Teagasc National Farm Survey

FERTILISER USE SURVEY

2005-2015

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Executive Summary

Methodology: The data used for this analysis is taken from the Teagasc National Farm Survey (NFS). The publication reports on average quantities of Nitrogen (N), Phosphorus (P) and Potassium (K) macro-nutrients and lime applied at farm level as well as the particular types of fertiliser used on grassland and arable farms in Ireland between 2005 and 2015. Trends in fertiliser use by nitrates zone, land use class, farm system, stocking rate and agri-environmental scheme participation are presented over the eleven-year period. Results were validated by comparison with published annual sales data of N, P and K from the Department of Agriculture, Food and the Marine (DAFM) and it was found that the NFS data closely tracks national fertiliser sales of N, P and K over the study period.

Grazing Area: N application rates on grazing area were highest at the start of the study period in 2005 at 82 kg ha^{-1}, before declining by between 15-30% to 57-70 kg ha^{-1} during the years 2008 to 2012. An increase towards the end of the period is evident, however, N application rates were still between 18-23% to 63-67 kg ha^{-1} lower in 2014/2015 compared to 2005. P application rates on grazing area were also highest at the start of the study period (7 kg ha^{-1}), before declining by between 43-57% to 3-4 kg ha^{-1} between 2008 and 2012 and increasing again to 5 kg ha^{-1} by 2015. Despite this, P application rates were 29% lower at the end of the study period compared to initial levels. K application rates followed a similar trend, highest in 2005 at 15 kg ha^{-1}, before declining by between 47-60% from 2008 to 2012. There was some increase towards the end of the study period, but application rates were still 20% lower in 2015 (12 kg ha^{-1}) than in 2005. Higher application rates of N, P and K were generally associated with farms in nitrates zone A (South and East of the country), farms of wide land use potential, dairy farms and farms with higher stocking rates.

Silage Area: There was significant volatility in N application rates on silage area over the study period, with the lowest and highest application rates recorded in 2008 (96 kg ha^{-1}) and 2013 (121 kg ha^{-1}) respectively. The 2013 recovery was likely to be a direct result of the poor weather in 2012 and resultant fodder crisis. P application rates on silage ground were highest at the start and end of the study period (11-12 kg ha^{-1}) but declined by between 25-42% to 7-9 kg ha^{-1} during the years 2008 to 2012. K application rates on silage area were again highest at the start of the study period at 37 kg ha^{-1} (2005) and declined by 32-43% to 21-25 kg ha^{-1} mid-period (2008-2012) before recovering by 2015 to 33 kg ha^{-1}. Higher N application rates on silage area were again associated with farms in nitrates zone A, farms of wide land use potential, dairy farms and farms with higher stocking rates. Higher P and K application rates on silage area were associated with farms in nitrates zone A, farms of limited land use potential and tillage farms producing silage from grassland areas.

Hay: N application rates on hay area ranged from 45-59 kg ha^{-1} over the study period. A high of 59 kg ha^{-1} was observed across a number of years (2006, 2007, 2010) and the lowest application rate (45 kg ha^{-1}) was evident at the end of the study period in 2015. Overall P application rates ranged from 7-10 kg ha^{-1}, with the lowest application rate (7 kg ha^{-1}) reported over a number of years (2008, 2009 and 2011) and the highest rate (10 kg ha^{-1}) observed at the start of the period in 2005. Overall, K application rates ranged from 17-25 kg ha^{-1}, with the highest application rates in 2005 (25 kg ha^{-1}) and the lowest in 2008 (17 kg ha^{-1}).

Total Grassland Area: N application rates on total grassland area were highest at the start of the study period (2005/06) at 99-100 kg ha^{-1}, before declining by between 7-23% to 76-92 kg ha^{-1} from 2008 to 2012. There was some increase, but overall N application rates were still between 11-16% lower at 83-88 kg ha^{-1} in the final years of the study period (2014/2015) compared to 2005. P application rates on grazing area were also highest at the start of the study period (9 kg ha^{-1}) before declining by between 44-56% to 4-6 kg ha^{-1} from 2008 to 2012. Although P application rates increased toward the end of the period in 2015 (8 kg ha^{-1}) they were still 11% lower than in 2005. K application rates followed a similar trend, highest in 2005 at 23 kg ha^{-1} before declining by between 35-52% mid-study period (2008-2012) with some recovery towards the end of the period but usage still 13% lower overall at 20 kg ha^{-1}. Higher application rates of N, P and K on grassland were generally associated with farms in nitrates zone A, farms of wide land use potential, dairy farms and farms with higher stocking rates.

Fertiliser compounds on Grassland: Six main fertilisers (N-P-K: 27.5-0-0, 27-0-0, 27-2.5-5, 24-2.5-10, 46-0-0, 18-6-12) accounted for the majority of N applied to grassland. CAN based fertilisers (27.5-0-0 and 27-0-0) dominated, accounting for between 30-49% of the total N applied. Four main fertilisers (18-6-12, 27-2.5-5, 24-2.5-10 and 10-10-20) were responsible for the majority of P (more than 70%) applied to grassland. Over 30% of total P at the end of the study period was accounted for by 18-6-12. There were only four main fertilisers with application rates consistently averaging over 5% of total K applied during the study period (18-6-12, 24-2.5-10, 27-2.5-5, 10-10-20) with 18-6-12 and 24-2.5-10 each accounting for between 23-25% of total K in 2015.

Main cereals: N application rates on the main cereal crops (wheat, barley and oats) were highest at 158 kg ha^{-1} in 2015. This was 10% higher than starting period levels and nearly 20% higher than the low in 2008 of 133 kg ha^{-1}. P application rates on cereals were broadly similar at the start and end of the study period (25-27 kg ha^{-1}) having dipped by 30% (18-19 kg ha^{-1}) in 2009/2010. K application rates were at a high of 80 kg ha^{-1} in 2015 up from 60 kg ha^{-1} in 2005. N application rates were

highest on winter crops. The highest application rates on average over the period were associated with winter wheat (190 kg ha^{-1}), winter barley (166 kg ha^{-1}) and winter oats (146 kg ha^{-1}) respectively. Of the spring crops the highest average N application rates were associated with malting barley (129 kg ha^{-1}), spring barley (125 kg ha^{-1}) and spring oats (105 kg ha^{-1}) respectively. Application rates of P over the study period were highest on winter and spring barley at 26 and 24 kg ha^{-1} respectively. Whereas the other cereal crops had average P application rates of 21-22 kg ha^{-1} over the period. Average K application rates were highest across winter crops, with winter wheat and winter barley having similar average applications rates over the study period at 77 kg ha^{-1} followed by winter oats at 69 kg ha^{-1}. Of the spring crops, average K application rates were highest across malting barley (66 kg ha^{-1}) followed by spring barley (58 kg ha^{-1}) and spring oats (55 kg ha^{-1}). CAN based fertilisers (27.5-0-0 and 27-0-0) on average accounted for over 60% of total N fertiliser applied to the main cereal crops over the study period. On average 60% of total P applied to the main cereal crops was derived from two fertilisers 18-6-12 (31%) and 10-10-20 (29%). Three main fertilisers (18-6-12, 10-10-20 and 0-0-50) accounted for over 50% of total K applied to the main cereal crops from 2005-2015.

Other Tillage crops: Fodder beet, maize, oilseed rape and peas/beans are grouped here as other tillage crops. N application rates varied by crop type over the period ranging from 138-172 kg ha^{-1} for fodder beet, from 137-179 kg ha^{-1} for oilseed rape and from 120-165 kg ha^{-1} for maize. N applied to peas and beans was much lower, ranging from 0 to 33 kg ha^{-1}. P application rates also varied by crop type, ranging from 43-54 kg ha^{-1} on fodder beet, from 27-39 kg ha^{-1} on maize, from 11-32 kg ha^{-1} on oilseed rape and from 14 to 24 kg ha^{-1} on peas and beans. Similarly, K application rates ranged from 153-210 kg ha^{-1} for fodder beet, from 75-95 kg ha^{-1} for maize, from 40-84 kg ha^{-1} for oilseed rape and from 53 to 88 kg ha^{-1} for peas and beans.

Selected Root Crops: N application rates on selected root crops (potatoes, sugar beet, fodder rape, turnips and kale) ranged from 106-151 kg ha^{-1} over the study period with rates at their highest in 2005 (151 kg ha^{-1}) falling between 17-30% thereafter. P application rates ranged between 39-59 kg ha^{-1} from 2005-2015 with the highest rate reported in 2006 (59 kg ha^{-1}) with a subsequent decline of 34% to a low of 39 kg ha^{-1} in 2015. K application rates ranged from 131-197 kg ha^{-1} over the period, highest in 2007 (197 kg ha^{-1}) followed by a decline of 34% to a period low of 131 kg ha^{-1} by 2015.

Agri-environmental scheme participation: Fertiliser application rates on total grassland area over the period 2005-2015 were on average nearly 36% lower for agri-environmental scheme participants (49-79 kg ha^{-1}) compared to non-participants (87-123 kg ha^{-1}). N applications rates were 45% lower

on grazing, 13% lower on silage and 8% lower on hay area for scheme participants. P application rates on total grassland area were on average almost 38% lower for scheme participants (4-7 kg ha^{-1}) compared to non-participants (5-11 kg ha^{-1}) over the eleven year period. The differential across grazing, silage and hay area for P was 45%, 16% and 7% respectively. K application rates across total grassland area were on average 34% lower for scheme participants (12-18 kg ha^{-1}) compared to non-participants (12-27 kg ha^{-1}). The differential across grazing, silage and hay area for K was 40%, 17% and 7% respectively. N application rates on the main cereal crops for non-scheme participants were on average 1.15 times higher at 150 kg ha^{-1} compared to scheme participants where the average rate applied was 130 kg ha^{-1} over the study period. Average P application rates on cereal area over the study period were broadly similar across scheme participants and non-participants, where the average application rate over the period was 23 kg ha^{-1} for non-participants compared to 21 kg ha^{-1} for scheme participants. K application rates on cereal area were also broadly similar, where the average rate applied for non agri-environmental participants was 64 kg ha^{-1} compared to 62 kg ha^{-1} for those participating in a scheme.

Liming: On average just over 20% of farms were using lime year-on-year over the study period. The lowest rate of liming was evident in 2006 at 16% and the highest liming rate over the period was recorded in 2013 at 26% of total farms. Higher rates of liming were associated with farms of wide land use potential, dairy farms and farms with higher stocking rates.

1. Introduction

This publication reports the quantities of macro-nutrients, Nitrogen (N), Phosphorus (P) and Potassium (K) and lime applied on Irish farms over the period 2005 to 2015. These data were collected through the Teagasc National Farm Survey (NFS) which contains information on the types of fertiliser used on both grassland and arable farms in Ireland on an annual basis. It should be noted that organic manure use is not included in this analysis. Trends for chemical fertiliser use only are presented by nitrates zone, land use class, farm system, stocking rate band and agri-environmental scheme participation. This is the fourth such fertiliser use survey which covers an important eleven year period (2005-2015) during which the EU Nitrates Directive came into operation bringing with it significant changes to chemical fertiliser management both at farm and field level. The EU Nitrates Directive Good Agricultural Practice (GAP) measures were first introduced in Ireland in 2006 through statutory instrument (S.I.) No. 378 of 2006 and were subsequently updated through Statutory Instruments S.I. 101 of 2009, S.I. 610 of 2010 and S.I. 31 of 2014 over the study period. The main aim of these regulations is to prevent pollution of surface waters and groundwater from agricultural sources and protect and improve water quality. These regulations regulate fertiliser use on farms and set down legal maximum application rates for N and P as well as a range of other measures.

1.1 Data

The data used for this analysis is taken from the Teagasc National Farm Survey (NFS). The Teagasc NFS has been carried out annually since 1972 and fulfils Ireland's statutory obligation to provide data on farm output, costs and income to the European Commission through the Farm Accountancy Data Network of the European Union (FADN). Over time, there has been an increased appreciation that data relating to the environmental aspects of agriculture are of growing importance and this has led to the collection of data beyond FADN requirements, such as quantities and types of chemical fertilisers used at farm level which is the foundation of this report. These data have been collected in Ireland for an extensive period and are now being collected (from 2016) across all other EU FADN countries.

The NFS is based on a nationally representative random sample which is selected annually in conjunction with the Central Statistics Office (CSO). Each farm is assigned a weighting factor so that the results of the survey are representative of the national population of farms. The 2015 results for example are based on a sample of 898 farms which represents 84,259 farms nationally. Farms are classified into major farming systems according to the standardised EU typology used by the FADN.

The NFS generally reports results across six main farm systems namely: dairying, dairying with other enterprises, cattle rearing, cattle with other systems, mainly sheep and tillage systems. These systems refer to the dominant enterprise in each group. For the purposes of this report the dairy and cattle systems were further merged and results are presented for four farm systems; namely dairy, cattle, sheep and tillage. The Teagasc NFS methodology dictates that data is only published where there are at least 10 farms in a cell. Where this criteria is not met the symbol "-" is used in the results tables to indicate there was an insufficient number of holdings to report national results.

1.2 Measurement

The report uses metric measurements throughout, and in the tables usages of the nutrients N, P and K are presented in elemental form. To facilitate comparisons with other surveys and reports (both national and international) a range of conversion factors for metric, imperial and popular units and for conversion between elemental P and K and their oxide forms are listed in Appendix 1.

1.3 Definition of key variables

Grassland: Total grassland area refers to the total area (hectares) under silage, hay and grazing. It excludes area under arable crops and rough grazing. Rough grazing is not included, as the definition of this area is that of ground that cannot be fertilised (however, it should be noted that rough grazing is eligible for inclusion in Organic N stocking rate calculations under the Nitrates Directive).

Silage: Silage area is defined as the area of ground in hectares cut at least once yearly for silage.

Hay: Hay area is the area of ground in hectares cut at least once yearly for hay.

Grazing: Grazing area is defined as total grassland area in hectares less area dedicated to hay and silage.

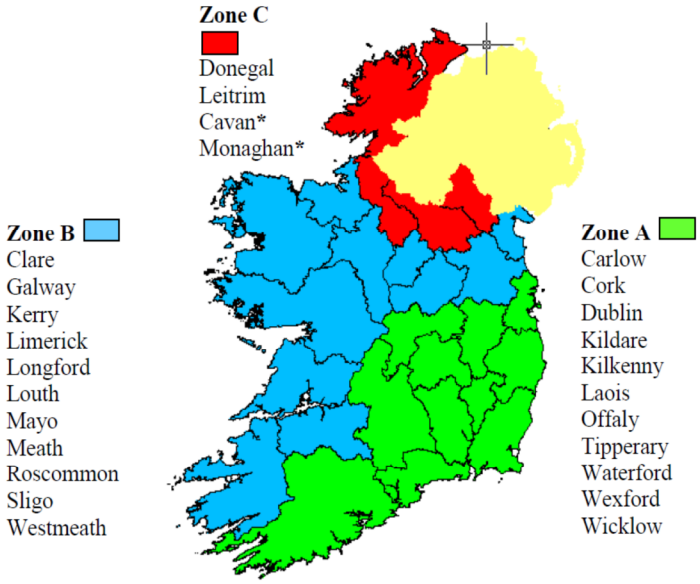
Please Note: Within the Teagasc NFS the application of nutrients to grassland is recorded according to the use made of the area at different periods throughout the year. As such, when an area is being used for silage, the nutrients applied are recorded under the silage crop, and when the same area is then later used for grazing, the nutrients used are recorded under the grazing heading. As a result, the area used for grazing only is recorded as the grazing area, and the areas under hay or silage are recorded as such even though they are grazed for part of the year. This approach results in an underestimation of the grazing area and therefore an overestimation of the rates of N, P and K applied per hectare on grazing land if the area of aftermath grazing is not taken into account. In order to estimate more accurately the use of nutrients on grazing land the approach of Lalor et al.

(2010) is used. This procedure assumes that the use of nutrients for grazing, silage and hay aftermaths are the same rates as those used for the grazing only areas, but in proportion to their yields. The yields of grazed grass from areas harvested once, twice, or three times per annum for silage or hay are assumed to be approximately 50%, 25% and 10% respectively, of the total annual yield. In calculating the N, P and K per grazed hectare, the amount recorded by the NFS for grazing is divided by the grazing area plus 50% of the area cut once for silage or hay, plus 25% of the area cut twice for silage or hay, plus 10% of any area cut three times. In this context average areas reported for grazing and silage will not tally with that for total grassland as some silage area is grazed and this proportional area is added to the total grazing area, while silage area is deemed to remain unchanged.

Arable Area: Results are presented for areas in hectares dedicated to individual crops. The Teagasc NFS collects data on areas dedicated to different individual crops as well as the nutrients applied to those areas.

Nitrate Zones: The EU Nitrates Directive National Action Programme was implemented on a whole territory basis in Ireland and the national territory was subdivided into three management zones (groups of counties) by reference mainly to land use class, rainfall and length of growing season. Regulations relating to nutrient management differ across these zones. These nitrate zones are displayed in Figure 1 below.

Figure 1: **Nitrate Zone designation in Ireland under the EU Nitrates Directive**



Source: Department of Agriculture, Food and the Marine

Nutrient usage by zone is presented in this report which is a departure from the regional approach (NUTS3 level) utilised in the previous report (Lalor et al., 2010). However, additional results relating to these regions are also contained in Appendix 3.

Land use class: In line with previous reports (Coulter et al., 2002, 2005 and Lalor et al., 2010) the categorisation of farms into different land use classes follows the classification of Gardiner and Radford (1980). Land use class is a qualitative method by which the range of potential uses of a soil can be expressed. There are six classes varying from wide, moderately wide, somewhat limited, limited, very limited and extremely limited. For the purposes of this report they are amalgamated into four classes by combining the bottom three classes into a single range described as limited. The wide land use has no limitation on land use, the moderately wide class has minor limitations due to soil texture, altitude or climatic conditions and the somewhat limited class has more significant use limitations associated with soil texture, altitude or climatic conditions. Finally the limited category has significant limitation on land use based on attitude, slope, soil texture or drainage.

Farm system: Within the Teagasc NFS, farms are classified into major farming systems according to the standardised EU typology used by FADN (a more detailed explanation can be found in Dillon et al., 2017). This report displays results for the four dominant farm systems namely, dairy, cattle, sheep and tillage.

Organic N stocking rate: Is derived based on Organic N excretion rates (e.g. a dairy cow = 85 kg of organic N) as set down in the GAP regulations of Statutory Instrument number 31 of 2014 (see Table 1) and the definition of grassland area set out above.

