yearly afforestation rate will be increased up to 16,000 ha. Keeping up this rate up to 2050, Ireland will reach the national forest cover of 18% of the land area by 2050. This will increase carbon sequestration, which can partially offset GHG emissions from the agricultural sector.

The second scenario "C-Neutral" considers the possibility of the AFOLU sector becoming carbon neutral by 2050 solely through land- use change towards forestry. To achieve this rate of carbon sequestration from forestry, the yearly afforestation rate up to 2050 needs to be increased to 35,000 ha annually.

Hence, these afforestation scenarios will show the pathways that the Irish agricultural sector has to take by 2030 in order to achieve the set targets by 2050. Efforts regarding afforestation rate have to be kept at the considered rate respectively to reach the targets by 2050.

4 Results

The scenario results for 2030 show that Irland can follow paths that would meet the targets set under the Forestry Programme as well as under the National Policy Position on Climate Action and Low Carbon development by 2050. Both targets involve a change of agricultural land-use throughout Ireland due to forestry and agriculture's strong linkage (Table 1).

Table 1: Main Changes in the Irish LULUCF sector in 2030

	Reference	National Forest	C-Neutral
		'000 ha	
Forest land	831.84	977.01	1225.29
Agricultural Area	4511.61	4175.84	3570.78

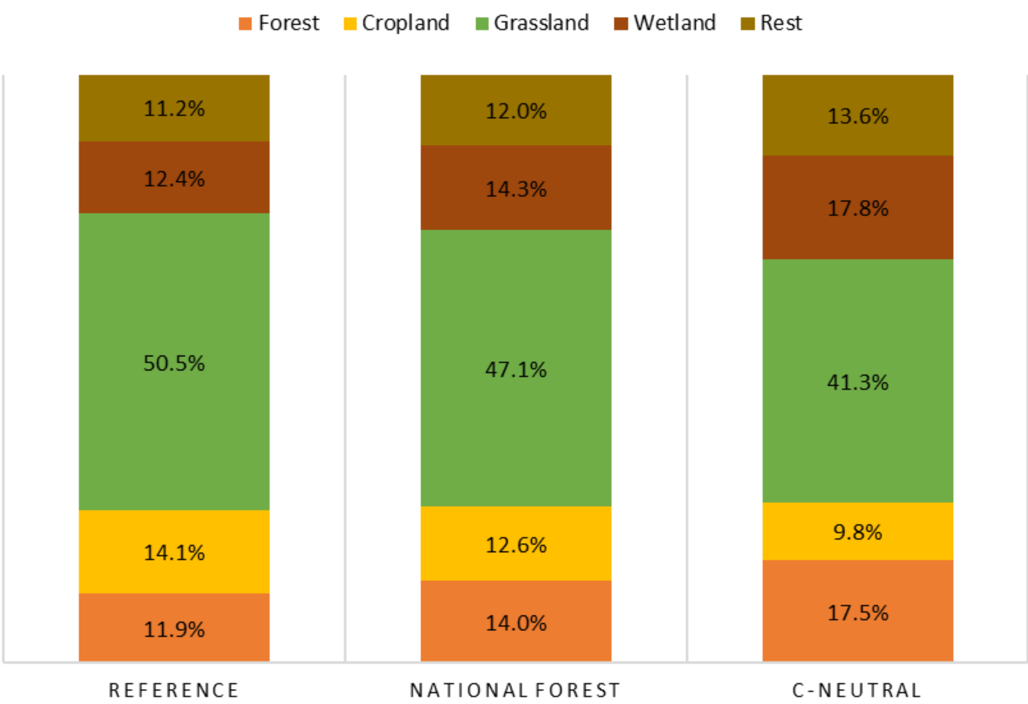
Source: Own compilation.

Through the annual afforestation rate of 16,000 ha, the forest area in the "National Forest" scenario will cover 977,010 ha by 2030. Increasing the annual afforestation rate up to 35,000 ha in the "C-Neutral" scenario will increase the forest area to 1.2 Mio ha by 2030 (Table 1).

