REFEREED ARTICLE

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# Socioeconomic drivers of land mobility in Irish agriculture

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**ABSTRACT**

Land mobility is becoming an increasingly important issue for European agriculture given the so-called "greying" of the farming population. This is especially the case in Ireland where meeting current and future policy goals will pose challenges to current agricultural land use and land structures. One of the most important of these policy goals is Food Harvest 2020 (FH2020), which envisages an increase in dairy milk volume of 50% by the year 2020. In order to facilitate this expansion, changes in Irish agricultural land use and land structures may be required.

Increased land mobility may be required to reach the FH2020 target. Currently, Ireland has the lowest rate of agricultural land rental in Europe and less than 1% of farmland is transferred by sale or inheritance annually. Although efforts have been made by policy makers to improve rates of land mobility, little improvement has occurred.

Given the current land structures, our analysis concludes that dairy farmers will require more land than is currently available to meet FH2020 targets. This extra land may come from non-dairy farmers. Cattle farmers are seen as most likely to transfer to dairy farming in the future but structural and demographic issues may mean that a far smaller amount of switching between cattle and dairy systems will occur than is expected by policy makers. This may impinge upon future growth in the Irish agri-food industry. In order to achieve policy objectives, better incentives may have to be developed to encourage the mobility of land between farmers.

**KEYWORDS:** Ireland: land use; land tenure: dairy: socio-economic determinants

## 1. Introduction

The removal of the milk quota for EU farmers in 2015 represents both a period of change but also opportunity for European farmers. Unlimited milk production allows EU countries that possess a comparative advantage in terms of dairy production to fully capitalise on that advantage for the first time in over 30 years. One such country is Ireland, where a combination of a grass-based feeding system and large amounts of productive land should allow great scope for increased dairy production. Despite continued milk price volatility in recent years, net margins for Irish dairy farms continue to outperform all other domestic farm systems (Dillon *et al*., 2017a). Irish public policy targets such as Food Harvest 2020 (FH2020) and Food Wise 2025 envisage an increase in dairy milk volume of 50% by the year 2020, followed by continued industry growth in subsequent years (DAFF, 2010a). This is based on an expected increase in demand for dairy products as a result of global population growth and rising per capita disposable incomes (DAFF, 2010b). This increased global demand is expected to lead to higher, albeit more volatile, prices for dairy products.

However, doubts have already been expressed concerning the likelihood of achieving FH2020 targets through increased herd size or increased milk yield without changes in Irish farm structures (Läpple and Hennessy, 2012). Meeting these targets, as well as fulfilling climate change and environmental obligations, will pose challenges to current land use and land structures. Land use change may require adjustments in what we formally consider agricultural land use change. Change may mean moving from agriculture to forestry, but may also mean a change in the mix of agricultural activities on a farm, for example, from cattle to dairy. Structural land change may involve changes in farm size and farm fragmentation.

Growth in the dairy sector will require changes to land use and land structures, which may prove difficult given Ireland's low level of land sales (O'Neill and Hanrahan, 2012) and land leasing (Ciaian *et al*., 2010). While there has been some increase in the average farm size over time, the rate of change is quite slow. Much of this increase has been via non-contiguous parcels, with the average land parcel number per farm increasing over time (Kearney, 2010). Measures to increase land mobility i.e. the transfer of agricultural land whether permanently or temporarily, have been introduced including incentivised land leasing, the removal of barriers associated with farm partnerships and farm consolidation stamp relief (Land Mobility Service, 2014).

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Nevertheless the pace of land mobility has been relatively slow. Recent work by Bogue (2013) has highlighted relatively limited understanding of the existence of these policies, as well as the existence of mistrust on the part of farmers in relation to these schemes. It is likely also that the interaction with other schemes such as the Basic Payment System and the Disadvantaged Area Payment may affect behaviour via the capitalisation of subsidies into land values (Latruffe and Le Mouël, 2009) and into reluctance to lease long term (Patton *et al.*, 2008). Low land mobility can impact on land price volatility (Roche and McQuinn, 2001), which can further reduce incentives to trade land. Ireland also shares many of the same issues facing other EU countries in terms of land mobility: increased concentration of land ownership (van der Ploeg, 2015); the inability of young farmers to access land (Hennessy, 2014; Zondag *et al.*, 2015) and increased competition for land use (Rounsevell *et al.*, 2006).