Table 1: Organic N excretion rates by animal type

Livestock Type*	Total N kg/year
Dairy cow	85
Suckler cow	65
Cattle (0-1 year old)	24
Cattle (1-2 years old)	57
Cattle (> 2 years)	65
Mountain ewe & lambs	7
Lowland ewe & lambs	13
Mountain hogget	4
Lowland hogget	6

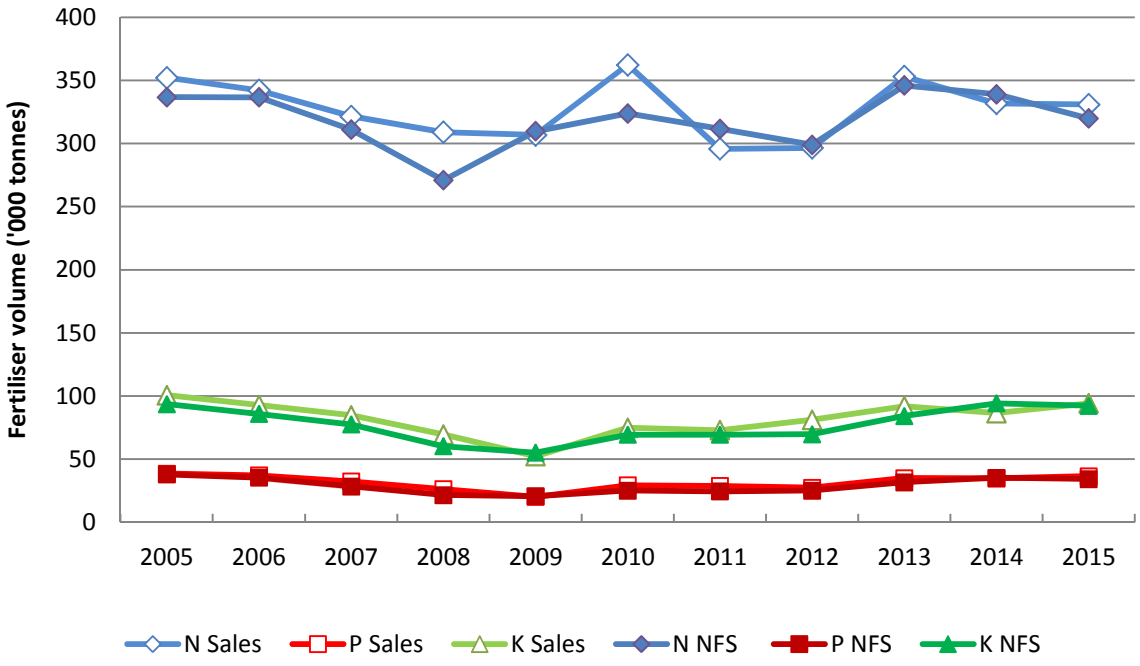
*See Table 6 of S.I No. 31 of 2014

Agri-environmental schemes: Participation or non-participation in agri-environmental schemes is recorded within the Teagasc NFS dataset as a binary (yes/no) variable. Over the time period in question the relevant schemes were REPS (Rural Environment Protection Scheme), the Agri-Environment Options Scheme (AEOS) and the Green Low Carbon Agri-Environment (GLAS) scheme.

1.4 Validation of results

Aggregated data on fertiliser use (N, P and K) from the Teagasc NFS for the period 2005-2015 were validated by comparison with published annual sales data from the Department of Agriculture, Food and the Marine (DAFM, 2017). Aggregate results from both data sources contained in Figure 2 below confirms the accuracy of the Teagasc NFS fertiliser application data given that it generally tracks national fertiliser sales over the period. However, it should be noted that some differences arise due to the potential carryover of stocks on farms and the fact that DAFM sales figures are compiled on the basis of the fertiliser sales year running from October 1st to September 30th, whereas the Teagasc NFS fertiliser use data is compiled for the calendar year in which it is applied.

Figure 2: National Fertilisers Sales (DAFM) & Fertiliser application data (Teagasc NFS) 2005-2015



Source: Department of Agriculture Food and the Marine & Teagasc National Farm Survey

1.5 Comparison with previous surveys

It should be noted that the results in this report are not directly comparable with previous fertiliser use survey reports (Lalor et al., 2010, Coulter et al., 2002, 2005) as the methodology has been updated to reflect best practice for the publication of data in line with EU Farm Accountancy Data Network (FADN) standards. All statistics presented in this report are population weighted to be reflective of Irish farming based on a national basis by farm size and system.

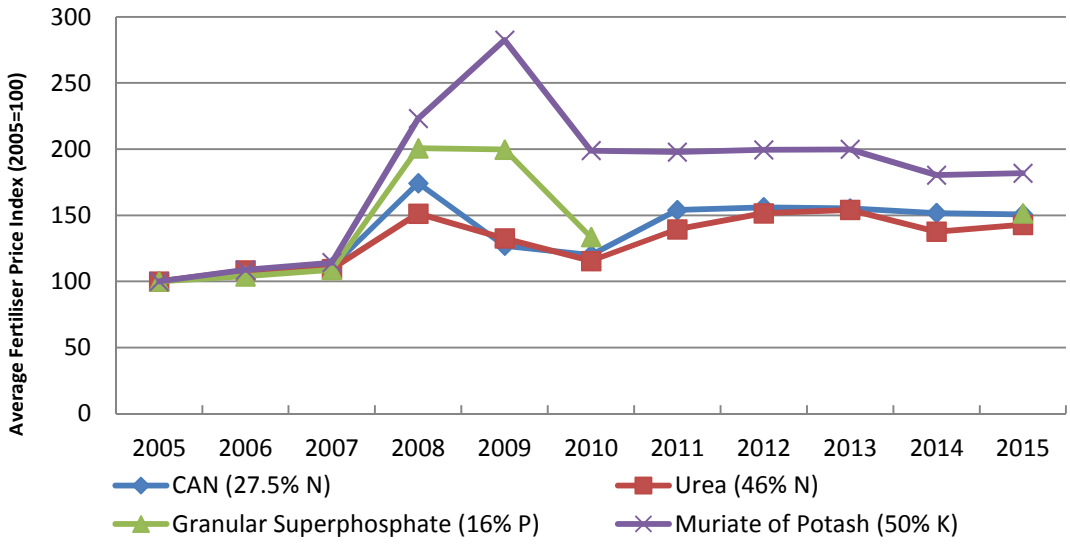
2. Demand drivers

This report presents data on macro-nutrients (N, P and K) usage on Irish farms over an eleven year period (2005-2015) across multiple dimensions. However, many factors external to the farm gate can influence fertiliser application rates. These include (but not exclusively) fertiliser prices, farm output prices, weather or changes to prevailing regulations. This report does not aim to assign causality to changes in fertiliser application rates over the period; however, results from the analysis suggest fertiliser application rates are affected by changes in these external factors. Within this context, developments in external factors are presented below to assist the reader in their interpretation of the results.

2.1 Fertiliser prices

Figure 3 presents a price index for N, P, K fertilisers over the study period setting 2005 as the base year (2005=100). This indicates significant price increases in 2008 compared to 2005-2007, with the CAN price on average 74% higher in 2008 compared to 2005, urea 51% higher, and granular superphosphate and muriate of potash more than doubling in price over the same period. Prices subsequently declined between 2008 and 2010 however, despite this, across all three, prices in 2010 were still between 43-82% higher than in the 2005 base year. Although relative price stabilisation was experienced from 2011 to 2015 prices remained almost 60% higher overall at the end of the study period compared to at the outset. The upward movement in prices largely relates to the increase in energy prices, grain prices and issues around global production capacity over the period.

Figure 3: **Price index for N, P, K fertilisers from 2005 to 2015**

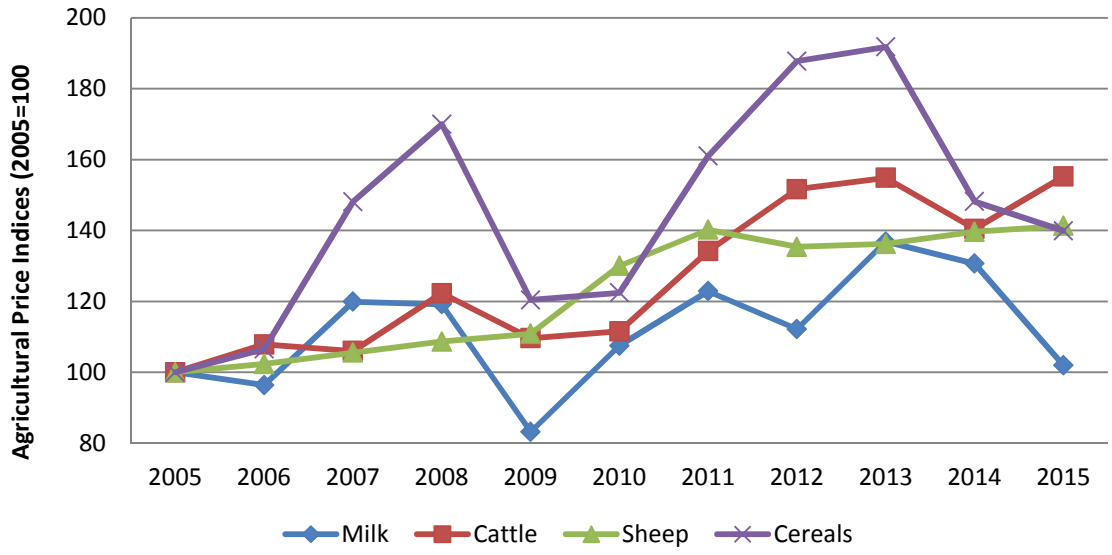


Source: Central Statistics Office *(please note data for granular superphosphate is unavailable from 2011-2014)*

2.2 Farm output prices

Changes in output prices (milk, livestock and crops) can influence the demand for fertilisers at the farm level. In general, higher intensity and higher income systems such as dairying tend to have a greater demand for fertiliser, with more price inelastic demand due to income effects. While these effects can explain differences in fertiliser demand between different farm systems, changes in output prices can also affect year-on-year demand across individual farm systems. In this context an agricultural output price index is presented in Figure 4 to illustrate changes in output prices across the four farm systems reported here, with a base year of 2005. Figure 4 indicates that there is significant price volatility in output prices for milk, cereals, cattle and sheep over the study period. For example milk price was nearly 20% lower in 2009 compared to the base year (2005) and was then nearly 40% higher in 2013. The situation on cereal farms is even more dramatic, with an almost doubling in prices in 2013 (compared to 2005). It should be noted that there may be a lag between output price changes and fertiliser purchase decisions. In addition, the timing of fertiliser purchase will differ across farm systems throughout the year.

Figure 4: Agricultural output price indices for milk, cattle, sheep and cereals from 2005 to 2015



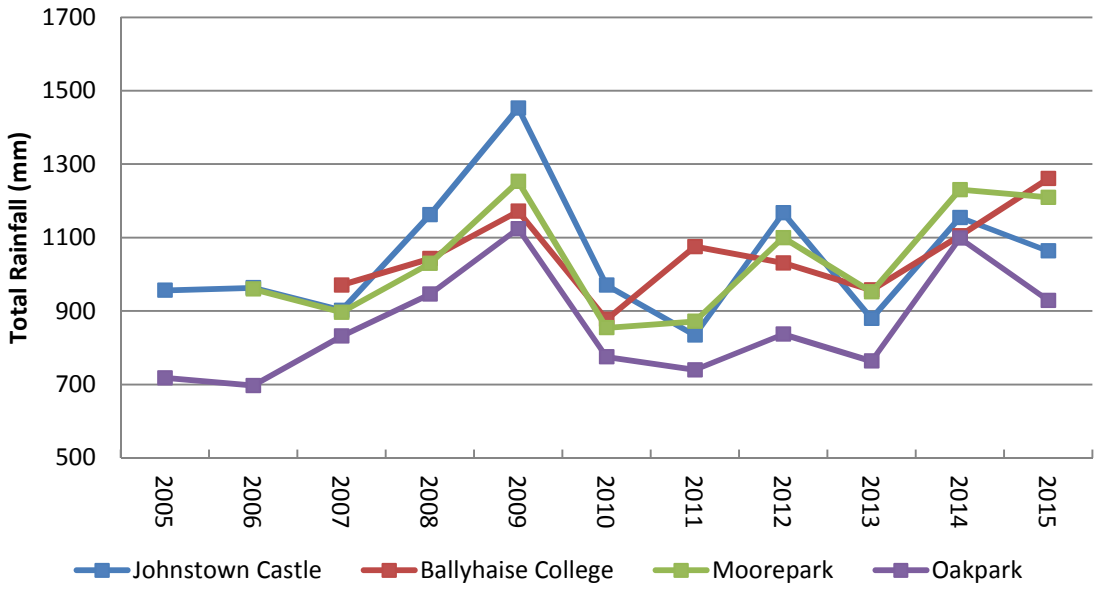
Source: Central Statistics Office

2.3 Weather

Prevailing weather condition (e.g. rainfall and temperature) can influence availability and utilisation of fertilisers. For example higher rainfall years tend to be associated with weaker crop growth and less availability of nutrients for agricultural production due to reduced nutrient concentrations in soil solution. For example, 2012-2013 is associated with weaker growth conditions in Ireland (where persistent lower spring temperatures in 2013 following high rainfall in 2012) which led to a national

fodder crisis during this period. This tended to precipitate greater fertiliser application in 2013 in an attempt to accumulate increased fodder stocks for the year ahead. Figure 5 presents total annual rainfall across four Teagasc based weather stations with results indicating significant annual variation across this one weather metric throughout the country.

Figure 5: Total rainfall across four Teagasc based weather stations 2005-2015



Source: Met Eireann

2.4 Regulatory changes

The regulatory framework for fertiliser management during the study period is set down by the EU Nitrates Directive. The EU Nitrates Directive Good Agricultural Practice (GAP) measures were first introduced in 2006 through statutory instrument (S.I.) No. 378 of 2006 and were subsequently updated through Statutory Instruments S.I. 101 of 2009, S.I. 610 of 2010 and S.I. 31 of 2014. Hence, since the second year of the study period (2006) maximum N and P allowances have been set down in regulation; however, some N and P allowances were increased in S.I. 31 of 2014. For example, P allowances for grassland were generally increased (except for soil with excess P and for farms at lower stocking rates) as were those for cereal crops on higher pH soils. N application rates on winter barley and spring wheat were also increased. For a more detailed review of regulatory changes see Department of Agriculture Food and the Marine (2014). These regulatory based changes tended to allow increased levels of P (and N on some crops) to be applied where warranted based on soil fertility levels at the tail end of the study period (2014-2015).

3. Results

3.1 Fertiliser Use on Grazed Grassland 2005-2015

3.1.1 Fertiliser Use on Grazed Grassland by Nitrate Zone

Table 2 outlines the profile of farms with grazed grassland by nitrate zone over the period 2005 to 2015. The average grazing area across farms in all zones ranged from 31 to 33 hectares over this period. The average area under grazing tended to be largest in zone A (33 hectares) and smallest in zone C (27 hectares). This is reflective of the geographical location of these farms, with zone A located in the South and East and zone C in the Border region. Nationally, these data indicate that 41% of the farms with grazing area were in zone A over the period, with 46% in zone B and only 12% in the smaller zone C.

Table 2: Average farm size, NFS farms and farm population by Nitrate Zone - Grazing Area

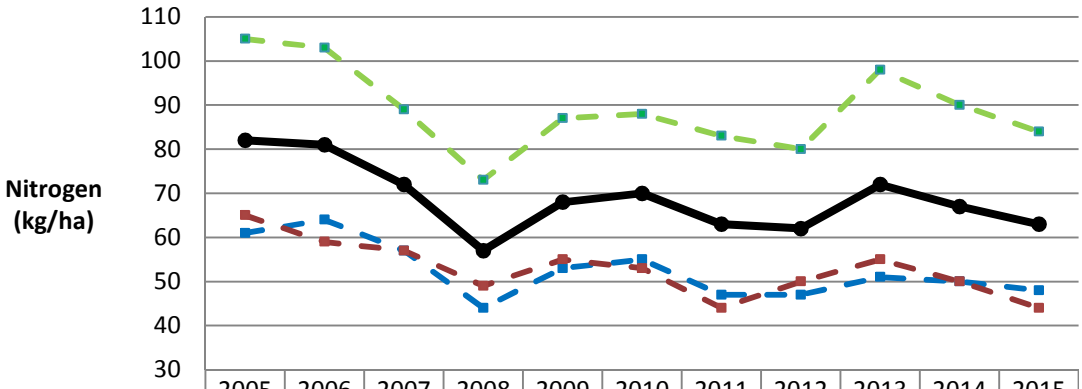
Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Average area (ha) – grazing area											
Zone A	34	34	33	33	34	33	34	35	33	33	32
Zone B	29	30	30	31	31	30	31	32	32	30	30
Zone C	27	27	27	26	27	27	28	30	28	25	26
All Zones	31	31	31	31	32	31	32	33	32	31	31
No. of Teagasc NFS farms with grazing area											
Zone A	524	514	525	532	505	493	516	503	502	477	477
Zone B	384	387	384	365	358	341	325	323	333	326	321
Zone C	121	119	113	117	111	118	112	103	104	105	103
All Zones	1,029	1,020	1,022	1,014	974	952	953	929	939	908	901
% of Total farm population with grazing area*											
Zone A	41%	41%	42%	42%	42%	42%	42%	42%	42%	40%	40%
Zone B	46%	46%	46%	46%	46%	46%	46%	46%	46%	47%	47%
Zone C	12%	12%	12%	12%	12%	12%	12%	12%	12%	13%	13%

*National population weights applied to Teagasc NFS farms

Figure 6 illustrates N applied on grazed grassland (kg ha^{-1}) by nitrate zone. Results indicate a general decline of approximately (30%) in N applied between 2005 and 2008 across all zones, with the reduction in 2008 associated with high fertiliser prices. N use subsequently increased slightly in 2009/10, with a further decline until 2013 - a year associated with poor growing conditions and a national fodder shortage. Following this increase in 2013, application rates further declined by 12% on average across all zones. Results indicate that N application rates in zone A were significantly

higher than in zones B and C (1.7 times on average). Across all zones overall application rates were on average 23% lower in 2015 compared to 2005.