4.1 LULUCF changes

Looking at the land-use changes for Ireland in more detail, that for both scenarios, mainly grassland is converted into forestry. The share of grassland in total land throughout the scenarios decreases from 50.5% (reference scenario) down to 41.3% under the "C-neutral" scenario (Figure 2).

Figure 2: Irish Land-Use by 2030



Source: Own compilation.

In order to achieve an 18% forest coverage by 2050 as set under the Forestry Programme, changes in land-use by 2030 appear to be moderate (Figure 2), with a reduction in grassland of 3% and of cropland of 1.5%. This indicates possible changes in the land-based agricultural production but only to a moderate extent under the “National Forest” scenario.

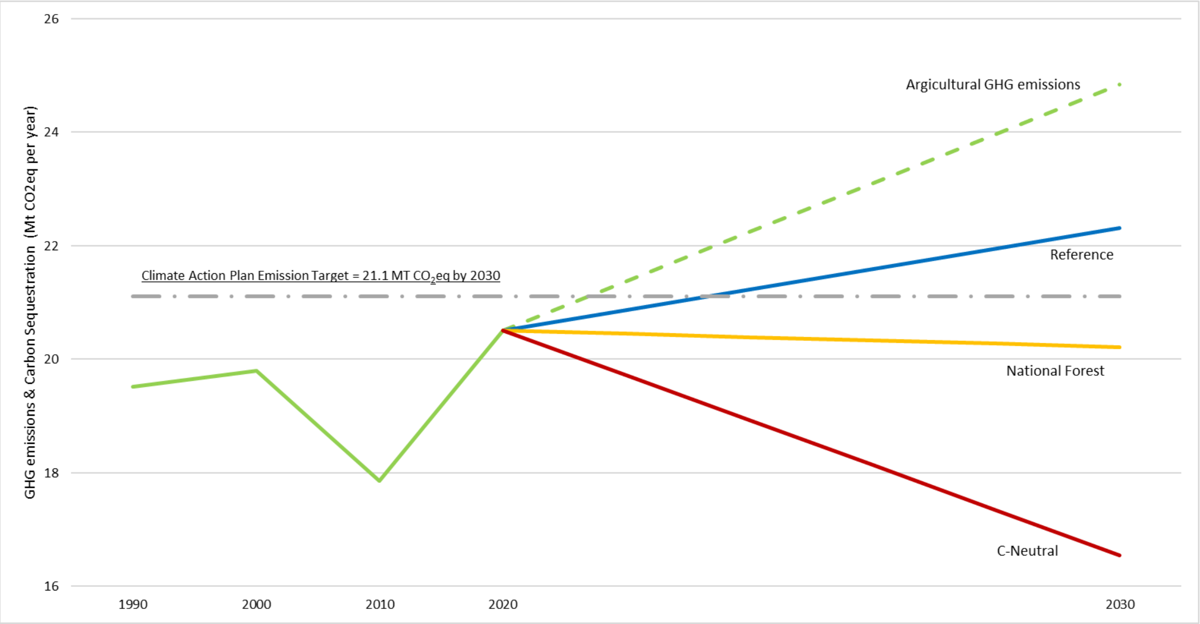
Taking the path of a carbon-neutral agricultural sector solely through carbon sequestration (“C-Neutral” scenario), however, requires a significant change in Irish land use. Available grassland will be reduced by 10% in 2030, and cropland will be reduced to 9.8% of the total land (Figure 2). This provides forestry as well as wetland with the area necessary to expand significantly.

Comparing these necessary land-use changes with the total area potentially suitable for forest expansion projected by COFORD, it occurs that these changes could be considered on land “limited” for agriculture, representing 1.8 million ha (COFORD, 2016). Land of better quality for agricultural use would not be affected. Still, such a significant change in land-use would indicate that changes in agricultural production will be drastic as the land limited for agricultural use is strongly cultivated by cattle farmers (49%), by dairy farmers (18%) and by sheep farmers (27%) (COFORD, 2016).