One consequence of this lack of land mobility is that it makes it difficult for those wishing to enter farming to acquire land. This is especially the case for young, aspiring farmers who are unlikely to have the financial means to compete for land even if it does become available. Despite the fact that Irish farmers are becoming older on average (Hennessy *et al.*, 2013), a renewed interest in farming amongst young people in Ireland is being observed. Enrolments in agricultural colleges have doubled between 2007 and 2014, with nearly 1,500 applications for Green Cert courses (the benchmark agricultural qualification in Ireland) (Healy, 2014). This is estimated to be three times the normal level of applications (Teagasc, 2015). This suggests that there is demand to enter the farming profession in Ireland. However, the increasing age profile of farmers suggests these prospective farmers are unable to access land. The inability to access land is particularly problematic in terms of dairy expansion as Irish dairy farmers tend to be younger on average than farmers in other systems (Hennessey & Moran, 2015).

The objective of this paper will be to utilise the Teagasc National Farm Survey (NFS) to describe the current land use structure and barriers for land use change in Ireland. From the perspective of meeting FH2020 and future strategic targets, it will look at the potential capacity for land use change and identify potential socio-economic barriers to change and restructuring. This will inform our understanding of what changes may be required to facilitate land use change to meet the ambitions of Irish agriculture. As Ireland shares many of the same land mobility challenges as many countries across the developed world, this paper will also give an insight into the issue of agricultural land mobility in general.

In terms of the structure of the paper, firstly we will look at the history and theory of land mobility and transfer. We will then consider the current pattern of land holdings in Ireland in terms of land use and land tenure and how the situation has changed over time. Following this, we will examine how agricultural land rents and values have evolved over time. The next section of the paper will describe the socio-economic drivers of land access and how these relate to the potential future expansion in dairy farming. Finally, the paper will examine the implications for land mobility policy and future dairy expansion.

## 2. Theory and background

Land markets are driven by supply and demand. Many factors can shift the supply of and demand for agricultural land, such as competing uses for land, changes in agricultural productivity, speculative forces, the potential of land to hedge against inflation and land's amenity values (Ciaian *et al.*, 2010; Ciaian *et al.*, 2012a). Individuals also hold land for many reasons besides agricultural production, such as prestige, lifestyle value and family traditions. Land may also be used as a store of wealth in times of high inflation or economic uncertainty.

Generally speaking, farmland is acquired either through attaining ownership (by purchase or inheritance) or through rental. In Western Europe, historical factors largely determine whether the majority of farmed land is owned or rented (Ciaian *et al.*, 2012b) Historically, European countries were dominated by large landlord-small tenant relations with poor tenure security and few tenant rights. In the early 20$^{th}$ century, policy strategies to improve the situation of tenants were enacted. In broad terms, one of two types of policy strategy was implemented. The first strategy was to improve the rental conditions for tenants through regulation and was followed in countries such as Belgium, France and the Netherlands. This led to a situation where farmers in these countries no longer wanted to purchase land because their tenure security was very high, and they could use their capital for other investments. In these countries, the rental share is relatively high.

The second strategy was to help tenants become landowners. This was the dominant strategy in countries like Denmark, Italy and Ireland. There, the government set up state funds to purchase farms for poor tenants or to subsidise the latter's purchase of land (or both). In all of these countries, the share of land rental is relatively low. The most dramatic impact occurred in Ireland, where almost all agricultural land was rented at the beginning of the 20$^{th}$ century, having since declined to around 17% in 2010 (CSO, 2012).

Agricultural land rental in Ireland is dominated by the conacre system, which involves land being rented on an 11-month basis. This type of short-term rental of agricultural land is unusual in the European context[1], with short-term or annual rental contracts being usually associated with developing countries (Deininger, 2009). The dominance of the conacre system goes back to the Land Commission, which was set up by the Land Act of 1881 to adjudicate on the fairness of rents and continued as a tool for implementing land policy following the setup of the Irish Free State in 1922. The leasing of land (excluding 11-month or conacre lettings) was subject to the express permission of the Land Commission, with land under longer leases being open to possible seizure by the Commission. Seized lands would be redistributed to local small farmers or migrants from 'congested' western counties. Landholders were reluctant to seek permission to let their land under leases longer than 11 months for fear of having such land taken over by the Land Commission (Conway, 1986). Long-term leases, common in

[1] Although there is a great deal of heterogeneity in the length of rental contracts across Europe, agreements generally last for multiple years with many countries regulating minimum contract length e.g. 9 years in France/Belgium, 5 years in Spain. See Ciaian et al. (2010) for further discussion.

European agriculture, have therefore remained relatively rare in Ireland (Ciaian *et al*., 2010).

In Ireland, only a limited amount of agricultural land comes on the market each year, typically arising from the retirement or death of the owner. As a result, only a tiny proportion of total agricultural land is sold in any given year. Bogue (2013) points to an aversion amongst Irish farmers to selling their farms (only 28% of farmers would consider doing so), as well as a strong desire to see their farm remain within their family (66% of farmers).