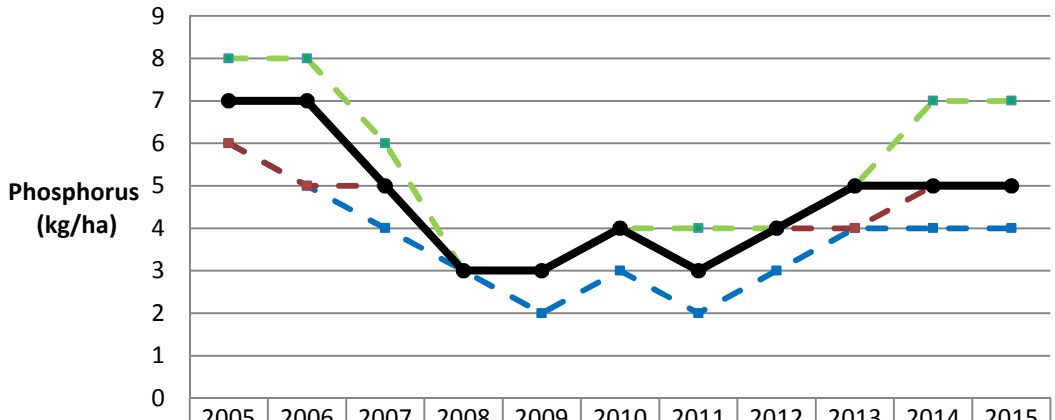
Figure 6: N use on Grazing Area by Nitrate Zone



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Zone A	105	103	89	73	87	88	83	80	98	90	84
Zone B	61	64	57	44	53	55	47	47	51	50	48
Zone C	65	59	57	49	55	53	44	50	55	50	44
All Zones	82	81	72	57	68	70	63	62	72	67	63

P applied on grazing land (kg ha^{-1}) by nitrate zone is presented in Figure 7. Application rates showed a general declining trend over the study period across all zones, with a steep reduction from 2005/06 and subsequent recovery from 2011/12 evident (in line with Teagasc advice). Results indicate that P application rates in zone A were on average 1.5 times higher than in zone B and 1.25 times higher than in zone C.

Figure 7: P use on Grazing Area by Nitrate Zone

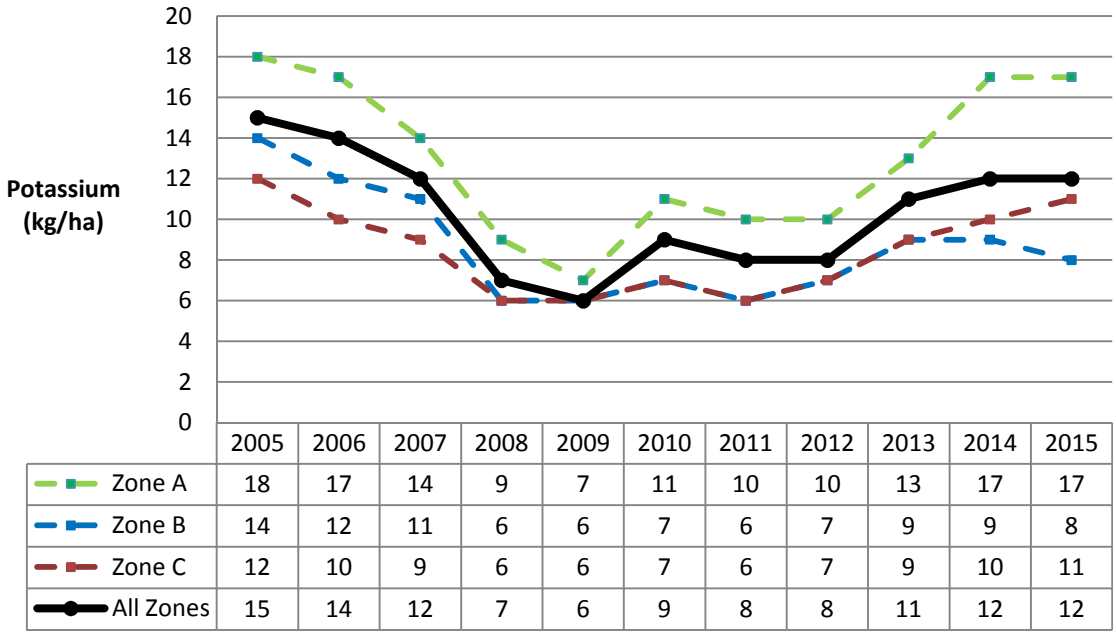


	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Zone A	8	8	6	3	3	4	4	4	5	7	7
Zone B	6	5	4	3	2	3	2	3	4	4	4
Zone C	6	5	5	3	3	4	3	4	4	5	5
All Zones	7	7	5	3	3	4	3	4	5	5	5

Average P application rates were in the order of 50 per cent lower during the middle of the period (2008-2012) and 15-30 per cent lower at the end (2013-2015) compared to those at the outset. Overall, P usage declined by 29% on average across all zones from 2005 to 2015 with the largest decline found in zone B at 33%. The equivalent figure for zones A and C were 13% and 17% lower respectively.

Figure 8 illustrates K applied on grazing land (kg ha^{-1}) by nitrate zone. Results indicate that average K application rates in zone A were 1.5 times higher than in both zones B and C over the study period. Average K application rates were 40-60 per cent lower during the middle of the period (2008-2012) and 20 per cent lower at the end (2013-2015) compared to the start. The decline is most evident in zone B, with K use in 2015 almost half that of 2005. On the other hand, K usage in zones A and C has increased since 2011/12 and was almost back to 2005 levels in 2015.

Figure 8: K use on Grazing Area by Nitrate Zone



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Zone A	18	17	14	9	7	11	10	10	13	17	17
Zone B	14	12	11	6	6	7	6	7	9	9	8
Zone C	12	10	9	6	6	7	6	7	9	10	11
All Zones	15	14	12	7	6	9	8	8	11	12	12

3.1.2 Fertiliser Use on Grazed Grassland by Land Use Class

Table 3 outlines the area of grazed grassland across farms by land use class over the study period. Farms of wide land use class tended to be slightly larger (at 34 hectares) than those on more limited soils (30-31 hectares). On average, 30% of farms nationally are in the wide land use category, 19% fall into the moderately wide land use class, 21% into the somewhat limited category and 30% into the limited category. Farms can thus be generally divided in two, with half on wide/moderately wide soils and the other half on limited/somewhat limited soils.

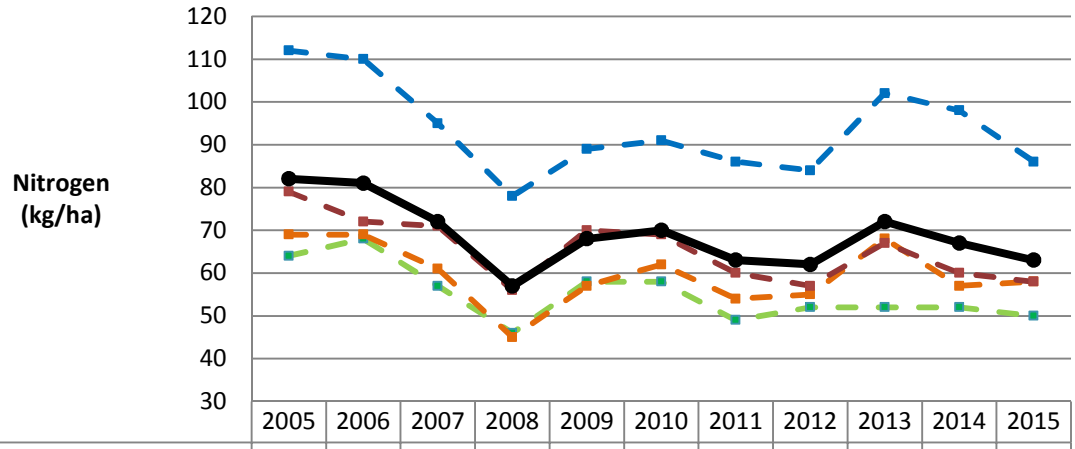
Table 3: Average farm size, NFS farms and farm population by Land Use Class - Grazing Area

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Average area (ha) – grazing area											
Limited	28	29	30	30	30	30	31	32	33	32	32
Somewhat Limited	31	29	30	30	31	30	30	33	33	31	32
Moderately Wide	31	31	30	31	30	29	31	31	30	28	29
Wide	34	34	34	34	34	34	34	35	33	32	31
All Soils	31	31	31	31	32	31	32	33	32	31	31
No. of Teagasc NFS Farms with grazing area											
Limited	321	311	307	295	282	278	260	255	245	233	234
Moderately Wide	172	180	179	177	176	170	168	160	171	166	167
Somewhat Limited	190	188	184	189	184	186	189	187	194	189	189
Wide	346	341	352	353	332	316	335	318	323	305	303
All Soils	1029	1020	1022	1014	974	950	952	920	933	893	893
% of Total farm population with grazing area*											
Limited	33%	31%	31%	30%	30%	30%	29%	29%	29%	28%	29%
Moderately Wide	18%	20%	19%	20%	20%	20%	20%	19%	18%	18%	18%
Somewhat Limited	20%	20%	19%	20%	20%	22%	21%	22%	23%	25%	23%
Wide	29%	29%	30%	30%	30%	29%	31%	30%	30%	29%	29%

*National population weights applied to Teagasc NFS farms

Figure 9 indicates that average N application rates on grazing area were 48% higher (84-112 kg ha^{-1}) for farms of wide land use class compared to those farms of moderately wide land use class (56-79 kg ha^{-1}), 57% higher than for farms of somewhat limited land use class (45-69 kg ha^{-1}) and over 70% higher than for farms of limited land use class (46-64 kg ha^{-1}). The highest application rates were recorded at the start of the study period (2005/2006) for all land use classes with the lowest rates recorded in 2008 (30% lower than at the start of the study period). Although there was some recovery in the intervening years (and in 2013 in particular), N application rates were on average 12-23% lower at the end of the study period (2013-2015) across all classes compared to at the outset.

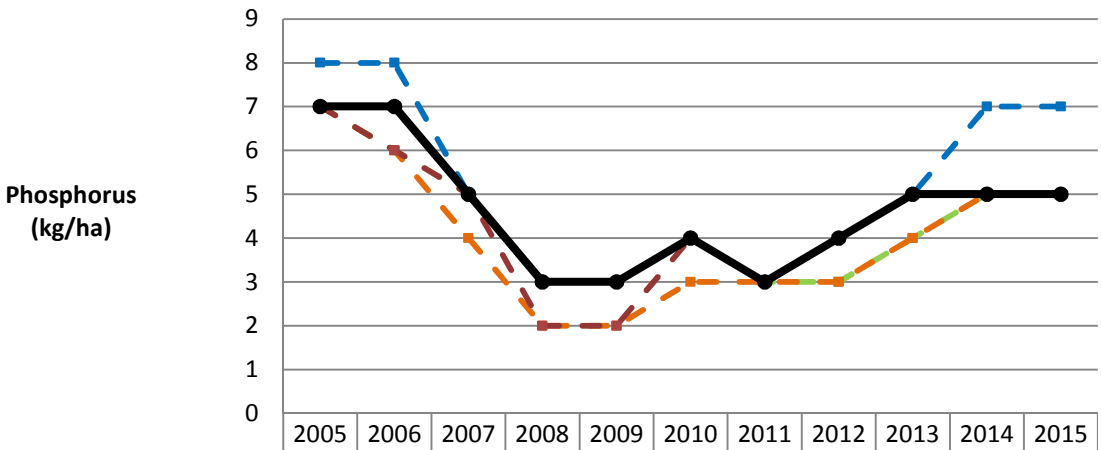
Figure 9: N use on Grazing Area by Land Use Class



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Limited	64	68	57	46	58	58	49	52	52	52	50
Somewhat Limited	69	69	61	45	57	62	54	55	68	57	58
Moderately Wide	79	72	71	56	70	69	60	57	67	60	58
Wide	112	110	95	78	89	91	86	84	102	98	86
All Soils	82	81	72	57	68	70	63	62	72	67	63

P use on grazing land from 2005 to 2015 is described in Figure 10. Results indicate that average P application rates for farms of wide land use class (3-8 kg ha^{-1}) were 19% higher than for farms of limited land use class (3-7 kg ha^{-1}), 30% higher than for farms of somewhat limited land use class (2-7 kg ha^{-1}) and 21% higher than for farms of moderately wide land use class (2-7 kg ha^{-1}).

Figure 10: P use on Grazing Area by Land Use Class

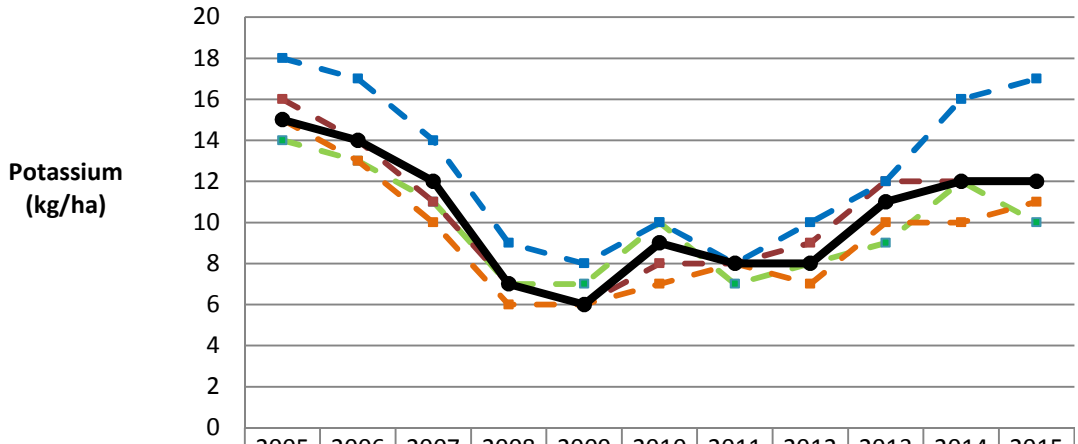


	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Limited	7	6	5	3	3	4	3	3	4	5	5
Somewhat Limited	7	6	4	2	2	3	3	3	4	5	5
Moderately Wide	7	6	5	2	2	4	3	4	5	5	5
Wide	8	8	5	3	3	4	3	4	5	7	7
All Soils	7	7	5	3	3	4	3	4	5	5	5

Application rates were highest across all land use classes at the start of the study period (2005-06) but were 43-57% lower on average from 2008 to 2012. Application rates recovered at the end of the study period (2013-15), especially on those farms of wide land use class, but on average were still 29% lower than at the start.

Figure 11 illustrates that K application rates on grazing area for farms of wide land use class (8-18 kg ha^{-1}) were on average 21% higher than for farms of moderately wide land use class (6-16 kg ha^{-1}), 35% higher than for farms of somewhat limited land use class (7-15 kg ha^{-1}) and 29% higher than for farms of limited land use class (7-14 kg ha^{-1}). Average application rates were highest at the start of the study period (2005) and were between 47-60% lower on average from 2008 to 2012. Application rates recovered at the end of the study period (2013-15), especially on those farms of wide land use class, but on average were still 20% lower than at the outset.

Figure 11: K use on Grazing Area by Land Use Class



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Limited	14	13	11	7	7	10	7	8	9	12	10
Somewhat Limited	15	13	10	6	6	7	8	7	10	10	11
Moderately Wide	16	14	11	7	6	8	8	9	12	12	12
Wide	18	17	14	9	8	10	8	10	12	16	17
All Soils	15	14	12	7	6	9	8	8	11	12	12

3.1.3 Fertiliser Use on Grazed Grassland by Farm System

Table 4 outlines grazing area by farm system over the study period. Dairy farms on average had the largest area under grazed grass between 2005 and 2015 (39 hectares). This was 37% higher than on cattle farms (29 hectares), 20% higher than on sheep farms (33 hectares) and 85% higher than on tillage farms (21 hectares) on average. In terms of the proportion of farms represented by the Teagasc NFS sample nationally, over half were cattle farms (53%) and 25% were in dairying with the remaining farms either sheep (14%) or tillage (7%) on average.

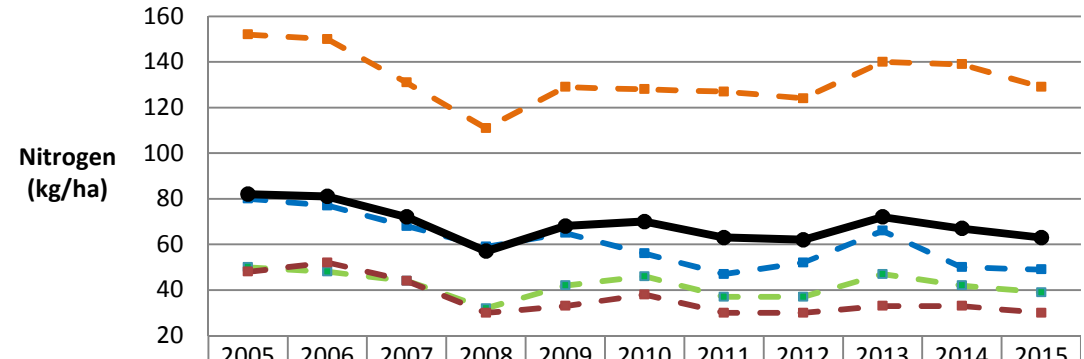
Table 4: Average farm size, NFS farms and farm population by Farming System - Grazing Area

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Average Area (ha) – grazing area											
Cattle	29	28	29	29	29	29	29	30	29	28	27
Dairy	38	38	38	39	40	39	39	41	40	41	41
Sheep	31	31	32	33	31	32	32	34	38	34	34
Tillage	22	24	23	22	22	19	21	21	21	19	20
All Systems	31	31	31	31	32	31	32	33	32	31	31
No. of Teagasc NFS farms with grazing area											
Cattle	368	381	404	421	413	395	386	366	369	365	360
Dairy	447	416	390	378	353	346	355	361	372	353	347
Sheep	144	148	144	125	122	125	123	119	118	120	126
Tillage	70	74	84	90	86	85	88	82	80	70	68
All Systems	1029	1019	1022	1014	974	951	952	928	939	908	901
% of Total farm population with grazing area*											
Cattle	53%	53%	53%	53%	53%	53%	53%	53%	53%	55%	55%
Dairy	26%	26%	26%	26%	26%	25%	25%	25%	25%	21%	22%
Sheep	14%	14%	14%	14%	14%	14%	14%	14%	14%	16%	16%
Tillage	7%	6%	6%	7%	7%	8%	7%	7%	7%	8%	7%

*National population weights applied to Teagasc NFS farms

N application rates on grazing area across the different farm systems presented in Figure 12 indicates that N application rates on dairy farms (111-152 kg ha^{-1}) were on average over 3 times greater than those on cattle and sheep farms (30-52 kg ha^{-1}) and twice as high as on tillage farms (52-80 kg ha^{-1}). Average N application rates were highest across all farm systems at the beginning of the study period (2005/06) but declined by between 15-30% on average during 2008-2012. A recovery in usage is reported from 2008 and again in 2013, however, application rates at the end of the study period (2013-2015) were lower than at the outset ranging from 12 to 23% reduction on average across all systems. The largest decline over the period is reported on sheep and tillage farms at close to 40% with more modest reductions reported on dairy and cattle farms at 15% and 22% respectively.