4.2 Reduction in agricultural GHG emissions

Although under the reference scenario (blue line), carbon sequestration can offset the projected agricultural GHG emissions (green line) to the extent that the projected increase in agricultural GHG emissions is slowed down up to 2030, this would not be sufficient enough to reach the GHG emission reduction defined under the Climate Action Plan (-15% by 2030, relative to 2030 emission). The GHG emission reductions achieved under the two afforestation scenarios, on the other hand, directly reflect the potential carbon sequestration achievable through an increased afforestation rate. The scenario results show that Ireland can meet the set target solely through land-use change (Figure 3).

Figure 3: Offset Irish GHG emissions through Carbon Sequestration in 2030



Source: Own compilation.

Increasing the yearly afforestation rate up to 16,000 ha under the "National Forest" scenario (yellow line) would offset 18.6% of the total agricultural GHG emissions exceeding the required reduction target by 2030 (Figure 3). Reaching a yearly afforestation rate of 35,000 ha under the "C-Neutral" scenario, could offset 33.4% of the total agricultural GHG emission by 2030, putting Ireland on a pathway of becoming carbon neutral in 2050 solely through land-use change towards forestry (Figure 3).

Even though the potential of offsetting GHG emissions from the agricultural sector through increased afforestation is high, it needs to be pointed out that reductions for Ireland are mainly the results of two main drivers: offsetting GHG emissions through carbon sequestration and changes in agricultural production (Table 2).

Table 2: Share of the emission reduction achieved in Ireland

	Reference	**National Forest**	**C-neutral**
Total GHG emission reduction	2.5 Mt	4.6 Mt	8.29 Mt
	Share in total agricultural GHG reduction		
Carbon sequestration	100%	86.4%	77.7%
Change in production	0%	13.6%	22.3%

Source: Own compilation.

With increasing the afforestation rate, the amount of GHG emission reductions from changes in the Irish agricultural production – especially land-based production – increases significantly by up to 22.3% by 2030 in the "C-neutral" scenario. Changes in production reduce agricultural GHG emissions in the two scenarios mainly through a decrease in CH_4 emissions and in N_2O emissions from mineral fertiliser applications. In the "National Forest" scenario they account together for 62% of the reduction in GHG emissions from agricultural production and in the "C-Neutral" scenario they account together for 63%. This development will become even more apparent when taking a closer look at the changes in Ireland's main agricultural activities.

4.3 Impacts on Irish Agricultural Production

Changes in agricultural production levels largely depend on how substantial the land-use changes are in the different scenarios as especially the ruminant livestock activities are highly dependent on the availability of land. The strong reduction in grassland area suggests a significant effect in the livestock sectors and this is supported through the reduction of the share of CH_4 and N2O emission reduction in the reduction of total agricultural GHG emissions. Considering that the livestock sector is responsible for up to 90% of CH_4 emissions from Irish agriculture (Duffy et al., 2019), these changes are to be expected.

In the "National Forest" scenario, decreases in herd size of Irish agriculture sector's main ruminant activities are the highest overall activities (Table 3). Especially livestock numbers in beef meat activities are affected and decrease by around -2% due to their high dependence on land and their lower profitability compared with dairy or sheep activities. Dairy cow numbers decrease by -0.36%, and sheep and goat numbers by -0.58% (Table 3). Meat and milk supply decreases are slightly lower than the reduction in herd size, showing that efficiency gains in the production systems occur by a reduction in low yield animals are more substantial than high yield animals.

Table 3: Change in area, herd size and supply for main activities in Ireland

	Reference		National Forest		C-Neutral	
	Hectares/ herd size	Supply	Hectares/ herd size	Supply	Hectares/ herd size	Supply
	1000 ha/hds	1000 t	%-difference to Reference			
Dairy cows	1637.25	9991.14	-0.38	-0.36	-1.18	-1.09
Beef meat activ.	3473.81	690.51	-2.05	-1.39	-6.17	-4.19
Sheep and Goat meat activities	2114.77	55.52	-0.58	-0.64	-1.74	-1.88
Gras and grazings ext.	1766.43	46080.57	-15.64	-15.61	-44.81	-44.76
Gras and grazings int.	1759.48	109446.57	2.51	2.49	8.81	8.80
Fallow land	15.69		-2.93		-4.89	

Note: Total supply of beef meat activities includes beef from suckler cows, heifers, bulls, dairy cows and calves (carcass weight).
Source: Own compilation.