Agricultural land availability in Ireland is seen as increasingly important in the light of policy developments such as FH2020 and the removal of the milk quota system in 2015 (Dillon *et al*, 2008; Läpple & Hennessy, 2012). FH2020 seeks to increase the volume of milk output by 50% by the year 2020, with further expansion likely to be targeted beyond that time. Since Irish dairy farmers use a predominantly grass-based production system, this expansion will require a substantial amount of extra land on which dairy cows can graze. Gaining access to this extra land will be important in terms of meeting FH2020 targets as well as sustainable dairy expansion beyond 2020.

Soil and land quality is an important issue in this context. Productive soils are vital for successful dairy farms due to the high grass growth rates needed for intensive grazing systems (Lalor *et al*., 2013). In order for dairy output to increase by targeted levels, productive land will have to become available for use by expanding dairy farmers and new entrants to the sector. A related topic is the productivity of dairy farming compared with other farming systems. It has been shown that dairy farming in Ireland is consistently more profitable than other farming systems such as cattle rearing, tillage and sheep farming (Hennessey *et al*., 2013). A movement of land that is currently being used for other types of farming to dairy farming could see a huge productivity gain for Irish agriculture.

## 3. Methodology and data

This paper utilises data from the National Farm Survey (NFS) which is a national farm survey of approximately 1,000 farms conducted every year by Teagasc. The survey data is weighted so as to be nationally representative of Irish dairy, cattle, sheep and tillage farms. In 2011[2], the survey reported results from 1,077 different farms, of which 1,073 were divided into one of six farming systems: dairy; dairy other[3]; cattle; cattle other[4]; sheep and tillage (see Table 1). The NFS also provides data on soil quality with soil being rated on a scale from one to six (one being the highest quality soil, six being the lowest). Soils rated one or two are good quality, those rated three or four are medium quality while soils rated five or six are poor quality[5].

Cattle farming is currently the dominant form of agriculture in Ireland across all soil types, accounting for 57% of land on NFS farms. Dairy farming accounts for 14.9% of agricultural land, with sheep farming taking place on 12.3% of land. Tillage farming takes up 8.6% of agricultural area. Figure 1 shows how agricultural land is used on different types of soil. Land with good quality soil makes up the majority of Irish farmland, accounting for 55% of agricultural land. Cattle farming uses the most good quality soil (54.5%), followed by dairy farming (17.1%) and tillage (14.8%). Cattle farming also dominates the use of medium quality soil (64.1%), with dairy farming taking up 14.6% and sheep farming 10.8%. Poor quality soil comprises 11.4% of agricultural land with cattle (46.8%) and sheep (32.4%) farming taking up the vast majority of this type of land.

**Table 1:** Farms by system in the National Farm Survey, 2011

| Farm System | Number of Farms | Share |
|---|---|---|
| Dairy | 272 | 25.3% |
| Dairy Other | 90 | 8.4% |
| Cattle | 202 | 18.76% |
| Cattle Other | 274 | 25.44% |
| Sheep | 132 | 12.3% |
| Tillage | 103 | 9.6% |
| Total | 1073 | 99.6% |

Although cattle farming uses the majority of agricultural land, Table 2 shows that cattle farms are not the largest on average. The NFS breaks down farms into one of six systems: dairy; dairy other; cattle; cattle other; sheep and tillage. Tillage farms are the largest on average, at just over 64 hectares per farm, followed by dairy farms at 54.8 hectares and dairy other farms at 48.9 hectares. Sheep farms are 40.8 hectares on average, with cattle other farms measuring 33.8 hectares and cattle farms being the smallest at 31 hectares per farm. In terms of soil quality, dairy and cattle farms tend to get smaller, on average, as soil quality worsens. The average size of sheep and tillage farms tends to increase as soil quality deteriorates.

Average farm sizes are now at their highest level in recent history. In 1996, the average farm size, according to NFS data, was 32.2 hectares. By 2011, this had risen to 40.3 hectares with increases in farm size evident across all systems. This farm size increase has resulted from a movement of land from small (under 25 hectares) to medium (50–75 hectares) and large farms (over 75 hectares). Land rental share has increased from 12.7% to 17.6% from 1996 to 2011 but the share of land rented out has dropped from 2.6% to 1.8% in that time. This suggests that active farmers are not the source of rented land.