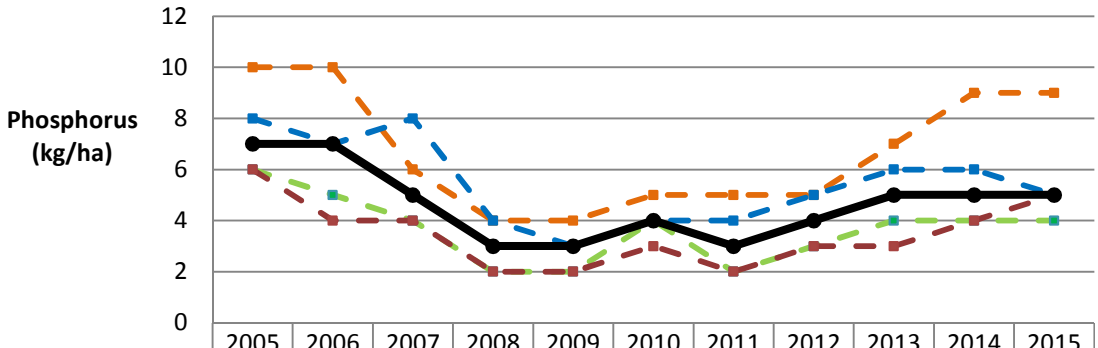
Figure 12: N use on Grazing Area by Farm System



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Cattle	50	48	44	32	42	46	37	37	47	42	39
Dairy	152	150	131	111	129	128	127	124	140	139	129
Sheep	48	52	44	30	33	38	30	30	33	33	30
Tillage	80	77	68	59	65	56	47	52	66	50	49
All Systems	82	81	72	57	68	70	63	62	72	67	63

Figure 13 illustrates P application rates by farm system on grazing area. Application rates on dairy farms (4-10 kg ha^{-1}) were on average 90-100% higher than on cattle and sheep farms (2-6 kg ha^{-1}) between 2005 and 2015. Average application rates were highest across all farm systems at the start of the study period (2005/06), but declined by between 43-57% on average from 2008 to 2012 across all systems. Application rates increased at the end of the study period (2013-15), especially on dairy and sheep farms, but on average were still 29% lower than at the start across all farms. The largest decline in P usage was evident on tillage and cattle farms at 38% and 33% respectively.

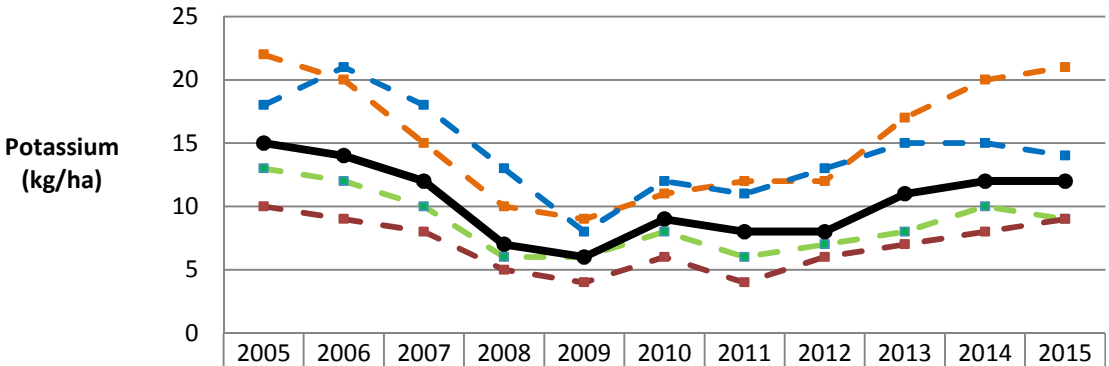
Figure 13: P use on Grazing Area by Farm System



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Cattle	6	5	4	2	2	4	2	3	4	4	4
Dairy	10	10	6	4	4	5	5	5	7	9	9
Sheep	6	4	4	2	2	3	2	3	3	4	5
Tillage	8	7	8	4	3	4	4	5	6	6	5
All Systems	7	7	5	3	3	4	3	4	5	5	5

A similar picture with regard to K use is evident across systems from 2005 to 2015 (Figure 14), with a general decline during the first half of the period with some recovery from 2009 and most significantly from 2012. Recovery is most evident on dairy farms, with K application rates in 2015 close to 2005 levels (only down 5% on average). Similarly, K usage in 2015 on sheep farms was also close to 2005 levels (down 10% on average). The decline in K usage on cattle and tillage farms was larger over the period at 30% and 22% respectively. Average K application rates on dairy farms (9-22 kg ha^{-1}) were 7% higher than on tillage farms (8-21 kg ha^{-1}), 78% higher than on cattle farms (6-13 kg ha^{-1}) and 122% higher than on sheep farms (4-10 kg ha^{-1}). Across all farms average K usage was 20% lower in 2015 than in 2005.

Figure 14: K use on Grazing Area by Farm System



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Cattle	13	12	10	6	6	8	6	7	8	10	9
Dairy	22	20	15	10	9	11	12	12	17	20	21
Sheep	10	9	8	5	4	6	4	6	7	8	9
Tillage	18	21	18	13	8	12	11	13	15	15	14
All Systems	15	14	12	7	6	9	8	8	11	12	12

3.1.4 Fertiliser Use on Grazed Grassland by Organic N Stocking rate

Table 5 outlines grazing area, sample and population statistics across a range of Organic N (ON) stocking rate bands. Stocking rate refers to total grassland stocking rate, rather than on the grazing platform in isolation. The largest average grazing area over the study period was associated with farms in the 170-210 kg ON ha^{-1} category at nearly 35 hectares, followed by the 130-170 kg ON ha^{-1} category at 33 hectares. The average grazing area across the <85, 85-130 and >210 kg ON ha^{-1} categories was 30-31 hectares. On average over the study period 28%, 37%, 22%, 9%, 4% of the population fell into the <85 , 85-130, 130-170, 170-210 and >210 kg ON ha^{-1} categories respectively.

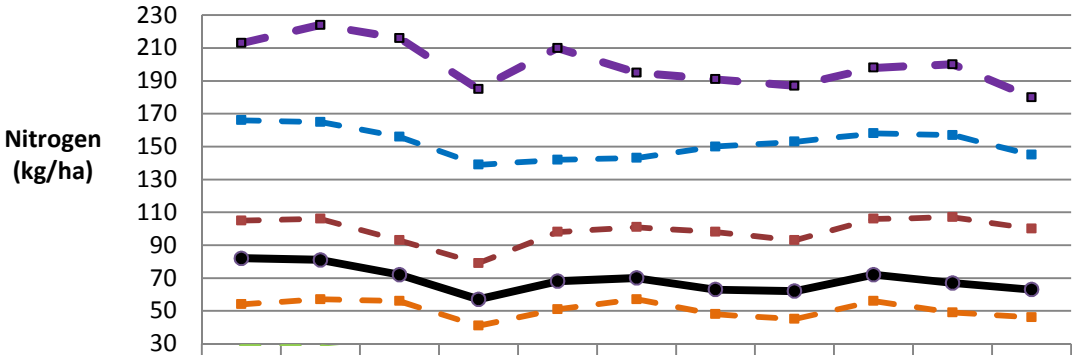
Table 5: Average Farm size, NFS farms and farm population by Org. N stocking rate – Grazing Area

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Average area (ha) – grazing area											
< 85 kg ON ha^{-1}	30	31	32	31	30	30	30	33	34	31	32
85-130 kg ON ha^{-1}	29	29	30	31	29	30	31	31	30	28	28
130-170 kg ON ha^{-1}	35	34	34	33	34	33	33	33	33	32	33
170-210 kg ON ha^{-1}	32	31	33	34	39	35	34	37	36	37	38
> 210 kg ON ha^{-1}	24	30	26	31	30	32	34	30	31	30	31
All Farms	31	31	31	31	32	31	32	33	32	31	31
No. of Teagasc NFS farms with grazing area											
< 85 kg ON ha^{-1}	162	195	224	226	236	250	271	235	224	230	232
85-130 kg ON ha^{-1}	332	331	342	349	338	317	295	291	289	275	265
130-170 kg ON ha^{-1}	277	281	261	269	225	218	220	229	222	211	204
170-210 kg ON ha^{-1}	166	138	133	103	113	107	106	121	131	126	125
> 210 kg ON ha^{-1}	92	75	62	67	62	60	61	53	73	66	75
All Farms	1029	1020	1022	1014	974	952	953	929	939	908	901
% of Total farm population with grazing area*											
< 85 kg ON ha^{-1}	20%	23%	25%	26%	28%	30%	33%	29%	28%	31%	31%
85-130 kg ON ha^{-1}	39%	38%	39%	39%	39%	37%	35%	38%	36%	35%	37%
130-170 kg ON ha^{-1}	23%	23%	22%	24%	21%	21%	20%	21%	21%	21%	19%
170-210 kg ON ha^{-1}	12%	11%	10%	7%	8%	8%	8%	9%	9%	8%	8%
> 210 kg ON ha^{-1}	6%	5%	4%	4%	4%	4%	4%	4%	5%	4%	5%

*National population weights applied to Teagasc NFS farms

N fertiliser application rates on grazing area were highest for the most intensively stocked category of >210 kg ON ha^{-1}, with application rates ranging from 185-224 kg ha^{-1} over the study period. This was in the order of 9 and 4 times higher than the two lowest stocked categories (<85, 85-130 kg ON ha^{-1}) respectively and was 102% and 31% higher than the 130-170, 170-210 kg ON ha^{-1} categories. Application rates tended to peak at the start of the study period and then followed a general declining trend, with a period low in 2008 across all categories. Application rates increased somewhat in 2010 and 2013 on average across all stocking rate categories, before declining towards the end of the study period, as illustrated in Figure 15. Application rates were on average 23% lower at the end of the period compared to starting period levels across all stocking rate categories.

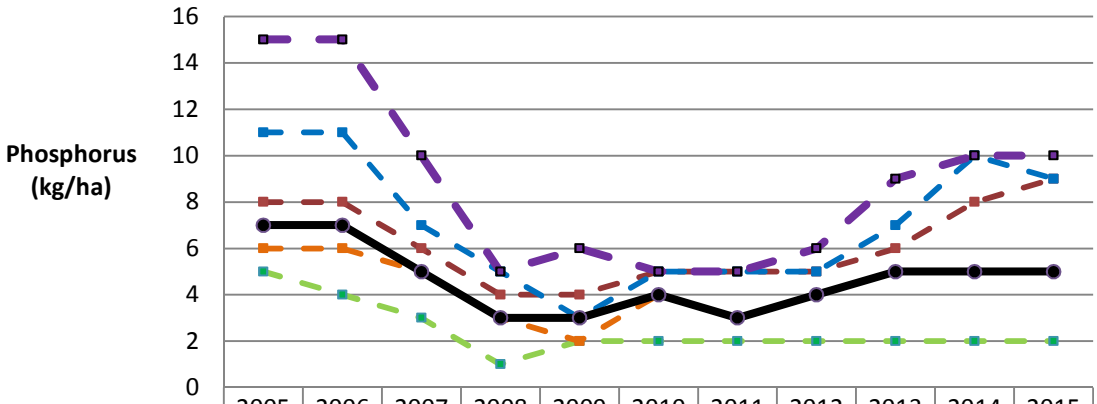
Figure 15: N use on Grazing Area by Organic N stocking rate category



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
< 85	28	28	23	17	23	27	21	20	22	17	17
85-130	54	57	56	41	51	57	48	45	56	49	46
130-170	105	106	93	79	98	101	98	93	106	107	100
170-210	166	165	156	139	142	143	150	153	158	157	145
> 210	213	224	216	185	210	195	191	187	198	200	180
All Rates	82	81	72	57	68	70	63	62	72	67	63

Figure 16 presents average P application rates on grazing area by organic N stocking rate and these were again highest for the most intensively stocked category of >210 kg ON ha^{-1} ranging from 5-15 kg ha^{-1} over the study period. This was 3.5 and 2 times higher than the two lowest stocked categories (<85, 85-130 kg ON ha^{-1}) respectively and was 41% and 23% higher than the 130-170, 170-210 kg ON ha^{-1} categories.

Figure 16: P use on Grazing Area by Organic N stocking rate category

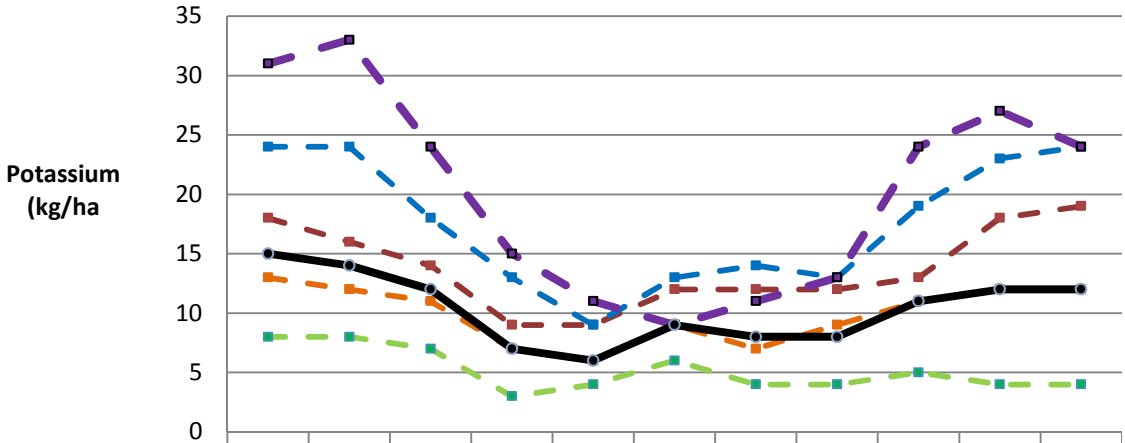


	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
< 85	5	4	3	1	2	2	2	2	2	2	2
85-130	6	6	5	3	2	4	3	4	5	5	5
130-170	8	8	6	4	4	5	5	5	6	8	9
170-210	11	11	7	5	3	5	5	5	7	10	9
> 210	15	15	10	5	6	5	5	6	9	10	10
All Rates	7	7	5	3	3	4	3	4	5	5	5

Again, application rates were generally higher at the start of the study period (2005/2006) and then declined by 43-57% across all rates mid-study period (2008-2012) before recovering at the end of the period (except for the highest and lowest stocking rate bands).

Average K application rates across total grassland area were again highest for the most intensively stocked category of >210 kg ON ha^{-1} ranging from 9-33 kg ha^{-1} over the study period as is evident from Figure 17. This was approximately 4 times and twice as high as the two lowest stocked categories (<85, 85-130 kg ON ha^{-1}) respectively and 46% and 14% higher than the 130-170, 170-210 kg ON ha^{-1} categories. Application rates generally peaked at the start of the study period (2005/2006) and then declined by 47-53% across all rates mid-study period (2008-2012), before recovering at the end of the period (except for the highest and lowest stocking rate bands).

Figure 17: K use on Grazing Area by Organic N stocking rate category



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
< 85	8	8	7	3	4	6	4	4	5	4	4
85-130	13	12	11	7	6	9	7	9	11	12	12
130-170	18	16	14	9	9	12	12	12	13	18	19
170-210	24	24	18	13	9	13	14	13	19	23	24
> 210	31	33	24	15	11	9	11	13	24	27	24
All Rates	15	14	12	7	6	9	8	8	11	12	12

Nutrient use by stocking rate was also considered by farm system and Table 6 displays data on N, P and K usage on dairy farms for the years 2005, 2010 and 2015. Results confirm that dairy farms are more intensive, with higher stocking rates and higher fertiliser application rates for grazed grassland compared to cattle and sheep farms (data for which are contained in Table 7 and Table 8). The higher average nutrient usage on dairy farms (particularly for N) is reflective of the higher enterprise

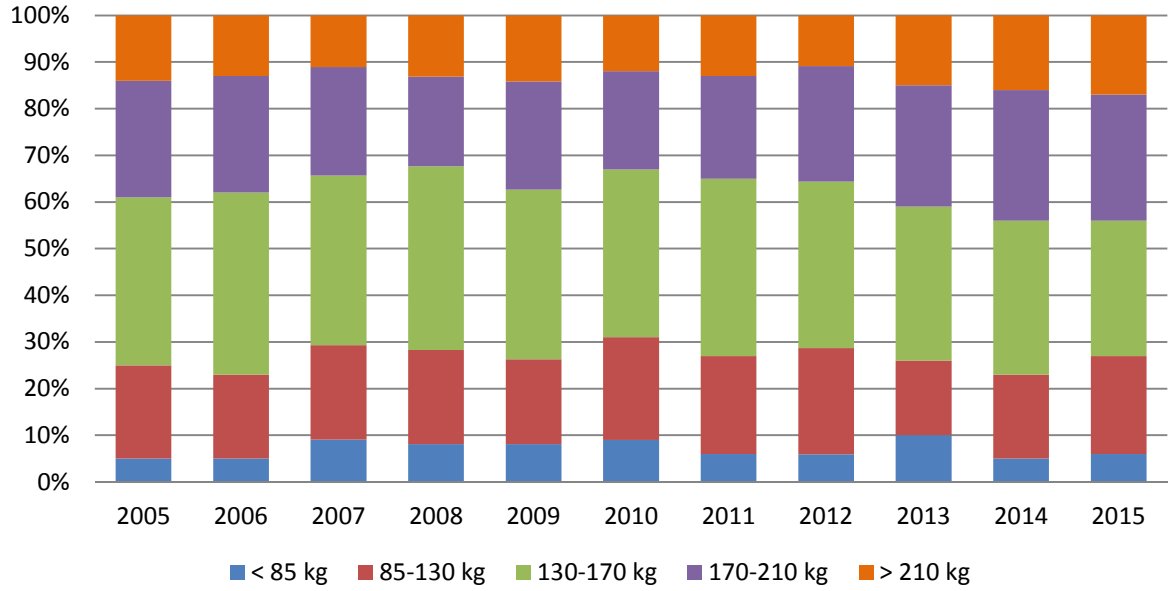
margins and consequently the higher economic optimum N rate, as well as greater nutrient removal in milk. Across dairy farms, a decline in both N and P application rates is evident across stocking rate bands over the period, with marginal increases in K application rates reported for both the 130-170 kg ON ha^{-1} and 170-210 kg ON ha^{-1} categories.