Herd size and supply changes in the ruminant sectors under the "C-Neutral" scenario clearly indicate, that the beef sector is affected strongly by the movement away from agriculture land towards forestry (Table 3). Even though the herd size decreases by -6%, supply is less effected by -4%. This is a result of a more substantial reduction in low weight than of high weight livestock numbers. The dairy sector as well as the sheep and goat sector see a reduction in herd size by 1.18% and 1.74% respectively and a similar reduction in supply (Table 3).

As a result of the reduction in grassland and cropland, in both scenarios, we can see reductions in herd size in all land-based sectors and a switch from extensive gras-based ruminant production systems towards a more intensive production system. Over all scenarios, the area under extensive usage reduces (-15% in the "National Forest" scenario and -45% in the "C-Neutral" scenario) and the area under intensive usage increases (2.5% in the "National Forest" scenario and 9% in the "C-Neutral" scenario) (Table 3). This indicates that an increased afforestation rate leads to an intensification of the ruminant production systems throughout Ireland. Further, the changes in land-use in both scenarios result in a reduction of fallow land by -3% respectively -5% (Table 3).

Furthermore, area under extensive use is more substantially reduced than area under intensive usage increases. This states that grassland moving out of agriculture is, to a strong extend, an extensively used area. These outcomes support the COFORD project's findings that see mainly land limited for agricultural use being transformed into forestry and are broadly consistent with previous farm afforestation practices in Ireland. Additionally, this partly explains why beef activities are more affected by an increased afforestation rate as cattle farmers are the main farmers (49%) cultivating land limited for agricultural use.

Fertiliser usage as a main input factor of the dairy and beef sector, is strongly impacted by the production changes in the scenarios. The reduction in ruminant herd size and the switch from extensive to intensive grass-based production systems, increases the usage of mineral nitrogen per ha of agricultural land (Table 4).

Table 4: Changes of Fertilizer usage for fodder activities

	Reference	National Forest	C-Neutral
	N kg/ha	%-difference to Reference	
Mineral nitrogen	70.52	4.56	17.14
Manure nitrogen	87.64	6.33	20.52

Source: Own compilation.

At the same time the usage of manure nitrogen also increases in both scenarios (+6% in "18%" scenarios and +20% in "C-Neutral" scenario). This increase is due to an intensification of agricultural production systems but also due to the reduction in total agricultural land available.

Regarding the fertiliser usage on total area, the usage decreases which explains the reduction of N_2O emissions from fertilizer as seen before.

4.4 Impacts on Irish farmers' income

As a result of the above discussed changes in the Irish agricultural markets, initiated through an increased afforestation rate, the Irish farmers' total income overall primary activities decreases in the "National Forest" scenario by -7.4% and "C-Neutral" scenario by -25.6% and costs increase in the "National Forest" scenario by 3.2% and "C-Neutral" scenario by 10.4% (Table 5).[2]

Table 5: Changes in Irish farmers' income and total cost from main agricultural activities

	Reference		National Forest		C-Neutral	
	Total Costs	Income	Total Costs	Income	Total Costs	Income
	€/ha or head		%-difference to Reference			
Dairy cows	1880.18	888.19	3.25	-5.13	10.15	-16.14
Beef meat activities	965.12	34.83	2.41	-55.06	7.34	-166.80
Sheep & goat meat activities	41.14	42.62	2.53	-1.90	7.60	-5.69
All primary activities	1469.84	170.55	3.23	-7.36	10.36	-25.29

Note: Red indicates a decrease in Irish farmers' income and green an increase.
Source: Own compilation.

Looking at the livestock activities in more detail, it appears that total costs increase due to substantial increases in prices for input factors such as feed. The rise in feed prices results from the reduced land available for agriculture and the increased intensification occurring.