## 4. Results I. Patterns of land access and transfers

The increase in farm size has been enabled by an increase in renting by farmers. The average amount of land rented per farm has been increasing steadily over the last number of years, reaching 16.3 hectares per farm in 2011. Farms with good soil have the highest amount of rented land per farm at an average of 19.8 hectares per farm. Farms with poor soil rent 16.4 hectares on average, while those on medium soil rent an average of 12 hectares of land (see Table 3).

Table 3 also shows the disparity between the amount of land rented in and rented out by farmers. It demonstrates

[2] Although this paper uses data from 2011 and before, more recent data shows similar results to those mentioned here (see Dillon et al., 2017b).
[3] Mainly dairy farming with beef cattle/tillage also on farm
[4] Mainly cattle fattening/finishing. The 'cattle' system refers to cattle rearing, usually up to one year of age.
[5] Soil quality is based on the use range of the land with the highest rated soil having the widest use and lowest rated soil the narrowest. Soil quality is measured in person by the survey recorder.

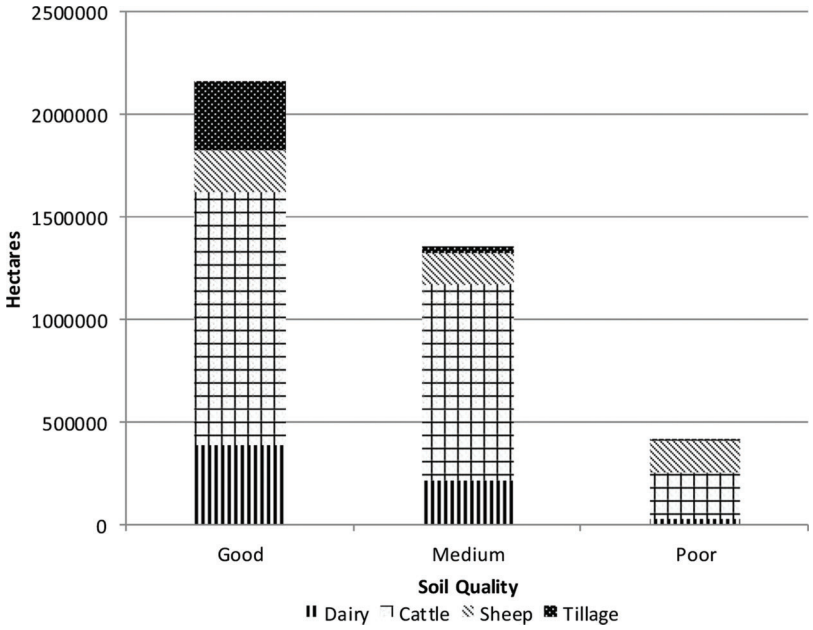


**Figure 1:** Land use on Irish farms by soil type (in hectares), 2011

**Table 2:** Average farm size by farm system and soil type (in hectares), 2011

| Farm System | Dairy | Dairy Other | Cattle | Cattle Other | Sheep | Tillage | Total |
|---|---|---|---|---|---|---|---|
| Soil | | | | | | | |
| Good | 55.4 | 59.9 | 32.4 | 35.9 | 38.0 | 64.3 | 44.0 |
| Medium | 54.1 | 42.2 | 28.9 | 31.3 | 37.9 | 68.6 | 35.6 |
| Poor | 52.8 | 31.4 | 35.3 | 33.7 | 47.6 | 0.0 | 40.4 |
| Total | 54.8 | 48.9 | 31.0 | 33.8 | 40.8 | 64.8 | 40.3 |

**Table 3:** Owned/rented share of agricultural land, 2011

| | Land Owned | Land Rented In | Land Rented Out | Land Owned (per farm) (Ha) | Land Rented (per farm) (Ha) |
|---|---|---|---|---|---|
| Soil | | | | | |
| Good | 82.5% | 20.0% | 2.5% | 37.7 | 19.8 |
| Medium | 85.5% | 15.4% | 0.8% | 31.9 | 12.0 |
| Poor | 87.6% | 13.6% | 1.2% | 37.1 | 16.4 |
| Total | 84.1% | 17.6% | 1.8% | 35.3 | 16.3 |

that the vast majority of land rented in by farmers is not rented from other active farmers. This land may be rented out by landowners, usually the non-farming offspring of farmers who inherit land upon their parent's death, who are not interested in farming the land themselves but wish to retain ownership of the land. The improved economic conditions in Ireland in the late 1990's and 2000's may have facilitated this as the offspring of farmers found non-agricultural employment rather than take over the family farm (Meredith & Gilmartin, 2014).