Table 6: Average farm size, NFS farms and farm population Dairy Farms by Org. N - Grazing Area

Year	Org N Stocking Rate	NFS Farms	Farm Pop.	% Pop.	N (kg/ha)	P (kg/ha)	K (kg/ha)	Area (ha)
2005	< 85 kg ON ha^{-1}	17	923	5%	44	4	8	42
2005	85-130 kg ON ha^{-1}	74	4,022	20%	90	8	18	34
2005	130-170 kg ON ha^{-1}	165	7,087	36%	135	9	20	42
2005	170-210 kg ON ha^{-1}	124	5,079	25%	192	11	24	39
2005	> 210 kg ON ha^{-1}	67	2,847	14%	260	17	35	30
2010	< 85 kg ON ha^{-1}	18	1,811	9%	39	2	5	30
2010	85-130 kg ON ha^{-1}	66	4,306	22%	82	4	10	39
2010	130-170 kg ON ha^{-1}	130	7,107	36%	127	5	12	41
2010	170-210 kg ON ha^{-1}	83	4,244	21%	163	5	13	38
2010	> 210 kg ON ha^{-1}	49	2,489	12%	203	5	9	39
2015	< 85 kg ON ha^{-1}	10	1,073	6%	29	2	4	48
2015	85-130 kg ON ha^{-1}	55	3,887	21%	73	6	13	39
2015	130-170 kg ON ha^{-1}	115	5,443	29%	130	9	21	44
2015	170-210 kg ON ha^{-1}	104	4,942	27%	164	10	27	43
2015	> 210 kg ON ha^{-1}	63	3,216	17%	188	10	25	33

Figure 18 illustrates the population distribution of dairy farms by stocking rate band over the study period and reflects the growing proportion of dairy farms in the higher stocking rate categories over time. Taking into consideration the beginning and end points of the study period (2005 and 2015) the data indicates that the proportion of farms in the most intensively stocked category of >210 kg ON ha^{-1} went from 14% to 17% over the eleven year period. Similarly, the proportion of farms in the 170-210 kg ON ha^{-1} category increased from 25% to 27%. Conversely, there was a decline of seven percentage points in the proportion of farms in the 130-170 kg ON ha^{-1} category with marginal increases of one percentage point for both the smallest <85 kg ON ha^{-1} and 85-130 kg ON ha^{-1} categories.

Figure 18: Dairy farm population distribution by N stocking rate band (2005-2015)



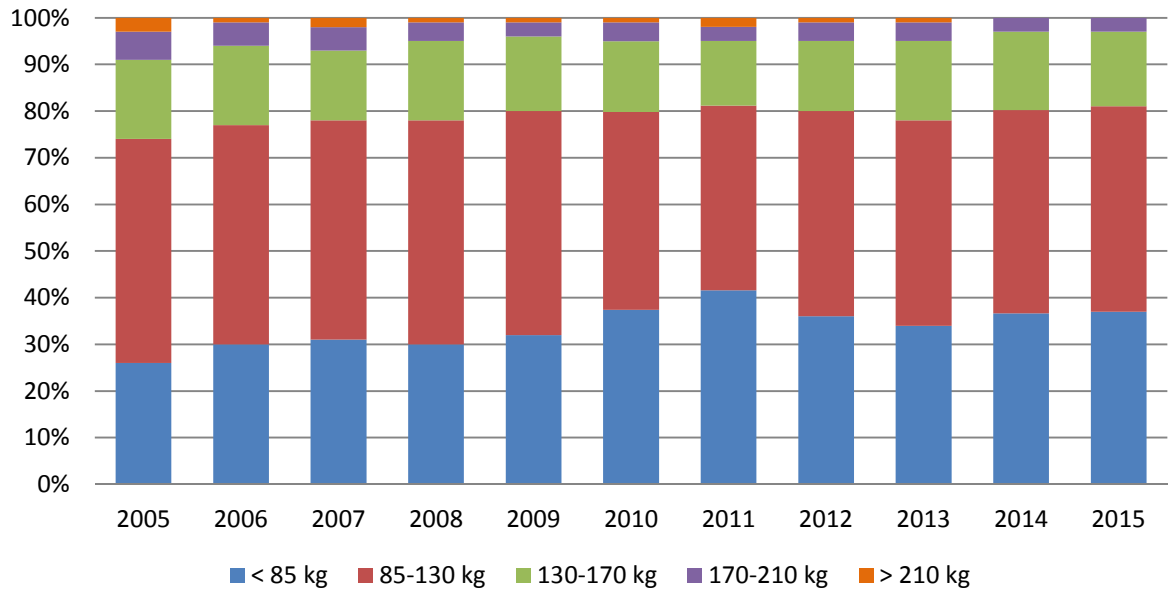
The situation on Irish cattle farms over the eleven-year period was quite different with Teagasc NFS data illustrating a decline in numbers across all stocking rate bands, apart from the lowest intensity <85 kg ON ha^{-1} category which increased from 26% to 37% over the timeframe. A decline in the proportion of farms in the 85-130 kg ON ha^{-1} category from 48% to 44% is also evident. Interestingly, the 2015 data indicates that there were no farms in the highest intensity >210 kg ON ha^{-1} category compared to 3% in 2005. The proportion of cattle farms in the 130-170 kg ON ha^{-1} category only fell from 17% to 16% over the period compared to those farms in the 170-210 kg ON ha^{-1} category which went from 6% to 3%. The lower average nutrient usage on cattle farms (particularly for N which is about half that of dairy farms) is reflective of the lower enterprise margins and consequently the lower economic optimum N rate on those farms.

Table 7: Average farm size, NFS farms and farm population Cattle Farms by Org. N - Grazing Area

Year	Org N Stocking Rate	NFS Farms	Farm Pop.	% Pop.	N (kg/ha)	P (kg/ha)	K (kg/ha)	Area (ha)
2005	< 85 kg ON ha^{-1}	95	10649	26%	25	4	8	31
2005	85-130 kg ON ha^{-1}	172	19822	48%	46	5	12	28
2005	130-170 kg ON ha^{-1}	65	6926	17%	77	8	17	32
2005	170-210 kg ON ha^{-1}	23	2661	6%	109	11	24	21
2005	> 210 kg ON ha^{-1}	13	1324	3%	105	11	27	18
2010	< 85 kg ON ha^{-1}	153	15379	37%	28	3	6	31
2010	85-130 kg ON ha^{-1}	163	17547	42%	52	4	9	28
2010	130-170 kg ON ha^{-1}	56	6353	15%	69	5	14	26
2010	170-210 kg ON ha^{-1}	18	1564	4%	78	4	8	26
2010	> 210 kg ON ha^{-1}	5	537	1%	-	-	-	-
2015	< 85 kg ON ha^{-1}	140	17262	37%	19	2	4	29
2015	85-130 kg ON ha^{-1}	148	20759	44%	40	5	11	25
2015	130-170 kg ON ha^{-1}	57	7287	16%	77	8	16	27
2015	170-210 kg ON ha^{-1}	11	1459	3%	72	4	10	25
2015	> 210 kg ON ha^{-1}	4	210	0%	-	-	-	-

A decline in N application rates is evident over the study period across all stocking rate bands, except for the 130-170 kg ON ha^{-1} where a figure of 77 kg ha^{-1} was reported at the beginning and end of the period (Table 7). A decline of 34% was reported on cattle farms in the 170-210 kg ON ha^{-1} category over the period.

Figure 19: Cattle population distribution by N stocking rate band (2005-2015)



Average P application rates either declined or remained stable across cattle farms over the study period, with most change evident on farms in the 170-210 kg ON ha^{-1} category, on which P usage went from 11 kg ha^{-1} in 2005 to 4 kg ha^{-1} in 2015. A similar situation is apparent with regard to K usage, with the largest decline (from 24 kg ha^{-1} to 10 kg ha^{-1}) in the 170-210 kg ON ha^{-1} category also.

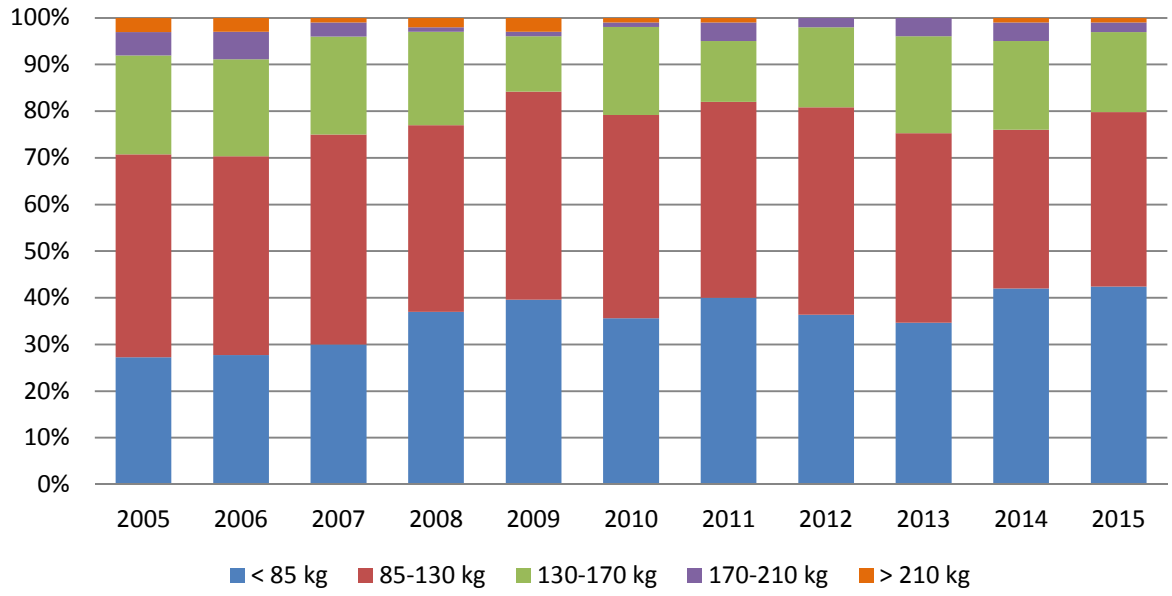
Teagasc NFS data on sheep farms also reflects a dramatic increase in the proportion of holdings in the least intensive stocking rate category <85 kg ON ha^{-1} over the period, the figure going from 27% in 2005 to 42% in 2015. Some variation in nutrient use is evident, with increased usage not necessarily correlated with stocking rate intensity. N and P application rates generally declined over the period across farms of all levels of intensity. Average K usage increased over the period for those farms in the <85 kg ON ha^{-1} and 130-170 kg ON ha^{-1} categories, with a decline in usage reported for farms in the 85-130 kg ON ha^{-1} category. Fertiliser usage on sheep farms >170 kg ON ha^{-1} are not reported here due to the small number of farms in the sample (N<10). In contrast to the increase in prevalence of sheep farms in the lowest intensity category <85 kg ON ha^{-1} over the period, the proportion of farms in the 85-130 kg ON ha^{-1} fell from 43% to 37%.

Table 8: Average farm size, NFS farms and farm population Sheep Farms by Org. N - Grazing Area

Year	Org N Stocking Rate	NFS Farms	Farm Pop.	% Pop.	N (kg/ha)	P (kg/ha)	K (kg/ha)	Area (ha)
2005	< 85 kg ON ha^{-1}	37	3042	27%	28	7	7	33
2005	85-130 kg ON ha^{-1}	62	4771	43%	46	5	11	32
2005	130-170 kg ON ha^{-1}	29	2354	21%	66	3	10	27
2005	170-210 kg ON ha^{-1}	9	595	5%	-	-	-	-
2005	> 210 kg ON ha^{-1}	7	351	3%	-	-	-	-
2010	< 85 kg ON ha^{-1}	47	3973	36%	20	2	4	39
2010	85-130 kg ON ha^{-1}	53	4895	44%	47	4	8	28
2010	130-170 kg ON ha^{-1}	21	2083	19%	61	3	7	27
2010	170-210 kg ON ha^{-1}	2	81	1%	-	-	-	-
2010	> 210 kg ON ha^{-1}	2	81	1%	-	-	-	-
2015	< 85 kg ON ha^{-1}	58	5722	42%	11	3	4	44
2015	85-130 kg ON ha^{-1}	40	5032	37%	38	6	12	26
2015	130-170 kg ON ha^{-1}	21	2313	17%	65	8	18	30
2015	170-210 kg ON ha^{-1}	5	330	2%	-	-	-	-
2015	> 210 kg ON ha^{-1}	2	144	1%	-	-	-	-

A decline (although smaller) in the proportion of farms in the 130-170 kg ON ha^{-1} category also occurred, with the figure going from 21% in 2005 to 17% in 2015. Likewise, the proportion of higher intensity sheep farms also declined by 3 percentage points and 2 percentage points respectively for those in the 170-210 kg ON ha^{-1} and >210 kg ON ha^{-1} categories.

Figure 20: Sheep population distribution by N stocking rate band (2005-2015)



3.2 Fertiliser Use on Silage Area 2005-2015

3.2.1 Fertiliser Use on Silage Area by Nitrate Zone

Silage Area is defined as the area of ground cut at least once for silage. The average area devoted to silage and the sample profile by nitrate zone are contained in Table 9. Between 2005 and 2015 the average area of silage conserved was 11 hectares across all zones. On average, higher levels of silage conservation were associated with zone A (13 hectares) compared to zones B and C (9-10 hectares). When population weighted, 41% of the farms with silage area were located in zone A, 46% were in zone B and 13% in zone C on average.

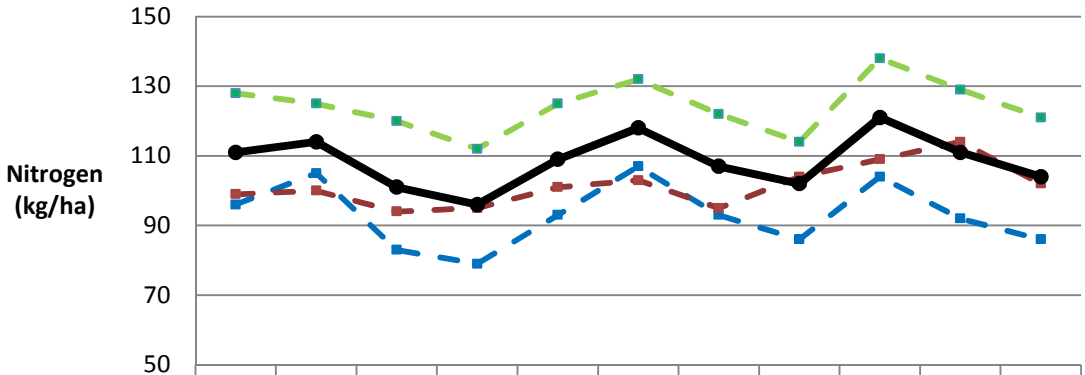
Table 9: Average farm size, NFS farms and farm population by Nitrate Zone – Silage Area

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Average area (ha) – silage area											
Zone A	12	12	13	13	13	13	14	13	14	13	13
Zone B	9	9	11	10	10	10	10	10	11	10	10
Zone C	9	9	9	8	8	9	9	9	10	8	9
All Zones	11	11	11	11	11	11	12	11	12	11	11
No. of Teagasc NFS farms with silage area											
Zone A	491	481	494	495	473	461	486	477	477	462	457
Zone B	354	357	360	335	330	315	300	306	314	305	303
Zone C	118	116	110	115	111	116	109	102	104	102	99
All Zones	963	954	964	945	914	892	895	885	895	869	859
% of Total farm population with silage area*											
Zone A	41%	41%	42%	41%	42%	41%	42%	41%	41%	40%	39%
Zone B	47%	46%	46%	46%	45%	46%	46%	46%	46%	47%	48%
Zone C	12%	13%	12%	13%	13%	13%	13%	13%	13%	14%	13%

*National population weights applied to Teagasc NFS farms

Figure 21 illustrates N applied on silage area by nitrate zone. Results indicate that average N application rates in zone A (112-138 kg ha^{-1}) were 22% higher than in zone C (94-114 kg ha^{-1}) and 33% higher than in zone B (83-107 kg ha^{-1}) over the study period. Significant volatility in application rates can be seen, with the lowest and highest application rates generally recorded in 2008 and 2013 across all zones and an overall decline across zones of 14% since 2013. By nitrate zone, a 5% decline from 2005 to 2015 is reported for zone A and 10% for zone B with a marginal increase in N use (3%) evident in zone C.

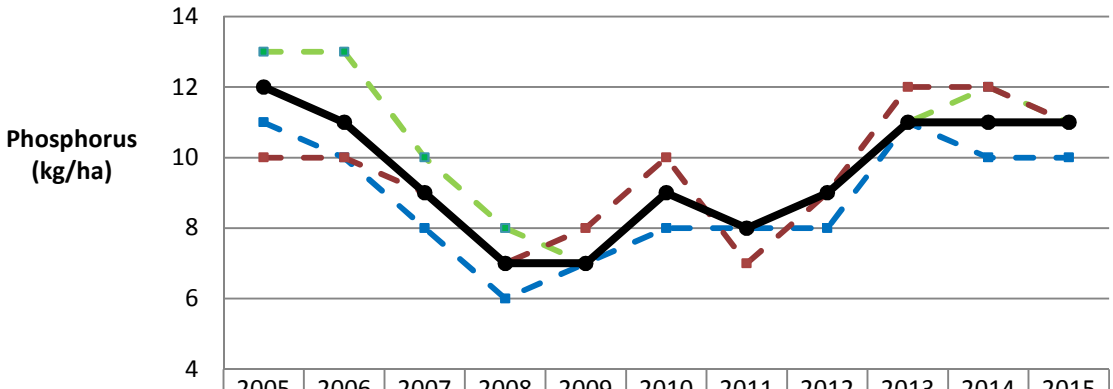
Figure 21: N use on Silage Area by Nitrate Zone



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Zone A	128	125	120	112	125	132	122	114	138	129	121
Zone B	96	105	83	79	93	107	93	86	104	92	86
Zone C	99	100	94	95	101	103	95	104	109	114	102
All Zones	111	114	101	96	109	118	107	102	121	111	104

P applied to silage area (kg ha^{-1}) by nitrate zone is detailed in Figure 22. Results indicate that P application rates in zone A were on average 14 per cent higher (7-13 kg ha^{-1}) compared to zone B (6-11 kg ha^{-1}) and 6% higher than in zone C (7-12 kg ha^{-1}). The highest application rates were recorded in 2005 (except for zone C) and the lowest application rates were reported in 2008/09 across all zones. A dramatic decline in P usage is evident from 2006 to 2009, with recovery thereafter and usage back to 2005 levels in 2015 for zone B, a modest increase in zone C and a small decrease in zone A.