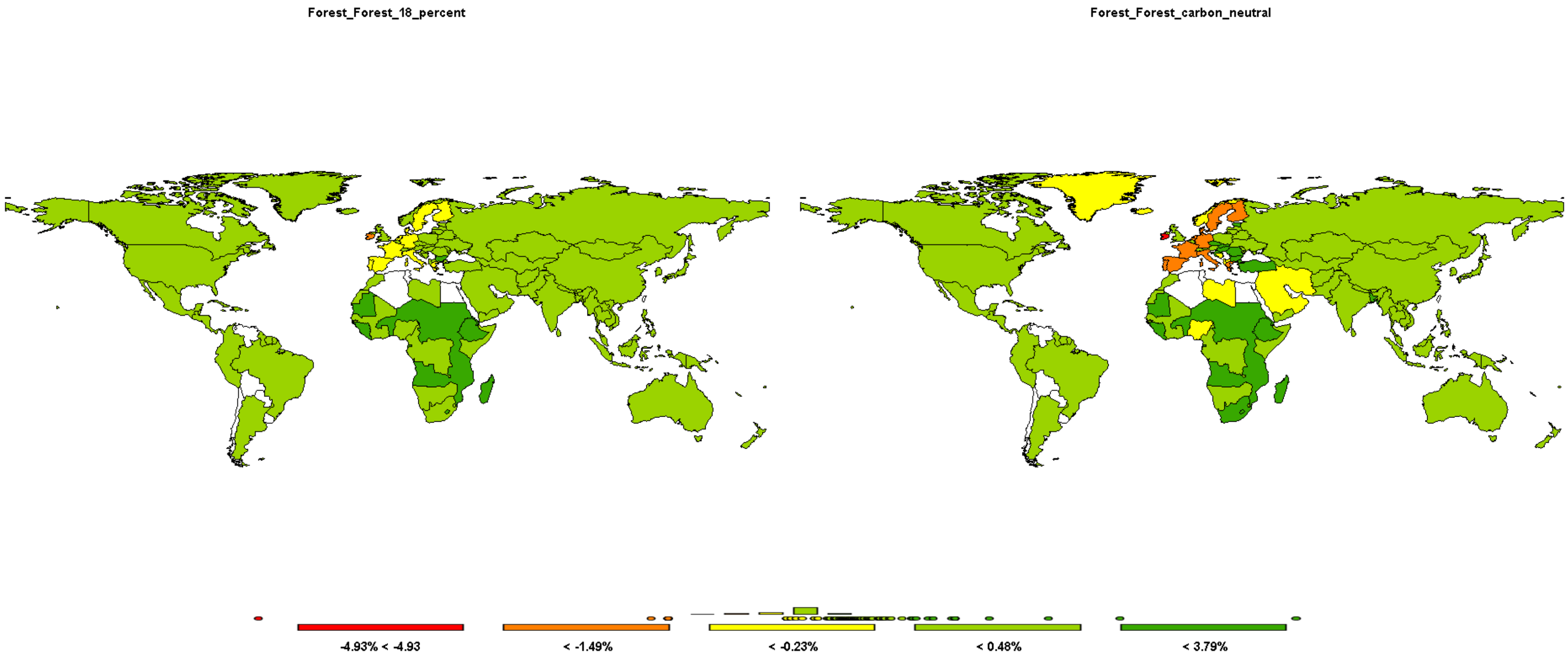
On the other hand, producer prices for meat and dairy products are not affected to the same extent as the input costs, whereby reduced supply due to decreased herd sizes reduces farm income of dairy farmers and beef farmers strongly. It appears that especially beef farmers who experience a substantial reduction in herd size (Table 3) would lose from an increased afforestation rate with a decrease in income of -5% in the "National Forest" scenario and -166% in the "C-Neutral" scenario (Table 5).

4.5 Impact on EU trade flows

As Ireland is a large exporter with regards to meat and dairy products (CSO, 2021, Eurostat, 2021), an increase in the annual afforestation rate not only affects Irish agricultural production in particular the beef sector but also leads to an increase in beef exports from other major beef exporters (Figure 4).