Average rent per hectare (in nominal terms) has stayed relatively stable over the last number of years (see Table 4). The average rent paid in 1996 was €230.24[6] per hectare while by 2011 this had only risen to €241.10 per hectare in nominal terms. On land with good soil, nominal average rent per hectare decreased steadily from 1996 to 2005, falling from €280.82/ha to €253.96/ha. However, nominal rents then started to rise again and stood at €279.15/ha in 2012. Nominal rents on land with medium quality soil stayed constant at just over €200/ha over the time period between 1996 and 2011. Nominal rents on land with poor quality soil rose steadily from 1997 onwards,

**Table 4:** Average rent per hectare by soil type (in €/ha), 1996 & 2011

| Year | 1996 | 2011 |
|---|---|---|
| Soil | | |
| Good | €280.82 | €279.15 |
| Medium | €203.52 | €213.91 |
| Poor | €136.96 | €154.62 |
| Total | €230.24 | €241.10 |

[6] At the time of writing (December 2016), €1 was approximately equivalent to $1.05 and £0.84.

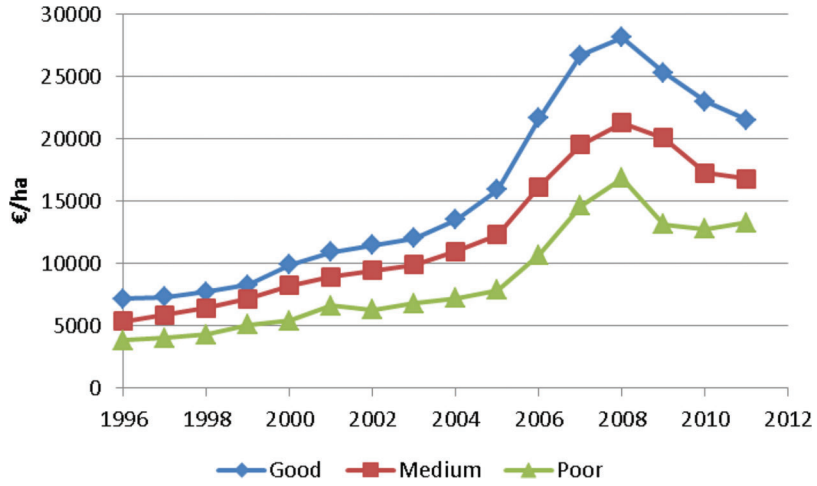


**Figure 2:** Average self-reported agricultural land values by soil type (in €/ha), 1995–2012

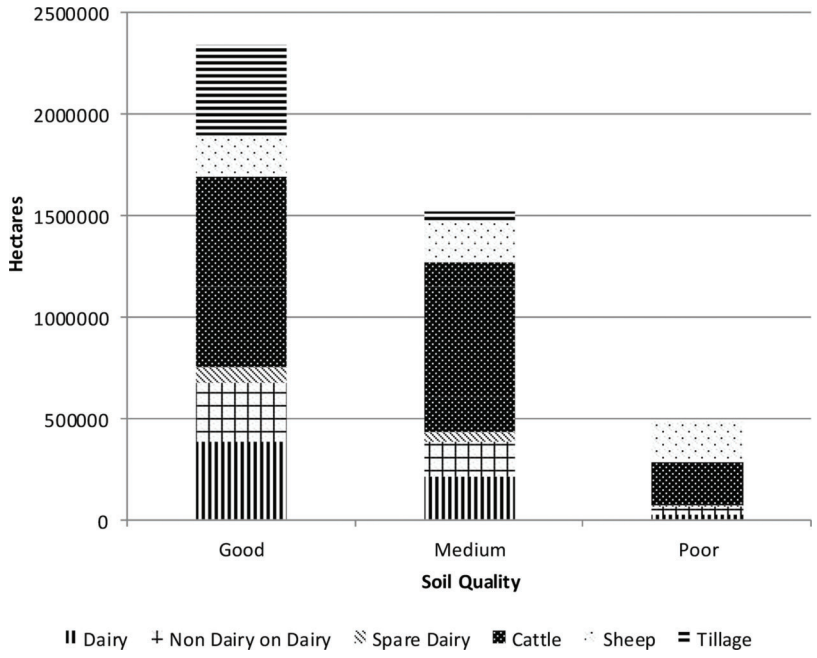


**Figure 3:** Land use on Irish farms by soil type (in hectares), 2011

peaking at €179.52 in 2007 but have since slipped to €154.62/ha in 2011.