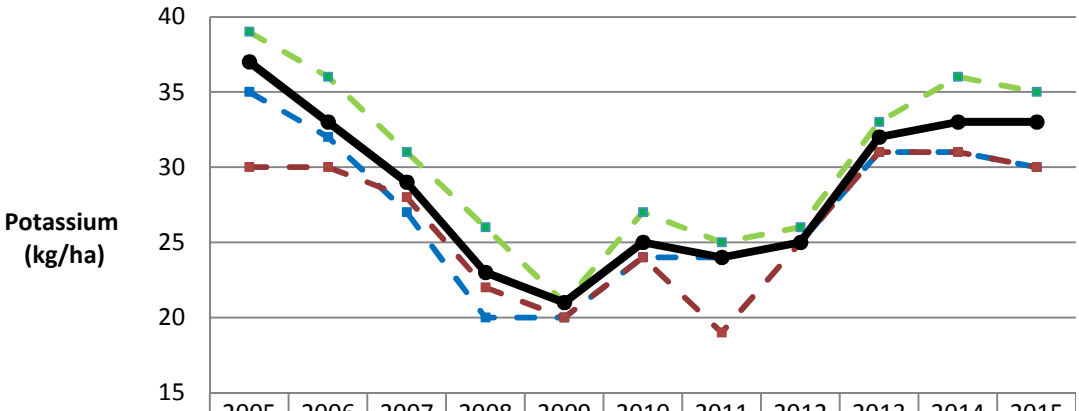
Figure 22: P use on Silage Area by Nitrate Zone



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Zone A	13	13	10	8	7	9	8	9	11	12	11
Zone B	11	10	8	6	7	8	8	8	11	10	10
Zone C	10	10	9	7	8	10	7	9	12	12	11
All Zones	12	11	9	7	7	9	8	9	11	11	11

K use on silage area (kg ha^{-1}) across nitrate zones is illustrated in Figure 23. Results indicate that average K application rates in zone A (21-39 kg ha^{-1}) were 12 per cent higher than in zone B (20-35 kg ha^{-1}) and 16 per cent higher than in zone C (19-30 kg ha^{-1}) over the study period. Average K application rates were 20-46 per cent lower during the middle of the period (2008-2011) and 8-15 per cent lower at the end (2013-2015) compared to the start for all zones, except for zone C which had similar application rates at the start and end of the study period.

Figure 23: K use on Silage Area by Nitrate Zone



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Zone A	39	36	31	26	21	27	25	26	33	36	35
Zone B	35	32	27	20	20	24	24	25	31	31	30
Zone C	30	30	28	22	20	24	19	25	31	31	30
All Zones	37	33	29	23	21	25	24	25	32	33	33

3.2.2 Fertiliser Use on Silage Area by Land Use Class

The average area of silage conserved and the proportion of farms conserving silage by land use class is outlined in Table 10. The average area of silage conserved ranged between 11-12 hectares across all land use classes. The average area of silage conserved was highest across the wide land use class category (13 hectares) compared to the other land use classes which ranged from (10-11 hectares).

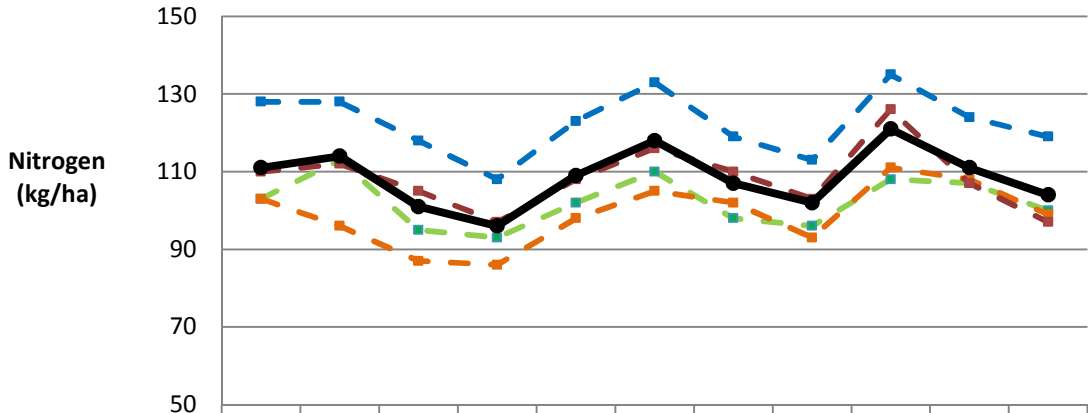
Table 10: Average farm size, NFS farms and farm population by Land Use Class – Silage Area

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Average area (ha) – silage area											
Limited	10	10	10	10	10	10	10	10	10	10	10
Somewhat Limited	10	10	10	9	10	10	10	11	12	11	12
Moderately Limited	10	10	11	11	11	11	11	11	11	10	11
Wide	12	12	13	13	13	13	14	13	14	14	13
All Soils	11	11	11	11	11	11	12	11	12	11	11
No. of Teagasc NFS farms with silage area											
Limited	298	292	287	269	258	257	242	241	230	218	219
Moderately Wide	160	167	170	165	165	159	157	156	166	161	161
Somewhat Limited	181	183	176	184	179	179	180	180	191	185	183
Wide	324	312	331	327	312	295	315	299	302	291	288
All Soils	963	954	964	945	914	890	894	876	889	855	851
% of Total farm population with silage area*											
Limited	32%	31%	31%	29%	29%	30%	28%	29%	29%	27%	29%
Moderately Wide	18%	20%	19%	20%	20%	19%	20%	19%	18%	18%	18%
Somewhat Limited	20%	21%	20%	21%	21%	22%	21%	23%	24%	26%	24%
Wide	29%	28%	30%	30%	30%	29%	31%	29%	29%	28%	29%

*National population weights applied to Teagasc NFS farms

Figure 24 outlines N application rates on silage area by land use class. Application rates for farms of wide land use class (108-128 kg ha^{-1}) were on average 13% higher than for farms of moderately wide land use class (97-112 kg ha^{-1}), 24% higher than for farms of somewhat limited land use class (86-111 kg ha^{-1}) and over 20% higher than for farms of limited land use class (93-113 kg ha^{-1}). The highest and lowest application rates were recorded in 2013 and 2008 respectively across the average of all land use classes. A decline in N application rates between 2005 and 2008 is evident (14% on average), with a steady increase in usage thereafter to 2013 with a decline in usage (of 14%) from then until the end of the study period.

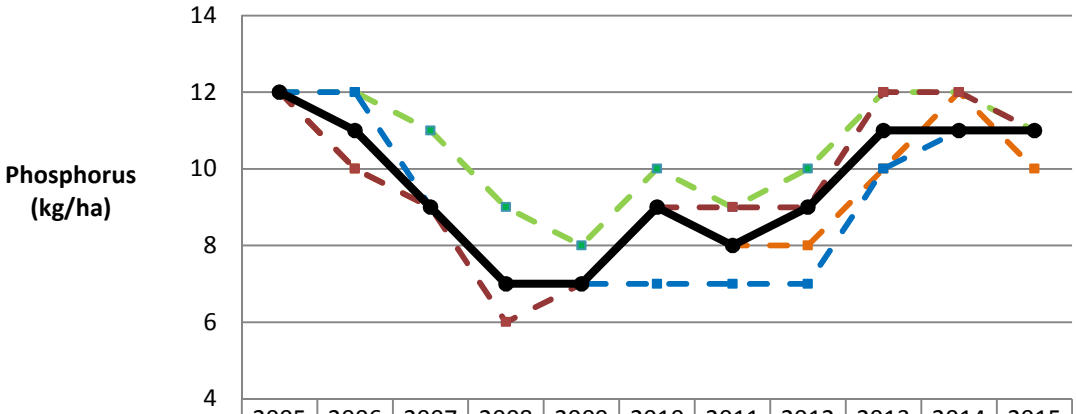
Figure 24: N use on Silage Area by Land Use Class



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Limited	103	113	95	93	102	110	98	96	108	107	100
Somewhat Limited	103	96	87	86	98	105	102	93	111	108	99
Moderately Wide	110	112	105	97	108	116	110	103	126	107	97
Wide	128	128	118	108	123	133	119	113	135	124	119
All Soils	111	114	101	96	109	118	107	102	121	111	104

Average P application rates on silage area by land use class are reported in Figure 25. Results indicate that P usage was highest on soils of limited land use potential, ranging from 9-12 kg ha^{-1} over the study period. This was on average 9% higher than for those of wide land use class, 14% higher than for farms of somewhat limited land use class and 16% higher than for farms of limited land use.

Figure 25: P on Silage Area by Land Use Class

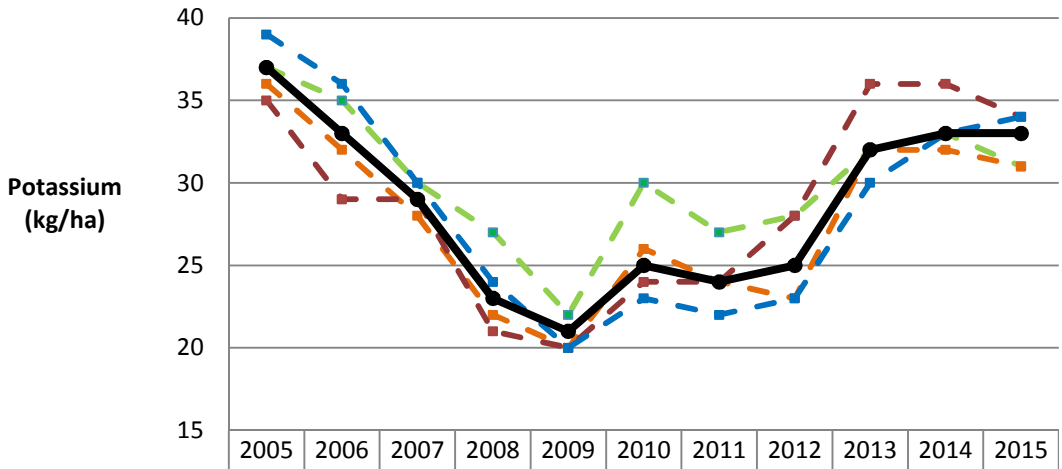


	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Limited	12	12	11	9	8	10	9	10	12	12	11
Somewhat Limited	12	10	9	7	7	9	8	8	10	12	10
Moderately Wide	12	10	9	6	7	9	9	9	12	12	11
Wide	12	12	9	7	7	7	7	7	10	11	11
All Soils	12	11	9	7	7	9	8	9	11	11	11

Application rates were broadly similar at the start and end of the study period across all land use classes, but declined significantly in the middle of the study period, between 25-42% between 2007 and 2012 on average. P use on silage area increased by almost 40% on average across all land use classes since 2011 in line with Teagasc advice, with the largest impact evident on soils of wide use class where the increase was almost 60%.

Figure 26 reports average K application rates over time on silage area by land use class. Again K usage was highest on land of limited use potential over the study period, ranging from 22-37 kg ha^{-1}. This was 8% higher on average than on farms of somewhat limited land use, 6% higher than for farms of wide land use potential and 5% higher than for farms of moderate land use potential. Application rates were at their highest in 2005 for all land use classes, but declined significantly in the middle of the study period, between 32-43% over the years 2008-2012 on average. The increase in usage was largest on limited and somewhat limited soils. However, application rates across all land use classes were on average still 11% lower in 2015 than at the start of the study period.

Figure 26: K use on Silage Area by Land Use Class



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Limited	37	35	30	27	22	30	27	28	32	33	31
Somewhat Limited	36	32	28	22	20	26	24	23	32	32	31
Moderately Wide	35	29	29	21	20	24	24	28	36	36	34
Wide	39	36	30	24	20	23	22	23	30	33	34
All Soils	37	33	29	23	21	25	24	25	32	33	33

3.2.3 Fertiliser Use on Silage Area by Farm System

Table 11 outlines the average area of silage conserved by farm system as well as the population of farms with silage area by farm system. Data from the NFS from 2005 to 2015 indicates that the average area of silage conserved on dairy farms (18 hectares) was twice as much as any other farm types over the period, increasing almost 20% since 2005. The population weighted data indicates that over half of the farms with silage area were cattle farms (56%), 26% were dairy farms, 12% were sheep farms and 6% were tillage farms.

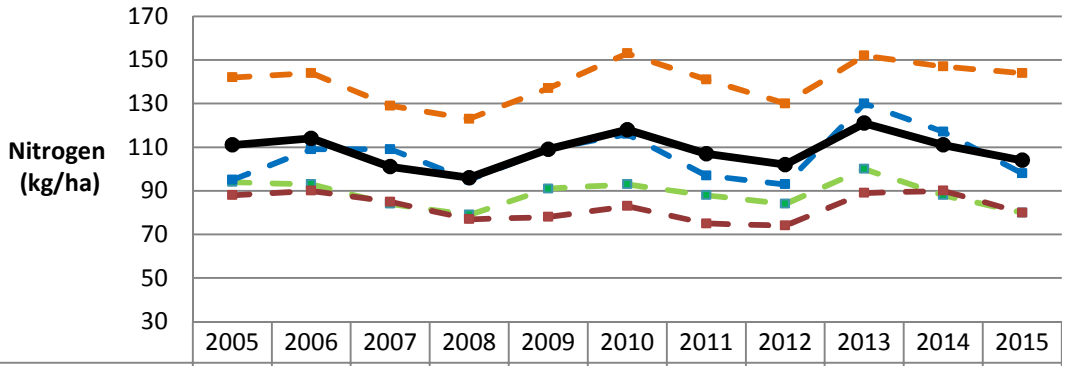
Table 11: Average farm size, NFS farms and farm population by Farm System – Silage Area

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Average area (ha) – silage area											
Cattle	9	8	9	9	9	9	10	9	10	9	9
Dairy	16	16	17	17	17	17	18	18	19	20	19
Sheep	8	8	9	8	8	8	8	7	8	8	8
Tillage	8	9	9	9	8	8	9	8	9	8	8
All Systems	11	11	11	11	11	11	12	11	12	11	11
No. of Teagasc NFS farms with silage area											
Cattle	353	366	394	409	401	386	378	362	359	358	353
Dairy	440	408	385	370	349	345	354	360	372	353	345
Sheep	115	118	113	95	92	96	95	99	100	100	106
Tillage	55	61	72	71	72	65	68	63	64	58	55
All Systems	963	953	964	945	914	892	895	884	895	869	859
% of Total farm population with silage area*											
Cattle	55%	55%	55%	56%	55%	56%	56%	55%	55%	57%	57%
Dairy	27%	27%	27%	27%	27%	27%	27%	26%	27%	23%	23%
Sheep	12%	12%	12%	11%	11%	12%	12%	12%	13%	14%	14%
Tillage	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%

*National population weights applied to Teagasc NFS farms

N application rates on silage area by farm system are outlined in Figure 27. Average application rates on dairy farms (123-153 kg ha^{-1}) were 59-70% higher compared to those on cattle and sheep farms (74-94 kg ha^{-1}) and 33% greater than on tillage farms (93-130 kg ha^{-1}) over the study period. Generally, N application rates on silage area across systems declined between 2005 and 2008 when they were at their lowest. Application rates were highest in 2013, but have been in decline since. Applications rates for dairy and tillage systems were slightly higher at the end of the period compared to the start having peaked in 2013 at the time of the fodder crisis. On the other hand, a decline is evident across cattle and sheep systems.

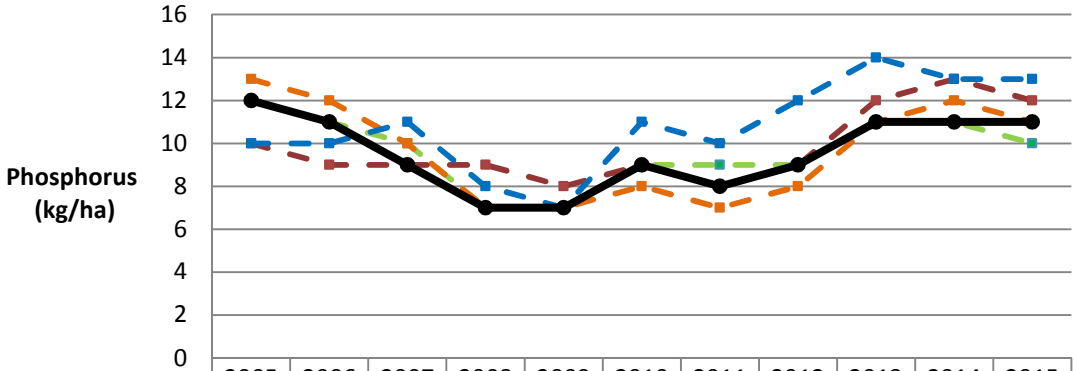
Figure 27: N use on Silage Area by Farm System



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Cattle	94	93	84	79	91	93	88	84	100	88	80
Dairy	142	144	129	123	137	153	141	130	152	147	144
Sheep	88	90	85	77	78	83	75	74	89	90	80
Tillage	95	109	109	95	109	116	97	93	130	117	98
All Systems	111	114	101	96	109	118	107	102	121	111	104

Average application rates of P on silage area were highest on tillage farms (7-14 kg ha^{-1}) and were 10% higher than on sheep farms and 12% higher than on cattle and dairy farms. An increase of between 20% and 30% is evident over the period on sheep and tillage farms with a decline evident across other systems. The overall decline reported across all farm types was 8% on average. Application rates for tillage and sheep farms peaked at the end of the study period (2014/2015), while the peak for cattle and dairy farms was at the start (2005/2006). There was a significant decline during the middle of the study period (25-42%) across all farm systems, except for sheep farms, as illustrated in Figure 28.