[2] It needs to be noted that CAPRI cannot provide any results on how many farms will remain active and as a result will be affected by the potential changes in total agricultural income (i.e. the model does not consider farm level structural change) (Perez Dominguez et al., 2016).

Figure 4 Change in export flows of Beef in 2030



Source: Own compilation

Under both scenarios, the Irish beef exports reduce by -1.6% (“National Forest” scenario) and -4.9% (“C-Neutral” Scenario) (Figure 4). As Ireland is the only country that experiences changes under the scenarios, it also is the single country with the greatest negative changes compared to the global market. Other European countries such as Germany, Spain and France experience under both scenarios a reduction in beef exports between -0.49% and -1.49% (Figure 4) in order to meet the demand of beef in their own country which is not covered through Irish beef exports anymore.

On the other hand, strong competitors of the Irish beef producers on the global beef market such as the Mercosur countries, appear to be able to increase their exports filling the occurring supply gap from the reduced Irish beef supply (Figure 4). This indicates a shift in the competitiveness of Irish beef farmers and a potential carbon leakage effect towards strong ruminant-based producing countries.

5 Discussion and Conclusion

The recently published Irish Climate Action Plan has outlined the leading role that the agriculture sector is required to take in order to achieve the Irish GHG emissions targets set out for the non-ETS sector by the EU. One possible way of achieving these is through an increase of carbon sequestration mainly an increased afforestation rate. This path would offset Irish GHG emission potentially resulting in a carbon neutral agriculture and land-use sector and at the same time result in in achieving the target under the Forestry Programme of expanding forest cover to maintain a sustainable forestry sector.

To reduce the Irish agricultural GHG emissions significantly by 2030 through carbon sequestration, the agriculture sector would need to increase its current afforestation rate substantially as the agriculture sector is the sector in Ireland that accounts for most of the afforestation since 1990. To assess the possible effects of an increased annual afforestation rate on the Irish agriculture sector and the offsetting of agricultural GHG emissions through carbon sequestration, two annual afforestation rates of 16,000 ha and 35,000 ha were set for Ireland. In the CAPRI simulations, these rates lead to an Irish forest coverage of 18% and 26% of the total area by 2050.

For the analysis, the agricultural sector model CAPRI was used. The two scenarios developed, allow for a move from land out of agricultural use into forestry and other land-use, in order to show the possible impact range that such a substantial land-use change could have already by 2030.

The results show that the set afforestation rates can be achieved by strongly adapting livestock production systems. In order to adapt to the increased afforestation and reduction in land available for agricultural activities, the grass-based ruminant sectors – in particular the beef sector - would likely reduce their livestock numbers. On the other hand, we would see in both scenarios a tendency towards intensifying the production systems which would result in a lower reduction of supply than in livestock numbers. This intensification tendency would slightly buffer the impact that increased afforestation rates would have on the Irish agricultural production in particular the Irish beef production. In both scenarios, fertilizer usage on agricultural used land increases due to the lower availability of agricultural land.

Further, the area under extensive use is more substantially reduced than area under intensive usage increases. These outcomes support the COFORD project's findings that see mainly land limited for agricultural use being transformed into forestry. Additionally, this partly explains why beef activities are stronger affected by an increased afforestation rate.

Resulting reductions in agricultural revenues are a result of the reduced land availability and increased costs due to the intensification of the livestock production costs. Changes in producer prices for beef and dairy products do not compensated for these changes. Hence, the impact on the income of Irish farmers is mostly negative in all scenarios – in particular for the beef sector.

As the increase of afforestation results in a reduction in total production, it needs to be pointed out that a production reduction could lead to carbon leakage effects with production and emissions shifting to countries with strong grass-based ruminant sectors. Changes in the trade flows – especially an increase in the export flows of the Mercosur countries in beef – suggest such a trend.

To increase the abatement potential of the agriculture sector and to substantially help bring the nexus between agricultural development and GHG emission targets in Ireland closer together, carbon sequestration can be a possible pathway in Ireland. But as a single measure it bears many market distorting affects that would potentially compromise the national capacity for sustainable food production. Offsetting agricultural GHG emissions through carbon sequestration can therefore only be one measurement in a set of many.

6 References

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