The amount of agricultural land sold in Ireland each year is very small, accounting for less than 1% of Irish farmland (Busteed, 2014). Supply of land for sale is inhibited by the traditional model of agricultural land mobility where land is inherited rather than sold. Agricultural land values are shown in Figure 2. These values are based on NFS data which are self-reported estimates of the value of farmland in the dataset. Values rose through the 1990's and most of the 2000's as Ireland experienced rapid economic growth and the development of a property bubble. As demand for residential and commercial land increased, agricultural land values also spiked as purchasers hoped to have the land rezoned for alternative uses. The disconnect between stable land rental prices and increasing agricultural land values shows that the increase in land values was not due to agricultural factors. As Figure 2 shows, values peaked in 2008 and fell rapidly afterwards as the property bubble collapsed and recession took hold.

## 5. Results II: Socio-economic drivers of land access

Dairy farming represents the second biggest share of agricultural land in Ireland but it remains far behind that of cattle farming. However, since public policy targets such as FH2020 envisage an expansion of dairy production, it may be necessary to increase the amount of land dairy farmers can access. Figure 3 shows that there is already a pre-existing share of land on dairy farms that is either spare dairy platform[7] or is being used for non-dairy purposes. Land used for non-dairy purposes is overwhelmingly used for cattle farming, with a small amount of sheep farming or tillage crops. These are likely to be farmers who are constrained by quota in the amount of milk they can produce so use some of their land for other types of production. The land on dairy

[7] Spare dairy platform refers to land on dairy farms that is within walking distance of the milking parlour and is not currently being used by the dairy herd for any other farming purpose.

**Table 5:** Description of yield scenarios

| Yield | Description |
|---|---|
| No Increase | Yield per cow stays constant at 2010 levels (5,000l/cow) |
| 50% Long-Term Rate | Yield per cow increases at 50% of long-term rate (0.65%) |
| Long-Term Rate | Yield per cow increases at long-term rate (1.3%) |
| 150% Long-Term Rate | Yield per cow increases at 150% of long-term rate (1.95%) |

**Table 6:** Milk production required to reach Food Harvest 2020 target (000,000's litres)

| | Stocking Rate | | | |
|---|---|---|---|---|
| Yield Increase | 1.8 LU/ha | 2 LU/ha | 2.5 LU/ha | 3 LU/ha |
| No Increase | 5007.8 | 5564.3 | 6955.3 | 8346.4 |
| 50% Long-Term Rate | 5343 | 5936.7 | 7420.9 | 8905.1 |
| Long-Term Rate | 5698.3 | 6331.4 | 7914.3 | 9497.2 |
| 150% Long-Term Rate | 6074.6 | 6749.6 | 8437.1 | 10124.5 |

**Table 7:** Distance from Food Harvest 2020 target

| | Stocking Rate | | | |
|---|---|---|---|---|
| Yield Increase | 1.8 LU/ha | 2 LU/ha | 2.5 LU/ha | 3 LU/ha |
| No Increase | -32% | -25% | -6% | +13% |
| 50% Long-Term Rate | -28% | -20% | 0% | +20% |
| Long-Term Rate | -23% | -14% | +7% | +28% |
| 150% Long-Term Rate | -18% | -9% | +14% | +37% |

farms currently being used for non-dairy purposes corresponds to 44.4% of land on dairy farms (11.9% of all agricultural land), while spare dairy platform corresponds to 11% of land on dairy farms (2.9% of all land). Therefore, there is quite significant land within dairy farms currently being used for other purposes, which will be the easiest on which to expand.

## Milk expansion scenarios

The policy aim accompanying dairy expansion is the achievement of a 50% milk production increase by 2020. Table 5 presents a number of potential scenarios of how milk production can be increased given the current land use and milk yield structure. This gives an insight into how much land will be required to reach the target of increasing milk production by 50%. Given that the baseline milk production on which the target is based is an average of production from 2008 to 2010, a 50% increase amounts to a milk production target of 7.4 billion litres by 2020. This target can be met in four ways: increasing yield; increasing stocking rate; increasing available land area or a combination of the three. Table 6 shows to what extent the FH2020 target is achievable with only yield and/or stocking rate increasing and no extra land becoming available.

Four yield and stocking rate levels are modelled. The yield scenarios are based on the long-term trend of milk yields since the introduction of quota in 1984 (see Table 5). From 1984 to 2010, there has been an average yearly increase of 1.3% in milk yields per cow based on CSO data. The first yield scenario has yield per cow remaining constant at 2010 levels of 5,000 litres per cow. The second scenario has yield per cow increasing yearly at half the long-term rate (0.65%) up to 2020. The third scenario has yield continuing to increase yearly at the long-term rate (1.3%) while the fourth scenario has yield increasing yearly at 50% above the long-term rate (1.95%) up to 2020. The four stocking rates that are modelled are 1.8 livestock units (LU) per hectare (the average stocking rate of dairy farms in 2010), 2 LU/ha, 2.5 LU/ha and 3 LU/ha.