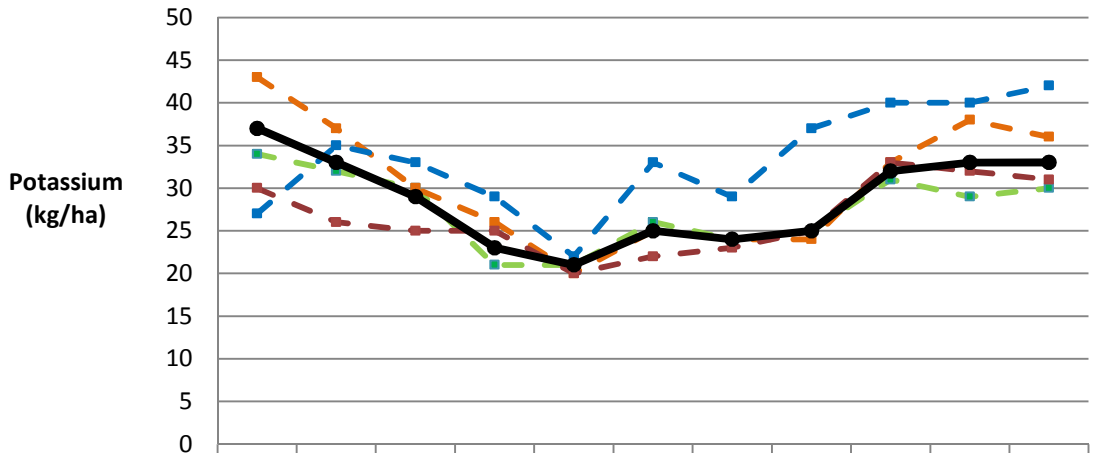
Figure 28: P use on Silage by Farm System



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Cattle	12	11	10	7	7	9	9	9	11	11	10
Dairy	13	12	10	7	7	8	7	8	11	12	11
Sheep	10	9	9	9	8	9	8	9	12	13	12
Tillage	10	10	11	8	7	11	10	12	14	13	13
All Systems	12	11	9	7	7	9	8	9	11	11	11

Figure 29 reports average K application rates on silage area by farm system. Results indicate that K usage was again highest on tillage farms (22-42 kg ha^{-1}) on average, 9% higher than on dairy farms, 21% higher than on cattle farms and 26% higher than on sheep farms over the study period. Application rates for tillage and sheep farms peaked at the end of the study period (2014/2015) whereas the highest usage on cattle and dairy farms was reported at the outset (2005/2006). There was a significant decline during the middle of the study period (32-43% on average) across the majority of farm systems except tillage. K application rates for silage increased 56% on tillage farms from 2005 to 2015, with a general decline across other farm types, except for sheep farms where there was a marginal increase of 3%. Overall, the data reports a 48% decline across all systems from 2005 to 2008 with a 57% recovery from 2009 to 2015.

Figure 29: K use on Silage Area by Farm System



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Cattle	34	32	30	21	21	26	24	25	31	29	30
Dairy	43	37	30	26	20	25	24	24	33	38	36
Sheep	30	26	25	25	20	22	23	25	33	32	31
Tillage	27	35	33	29	22	33	29	37	40	40	42
All Systems	37	33	29	23	21	25	24	25	32	33	33

3.2.4 Fertiliser Use on Silage Area by Organic N stocking Rate

The variation in silage area by organic N stocking rate is evident from Table 12. Data from the Teagasc NFS from 2005 to 2015 indicates that silage area tends to be smaller on less intensive holdings, as is to be expected. The average area for those farms in the <85 kg ON ha^{-1} ranged from 7 to 8 hectares over the period, with the corresponding figure on farms in the 85-130 kg ON ha^{-1} ranging from 9 to 11 hectares and 13 to 14 hectares for farms in the 130-170 kg ON ha^{-1} category. More intensively stocked farms (>170kg ON ha^{-1}) reported silage area of between 14 and 20 hectares on average over the study period.

Table 12: Average farm size, NFS farms and farm population All Farms by Organic N - Silage Area

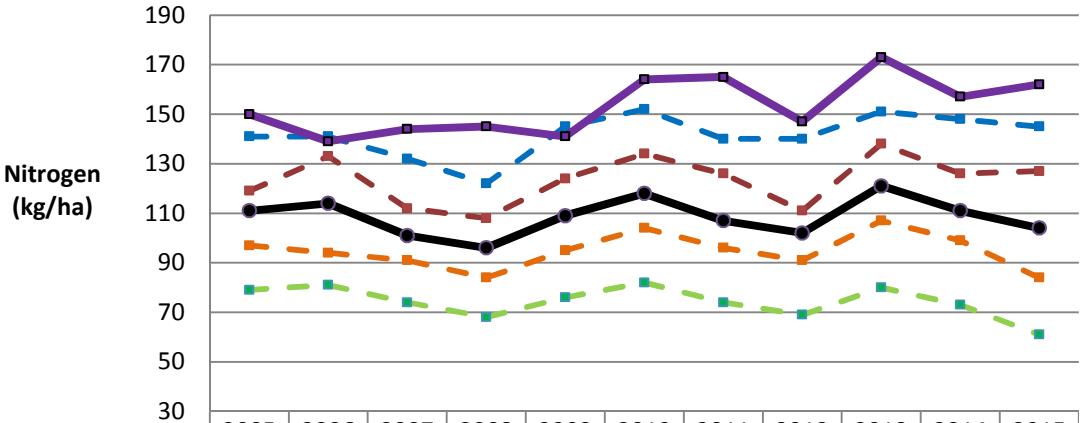
Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Average Area (ha) – silage area											
< 85 kg ON ha^{-1}	7	7	8	7	7	8	8	8	8	7	8
85-130 kg ON ha^{-1}	9	9	10	10	10	10	11	10	10	10	10
130-170 kg ON ha^{-1}	13	13	14	13	13	13	14	14	14	14	14
170-210 kg ON ha^{-1}	15	14	16	17	19	17	18	18	19	20	19
> 210 kg ON ha^{-1}	14	17	16	17	18	19	19	17	19	19	18
All Rates	11	11	11	11	11	11	12	11	12	11	11
No. of Teagasc NFS Farms – farms with silage area											
Year	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
< 85 kg ON ha^{-1}	140	168	193	186	200	216	239	208	197	202	203
85-130 kg ON ha^{-1}	309	308	333	334	322	300	277	280	280	269	260
130-170 kg ON ha^{-1}	268	274	252	263	224	214	217	225	218	208	199
170-210 kg ON ha^{-1}	159	135	129	101	111	105	103	120	129	125	124
> 210 kg ON ha^{-1}	87	69	58	62	57	57	59	52	71	65	73
All Rates	963	954	965	946	914	892	895	885	895	869	859
% of Population											
Year	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
< 85 kg ON ha^{-1}	19%	22%	24%	23%	25%	28%	32%	27%	27%	28%	29%
85-130 kg ON ha^{-1}	39%	38%	40%	40%	40%	38%	35%	38%	37%	37%	38%
130-170 kg ON ha^{-1}	24%	24%	22%	25%	22%	22%	21%	22%	22%	22%	19%
170-210 kg ON ha^{-1}	12%	12%	10%	8%	8%	8%	8%	9%	9%	9%	9%
> 210 kg ON ha^{-1}	7%	5%	4%	4%	4%	4%	4%	4%	5%	4%	5%
All Rates	101%	101%	100%	100%	99%	100%	100%	100%	100%	100%	100%

*National population weights applied to Teagasc NFS farms

The data indicates that the proportion of farms with silage area in the lowest stocking rate band <85 kg ON ha^{-1} increased by ten percentage points from 19% to 29% over the period. At the other end of the scale, there was a marginal decrease (two percentage points) in the proportion of farms in the most intensive category >210 kg ON ha^{-1}. The proportion in the 85-130 kg ON ha^{-1} category remained unchanged at 39%, whereas a decline of five and three percentage points respectively is evident in the remaining categories 130-170 kg ON ha^{-1} and 170-210 kg ON ha^{-1}.

Figure 30 illustrates a decline in average N usage for silage production over the study period on less intensive farms, with a 23% decline on those farms in the <85 kg ON ha^{-1} category where average N application rates ranged from 61-82 kg ha^{-1}. Similarly a 13% decline is reported on those farms in the 85-130 kg ON ha^{-1} category with N application rates ranging from 84-107 kg ha^{-1} on average. For those farms >130 kg ON ha^{-1} N use increased between 3 and 8% over the period. A correlation between levels of intensity and increased N usage can be seen from Figure 30 which indicates that average N application rates were more than twice as high on the most intensive farms (139-173 kg ha^{-1}) compared to the least intensive farms and more than one and a half times higher than on those farms in the 85-130 kg ON ha^{-1} category. Average N application rates ranged from 108 to 138 kg ha^{-1} on those farms in the 130-170 kg ON ha^{-1} category and 122 to 152 kg ha^{-1} on those in the 170-210 kg ON ha^{-1} category over the time period.

Figure 30: N use on Silage Area by Organic N stocking rate – All farms

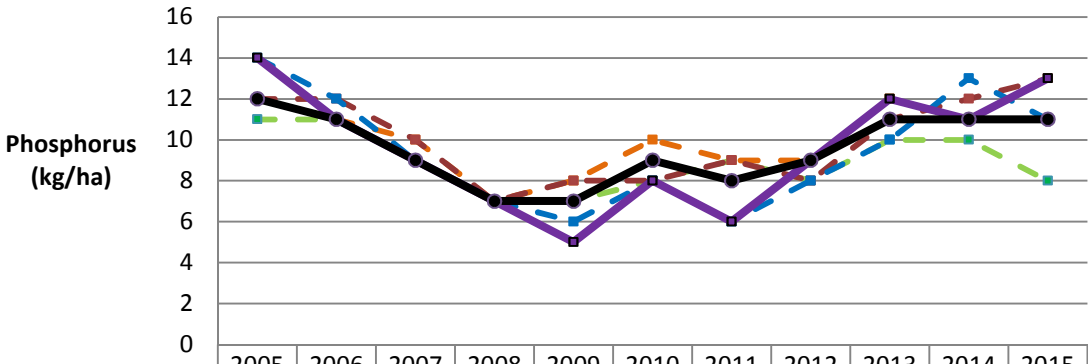


	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
< 85	79	81	74	68	76	82	74	69	80	73	61
85-130	97	94	91	84	95	104	96	91	107	99	84
130-170	119	133	112	108	124	134	126	111	138	126	127
170-210	141	141	132	122	145	152	140	140	151	148	145
> 210	150	139	144	145	141	164	165	147	173	157	162
All Rates	111	114	101	96	109	118	107	102	121	111	104

There is less variation in P usage across stocking rate bands over the period according to Figure 31, which indicates that average application rates ranged from 7-11 kg ha^{-1} on farms <85 kg ON ha^{-1}, 7-12 kg ha^{-1} on farms of 85-130 kg ON ha^{-1} and 7-13 kg ha^{-1} on farms of 130-170 kg ON ha^{-1}. Unlike with N usage, there is no clear correlation between farm intensity and P usage with average application rates only marginally higher on those farms in the 170-210 kg ON ha^{-1} and >210 kg ON ha^{-}

[1] categories, with average application rates ranging from 6 to 14 kg ha^{-1} and 5 to 14 kg ha^{-1} respectively. A general decline in P usage, ranging from 8% to 28%, is evident over the period across farms of all levels of intensity, except from those in the 130-170 kg ON ha^{-1} category, where average P application rates increased by 8% over the period 2005-2015.

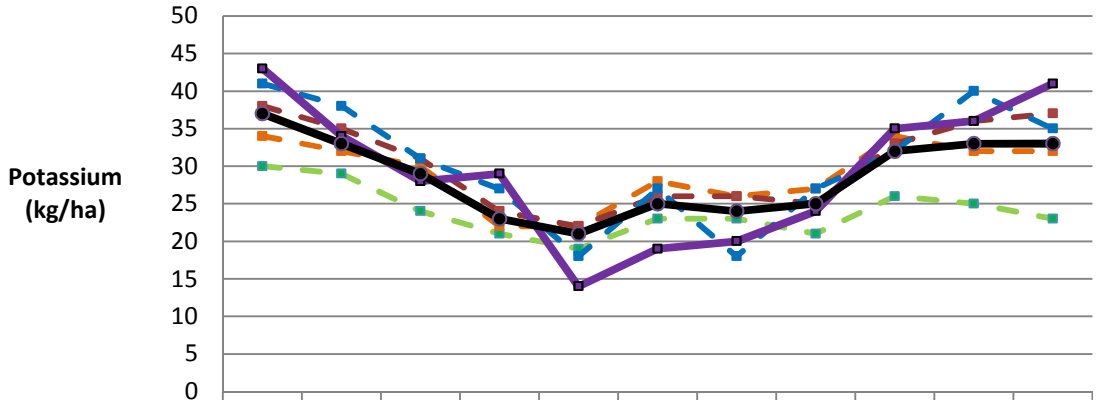
Figure 31: P use on Silage Area by Organic N stocking rate – All farms



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
< 85	11	11	9	7	7	8	9	8	10	10	8
85-130	12	11	10	7	8	10	9	9	12	11	11
130-170	12	12	10	7	8	8	9	8	11	12	13
170-210	14	12	9	7	6	8	6	8	10	13	11
> 210	14	11	9	7	5	8	6	9	12	11	13
All Rates	12	11	9	7	7	9	8	9	11	11	11

A decline in average K usage across stocking rate bands over the study period can be seen from Figure 32, with the largest reduction (23%) evident on the least intensive farms <85 kg ON ha^{-1}. Despite a general reduction in K application rates over the period, recovery towards starting levels can be seen across some farm categories e.g. 130-170 kg ON ha^{-1}. There was much variation in application rates across stocking rate bands over the period, particularly on farms in the >210 kg ON ha^{-1} where K application rates ranged from 19 to 43 kg ha^{-1} on average and farms in the 170-210 kg ON ha^{-1} category where rates ranged from 18 to 41 kg ha^{-1}. Average K application rates ranged from 19 to 30 kg ha^{-1} on farms <85 kg ON ha^{-1}, 22 to 34 kg ha^{-1} on farms in the 85-130 kg ON ha^{-1} category and 22 to 38 kg ha^{-1} on farms of 130-170 kg ON ha^{-1}. On average K usage was marginally higher over the period on those farms in the latter category, with the differential largest (1.3 times higher) on those farms compared to those in the <85 kg ON ha^{-1} category.

Figure 32: K use on Silage Area by Organic N stocking rate – All farms



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
< 85	30	29	24	21	19	23	23	21	26	25	23
85-130	34	32	30	22	22	28	26	27	34	32	32
130-170	38	35	31	24	22	26	26	25	33	36	37
170-210	41	38	31	27	18	27	18	27	32	40	35
> 210	43	34	28	29	14	19	20	24	35	36	41
All Rates	37	33	29	23	21	25	24	25	32	33	33

3.3 Fertiliser Use on Hay Area 2005-2015

Hay area is defined as the basic area of ground cut at least once for hay with no adjustment made for grass cut more than once or for grazing. The production of hay is highly dependent on weather, which leads to significant variation over the period as illustrated by Table 13. As a result, nutrient use on hay area is reported here by the total number of farms only. According to these data, the average area under hay across farms was 4 hectares.

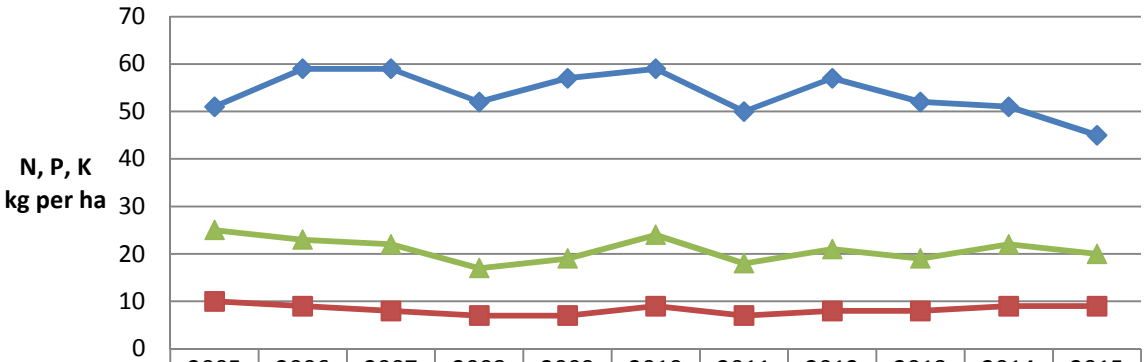
Table 13: Average farm size, NFS farms and farm population by Nitrate Zone – Hay Area

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Average Area (ha) – hay area											
All Farms	4	4	4	4	3	4	4	4	4	4	4
Total NFS farms	361	380	263	242	233	268	220	124	314	275	161
% of total population	35%	37%	26%	24%	23%	28%	23%	13%	33%	30%	18%

*National population weights applied to Teagasc NFS farms

The average N application rate on hay ranged from 45-59 kg ha^{-1} over the study period, with a 12% decline in usage reported across years (Figure 33). A steady decline in N usage on hay area is evident from 2012. Although the average rate of N applied in 2015 was below that in 2005, the level of P usage at the end of the period (at 8 kg ha^{-1}) was almost back to that reported in 2005 (despite a 10% decline in the intervening years). Overall P application rates ranged from 7-10 kg ha^{-1} over the study period. Average K application rates ranged from 17-25 kg ha^{-1} with a 20% decline in K usage reported from 2005 to 2015.

Figure 33: N, P and K use on Hay area



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
N	51	59	59	52	57	59	50	57	52	51	45
P	10	9	8	7	7	9	7	8	8	9	9
K	25	23	22	17	19	24	18	21	19	22	20

3.4 Fertiliser Use on Total Grassland Area 2005-2015

3.4.1 Fertiliser Use on Total Grassland Area by Nitrate Zone

Grassland is defined as the total area of pasture on the holding. This includes land dedicated to grazing, silage and hay but excludes area under arable crops and rough grazing (defined as ground that cannot be fertilised). Data from the NFS on the average grassland area across zones and the population represented from 2005 to 2015 are contained in Table 14. The average area dedicated to grassland across the three zones over the period was 38 hectares. The average area under grassland tended to be largest in zone A (41 hectares) and smallest in zone C (32 hectares) which is reflective of the geographical location of these farms. When population weighted, 41% of the farms with grazing area were in zone A, with 46% in zone B and only 12% in the smaller zone C on average. It should be noted as outlined in section 1.3 that average areas reported for grazing and silage will not tally with that for total grassland as some silage area is grazed and this proportional area is added to the total grazing area, while silage area is deemed to remain unchanged.