The results show that without a large increase in stocking rate, extra land will be required to meet the FH2020 milk production target (see Tables 6 & 7). At both the current stocking rate of 1.8 LU/ha and the increased rate of 2 LU/ha, none of the modelled yield rates produces enough milk to reach the target of 7.4 billion litres. When the stocking rate is raised to 2.5 LU/ha, yield growth is still required although growth at 50% of the long-term rate is sufficient to reach the target. When the stocking rate is set at 3 LU/ha, the FH2020 target is achieved, even without any increase in yield over 2010 levels.

In reality, reaching the FH2020 target only through increased yield and/or stocking rate is unrealistic. Although Irish dairy farmers are constantly improving efficiency in terms of increased grazing through grassland management, increased stocking rates usually have the effect of slowing per cow yield growth or even causing yields per cow to fall (Baudracco *et al*., 2010; MacDonald *et al*., 2008). Additionally, increased stocking rates may conflict with the European Union Nitrates Directive. The Nitrates Directive aims to address water pollution by nitrates from agriculture by capping the amount of livestock manure that can be applied to land at 170 kg of nitrogen per hectare. This has the effect of limiting the stocking rate a farmer can maintain on their farm. Currently, Ireland has a derogation that allows a 250 kg nitrogen limit but this derogation runs out in 2021. There are no guarantees that such derogations will be available again after 2021, which poses a risk to expanding dairy farmers who aim to maintain high stocking rates going forward. Given these difficulties around yield and stocking rates, it seems likely that extra land will be required to reach FH2020 target.

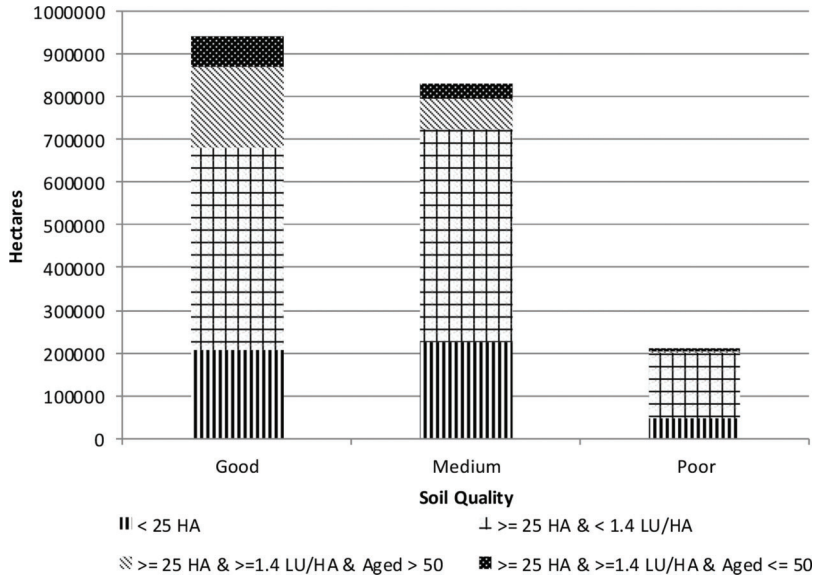


**Figure 4:** Land structure of cattle farms (in hectares), 2011

### Socio-economic scenarios by land use type

Accessing extra land for dairy farming would require structural change in Irish agriculture. This could occur through existing dairy farmers acquiring land via land markets, collaborative farming arrangements or through current land owners becoming new entrant dairy farmers. Given, the static nature of the Irish land market, as well as the low uptake of collaborative farming arrangements in Ireland, current land owners becoming new entrant dairy farmers seems the most likely future scenario. Looking at current land use, 19.4% all agricultural land with good quality soil is used for tillage farming. While these farms have sufficient quality land and are generally large in size, they are unlikely to have facilities or experience for handling dairy animals. They would thus require quite significant investment and re-skilling and/or change of management to move into dairy farming. Additionally, conversion of tillage land to dairy may reduce Ireland's level of self-sufficiency in relation to cereal crops, as well as having environmental implications in terms of birds and wildlife (DAFM, 2014). In terms of land with good and medium soils, 11% of this land is used by sheep enterprises, which again are likely to face issues in terms of investment and specific dairy management skills.

Of the alternative farming systems, cattle managing systems are the most complementary for moving into dairy. Nearly half of the land on farms with good or medium soils is used for cattle farming. However, several issues may inhibit the movement of cattle farmers into the dairy sector (see Figure 4). Firstly, 24% of cattle farms with sufficient soil quality are less than 25 hectares and would thus require consolidation before moving into dairy. This consolidation is required as dairy transition would not be economically viable on such a small grazing land base. Secondly, of the farms larger than 25 hectares, 55% have stocking rates of less than 1.4 LU/ha. The stocking rate is low largely due to either age (31% aged 65+) or due to other work commitments (33% with an off-farm job). These farmers are unlikely to want to move into a more intense system such as dairy. Those most likely therefore to consider moving into dairy are those with stocking rates of 1.4 LU/ha or higher and a farm of at least 25 hectares, which amount to 21% of cattle farmland in the good/medium soil range and to 10% of all farmland with these soils. Of the farmers with the necessary land and stocking rate, 25% have off-farm employment. Age is also likely to be an issue with 19% over 65 in 2011, and only 29% 50 years of age or younger. When all these factors are taken into account, just over 100,000 hectares of cattle land are likely to become available for dairy purposes, corresponding to 2.5% of total agricultural land. Roughly speaking, if stocking rates remained unchanged and milk yields continued to grow at the long-term rate of 1.3%, around 166,000 extra hectares of land would be required to meet the FH2020 target.

## 6. Conclusions and policy recommendations

The agricultural land market in Ireland is characterised by stasis. Cattle farming is the dominant use of farmland, with over half of the total agricultural land in the country being devoted to it. The share of farmland that is rented in rather than owned has increased to over 17% of all agricultural land but this figure still rests well below the European average of approximately 55% (European Commission, 2018). This increase in land rented in by farmers is not matched by the amount of land farmers are renting out (1.8% of total UAA), suggesting that farmers are renting land from non-farmers rather than from other farmers. Nominal rent prices have remained stable over time, regardless of the quality of the land. Agricultural land values underwent a boom in concert with residential and commercial property prices from the late 1990's until the economic crash of 2008 caused prices to fall precipitously. A very small amount of farmland is bought and sold each year, a pattern that predates the rise in agricultural land values during the economic boom (Kelly, 1983; Roche & McQuinn, 2001). Much of the land sold is of a very small size (less than one hectare), with these plots of land likely used to build one-off houses.

In terms of dairy expansion, there is a not insignificant amount of land that dairy farmers can immediately expand onto following the removal of quota restrictions. This land consists of land on dairy farms currently used for non-dairy farming purposes. Given the increased stocking rates and/or increased milk yield that would be necessary to reach FH2020 targets, it is almost certain that additional land will be required in the future by dairy farmers. This corresponds with the findings of Läpple and Hennessy (2012) who found that achieving the FH2020 target of a 50% increase in milk output on current dairy farms' land base is unlikely. Cattle farmers are likely to be in the best position in terms of skills and land quality to transfer to dairy farming but multiple hurdles may prevent this from happening. Small farm size, low stocking rates and age-related concerns mean that in actuality, only a small number of cattle farmers may be likely to switch to dairy farming. The farmland accounted for by these farmers corresponds to 2.5% of total agricultural land.

The environmental effect of increasing dairy production must also be considered. Ireland has international obligations in terms of greenhouse gas (GHG) emissions reduction and water quality maintenance through the Nitrates Directive. Dillon *et al.* (2016) report that although the economically top-performing dairy farms emit less GHG emissions than their less intensive counterparts, the same top performing farms have a higher nitrogen surplus per hectare on average. Given that the most economically productive farmers are also the most intensive and therefore the most likely to expand following quota removal, achieving environmentally sustainable dairy production may prove difficult. Changing land use from other forms of farming to dairy may also have other environmental implications including increasing overall GHG emissions from agriculture (Donnelan *et al.*, 2014), increasing the risk of flood generation at the local scale (Williams *et al.*, 2012), and reducing farmland biodiversity (Sheridan *et al.*, 2011).

While immediate and significant dairy expansion following quota removal seems feasible given current land structures, medium and long-term growth in milk production will require more land to become available than currently seems likely. In order to achieve policy targets, increased land mobility will have to be facilitated. The low levels of renting and thin transaction market show a bias amongst Irish farmers toward owning the land that they farm. This is despite increased government interest in the area and a land market found to be the least regulated in the EU (Swinnen *et al.*, 2014). However, relatively little is known about the attitudes of Irish farmers to land mobility. It must also be noted that policies leading to effective changes in tenure systems are very politically sensitive and difficult to achieve (Swinnen *et al.*, 2016). More work is required to determine why Irish farmers are more averse to entering the land market than their European counterparts and to identify new policy options that can make land mobility more attractive to farmers.

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