Table 14: Average farm size, NFS farms and farm population by Nitrate Zone – Grassland Area

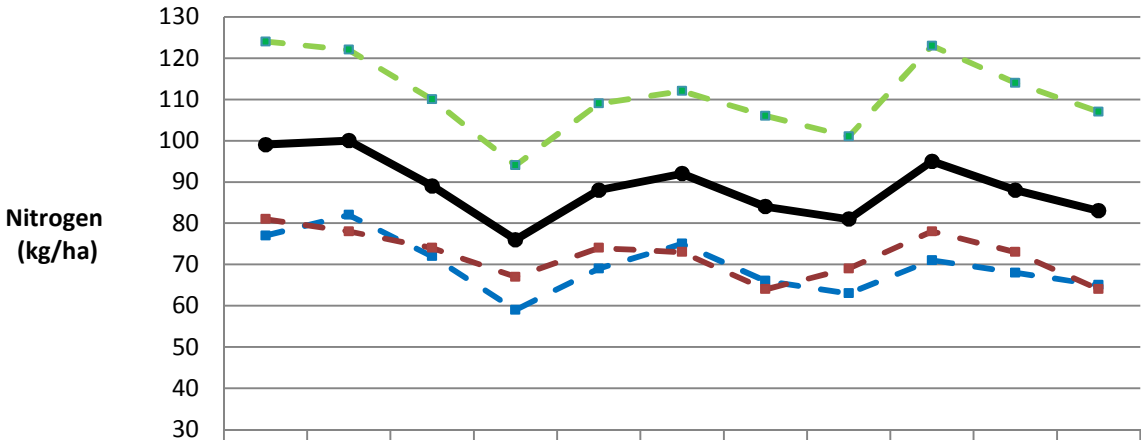
Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Average Area (ha) – grassland area											
Zone A	41	41	41	40	41	41	42	42	42	41	40
Zone B	35	35	36	36	36	36	36	37	38	36	36
Zone C	32	32	32	31	32	32	33	36	34	31	31
All Zones	37	37	38	37	38	38	38	39	40	37	37
No. of Teagasc NFS farms with grassland area											
Zone A	524	514	525	532	505	493	516	503	502	477	477
Zone B	384	387	384	365	358	341	325	323	333	326	321
Zone C	121	119	113	117	111	118	112	103	104	105	103
All Zones	1029	1020	1022	1014	974	952	953	929	939	908	901
% of Total farm population with grassland area*											
Zone A	41%	41%	42%	42%	42%	42%	42%	42%	42%	40%	40%
Zone B	46%	46%	46%	46%	46%	46%	46%	46%	46%	47%	47%
Zone C	12%	12%	12%	12%	12%	12%	12%	12%	12%	13%	13%

*National population weights applied to Teagasc NFS farms

Figure 34 illustrates N applied on total grassland area (kg ha^{-1}) by nitrate zone. Average N application rates ranged between 76-100 kg ha^{-1} across all zones over the period. Application rates were typically 54-60% higher in zone A (94-124 kg ha^{-1}) compared to zone B (59-82 kg ha^{-1}) and zone C (64-81 kg ha^{-1}) on average. Post 2005/2006, application rates declined in general and were 23% lower in 2008 compared to starting period levels. Applications rates recovered to near starting period levels in 2013, before declining again towards the end of the study period. Overall, a 16%

decline in N usage is evident across zones with the decline from 2005 to 2015 least in zone A at 14% and largest across zone C at 21%.

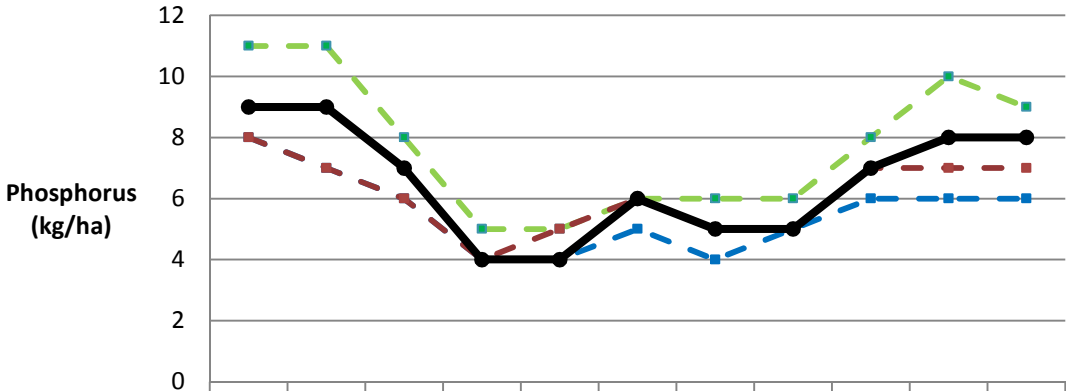
Figure 34: N use on Total Grassland Area by Nitrate Zone



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Zone A	124	122	110	94	109	112	106	101	123	114	107
Zone B	77	82	72	59	69	75	66	63	71	68	65
Zone C	81	78	74	67	74	73	64	69	78	73	64
All Zones	99	100	89	76	88	92	84	81	95	88	83

P application rates on total grassland area (kg ha^{-1}) by nitrate zone are outlined in Figure 35. Results indicate that P application rates in zone A (5-11 kg ha^{-1}) were on average nearly 40% higher than in zone B and 27 per cent higher than in zone C on average. Average P application rates were in the order of 50% lower during the middle of the study period (2008-2012) compared to the start. Despite some recovery thereafter an overall decline of 11% is reported over the eleven-year period with the largest decline (18%) evident in zone A.

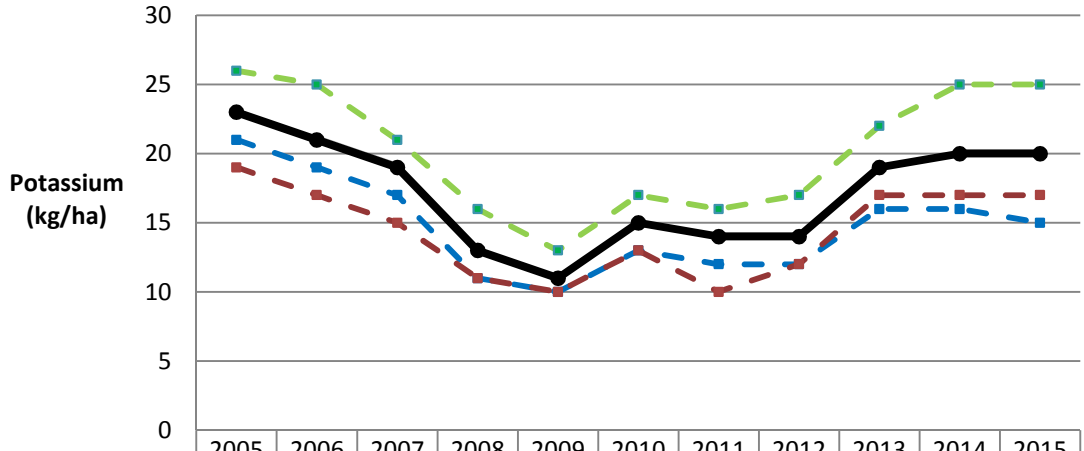
Figure 35: P use on Total Grassland Area by Nitrate Zone



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Zone A	11	11	8	5	5	6	6	6	8	10	9
Zone B	8	7	6	4	4	5	4	5	6	6	6
Zone C	8	7	6	4	5	6	5	5	7	7	7
All Zones	9	9	7	4	4	6	5	5	7	8	8

K usage on average ranged from 11-23 kg ha^{-1} across zones over the reporting period. Application rates were in the order of 40% higher in zone A (13-26 kg ha^{-1}) compared to zones B and C. Average application rates declined by between 39-52% from the start of the study period to the middle (2008-2012) before recovering towards the end (with the exception of zone B) where usage was 29% lower in 2015 than in 2005.

Figure 36: K use on Total Grassland Area by Nitrate Zone



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Zone A	26	25	21	16	13	17	16	17	22	25	25
Zone B	21	19	17	11	10	13	12	12	16	16	15
Zone C	19	17	15	11	10	13	10	12	17	17	17
All Zones	23	21	19	13	11	15	14	14	19	20	20

3.4.2 Fertiliser Use on Total Grassland Area by Land Use Class

Table 15 outlines average grassland area by land use class and the relative proportion of farms with grassland across each category. Across all soils the average area of total grassland was 38 hectares over the study period. Across individual land use class categories, the average area was largest on soils of wide use potential (at 41 hectares) and smallest on limited soils (at 36 hectares). The population weighted data indicates that approximately 30% of the farm population are located on soils of wide use potential, a further 30% on soils of limited use potential, 21% on land of somewhat limited use and 19% on land of moderately wide land use potential.

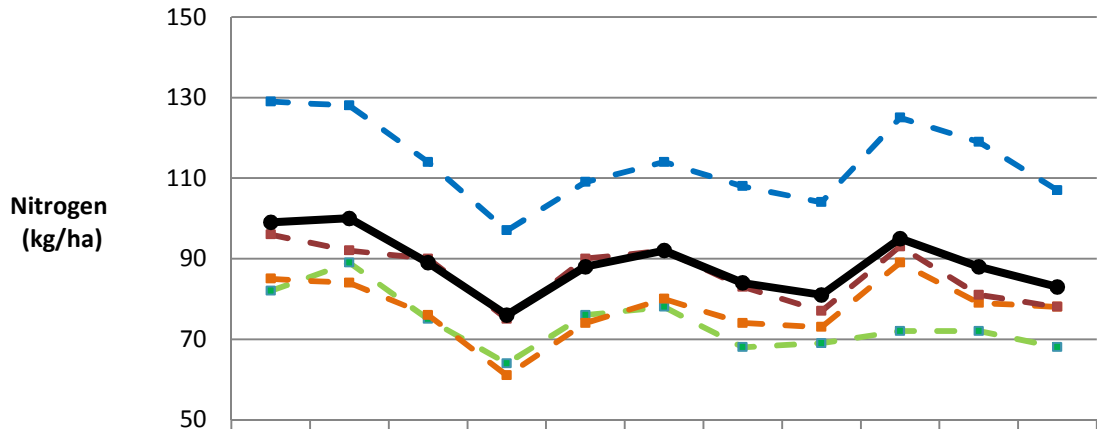
Table 15: Average farm size, NFS farm and farm population by Land Use Class – Grassland Area

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Average Area (ha) - grassland area											
Limited	33	35	35	35	35	35	36	37	39	37	37
Somewhat Limited	37	35	36	35	36	36	36	39	40	38	38
Moderately Wide	37	38	36	37	37	36	37	37	37	35	36
Wide	41	41	42	42	42	42	42	42	42	40	39
All Soils	37	37	38	37	38	38	38	39	40	37	37
No. of Teagasc NFS farms with grassland area											
Limited	321	311	307	295	282	278	260	255	245	233	234
Moderately Wide	172	180	179	177	176	170	168	160	171	166	167
Somewhat Limited	190	188	184	189	184	186	189	187	194	189	189
Wide	346	341	352	353	332	316	335	318	323	305	303
All Soils	1029	1020	1022	1014	974	950	952	920	933	893	893
% of Total Farm Population with grassland area*											
Limited	33%	31%	31%	30%	30%	30%	29%	29%	29%	28%	29%
Moderately Wide	18%	20%	19%	20%	20%	20%	20%	19%	18%	18%	18%
Somewhat Limited	20%	20%	19%	20%	20%	22%	21%	22%	23%	25%	23%
Wide	29%	29%	30%	30%	30%	29%	31%	30%	30%	29%	29%

*National population weights applied to Teagasc NFS farms

N application rates on total grassland area by land use potential are presented in Figure 37. Results indicate that application rates for farms of wide land use class (97-129 kg ha^{-1}) were on average 54% higher than for farms of limited land use class, 47% higher than on farms of somewhat limited land use class and 32% higher than on farms of moderately wide land use class. The highest application rates were recorded at the start of the study period (2005/2006) for all land use classes. The lowest application rates were recorded in 2008 across all land use classes (23% lower than the start of the study period on average). Application rates recovered in 2013 to levels near to those at the start of the study period, but then declined in 2014-15 and were on average 11-16% lower than at the start of the study period.

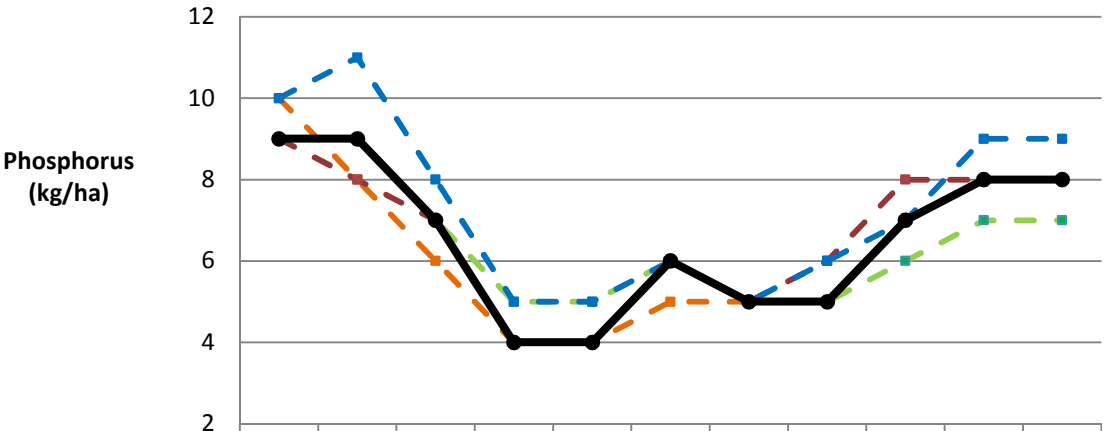
Figure 37: N use on Total Grassland Area by Land Use Class



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Limited	82	89	75	64	76	78	68	69	72	72	68
Somewhat Limited	85	84	76	61	74	80	74	73	89	79	78
Moderately Wide	96	92	90	75	90	92	83	77	93	81	78
Wide	129	128	114	97	109	114	108	104	125	119	107
All Soils	99	100	89	76	88	92	84	81	95	88	83

Figure 38 outlines P application rates on total grassland area by land use class. Results indicate that application rates for soils of wide land use class (5-11 kg ha^{-1}) were on average 14% higher than for soils of limited land use class, 16% higher than for soils of somewhat limited land use class and 11% higher than for soils of moderately wide land use class.

Figure 38: P use on Total Grassland Area by Land Use Class

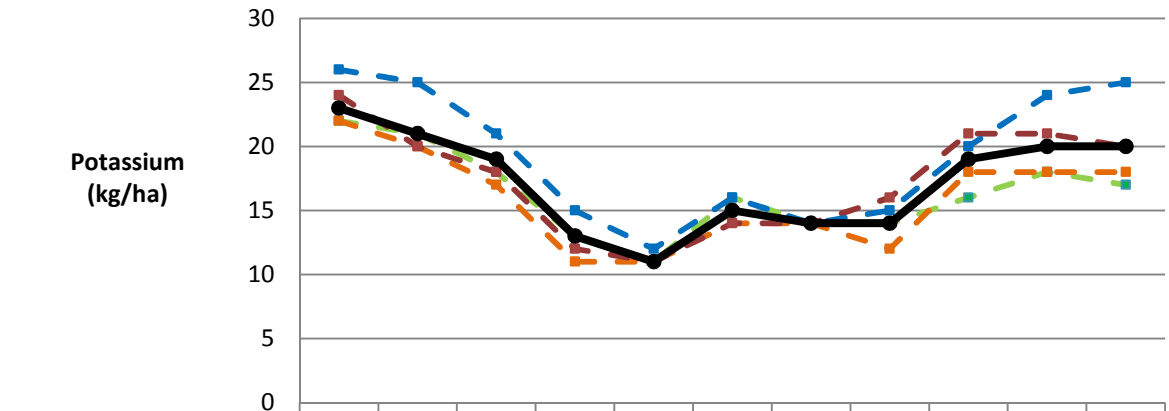


	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Limited	9	9	7	5	5	6	5	5	6	7	7
Somewhat Limited	10	8	6	4	4	5	5	5	7	8	8
Moderately Wide	9	8	7	4	4	6	5	6	8	8	8
Wide	10	11	8	5	5	6	5	6	7	9	9
All Soils	9	9	7	4	4	6	5	5	7	8	8

P application rates were highest across all land use class categories at the start of the study period (2005/2006) but declined by between 44-56% on average from 2008 to 2012. Application rates recovered from 2012 but were still on average 11% lower in 2015 compared to 2005.

Application rates of K for farms of wide land use class (12-26 kg ha^{-1}) were on average 18% higher than for farms of limited land use class, 22% higher than for farms of somewhat limited land use class and 12% higher than for farms of moderately wide land use class. Again application rates were highest at the start of the study period (2005) and declined by between 35-52% on average during 2008-2012. Application rates recovered at the end of the study period (2013-2015), especially on those farms of wide land use class, but were on average still 13% lower than at the start of the study period as illustrated in Figure 39.

Figure 39: K use on Grassland Area by Land Use Class



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Limited	22	21	18	13	11	16	14	14	16	18	17
Somewhat Limited	22	20	17	11	11	14	14	12	18	18	18
Moderately Wide	24	20	18	12	11	14	14	16	21	21	20
Wide	26	25	21	15	12	16	14	15	20	24	25
All Soils	23	21	19	13	11	15	14	14	19	20	20

3.4.3 Fertiliser Use on Total Grassland Area by Farm System

Table 16 outlines the total grassland area as well as the proportion of the farm population by system. Area under grassland was largest on dairy farms (50 hectares). This was 37% greater than on sheep farms (37 hectares), 48% greater than on cattle farms (34 hectares) and 92% greater than on tillage farms (26 hectares). Cattle farms accounted for over half of the sample (53%), with grassland area on dairy, sheep and tillage farms comprising 25%, 14% and 7% respectively.

Table 16: Average farm size, NFS farms and farm population by farm system – Grassland Area

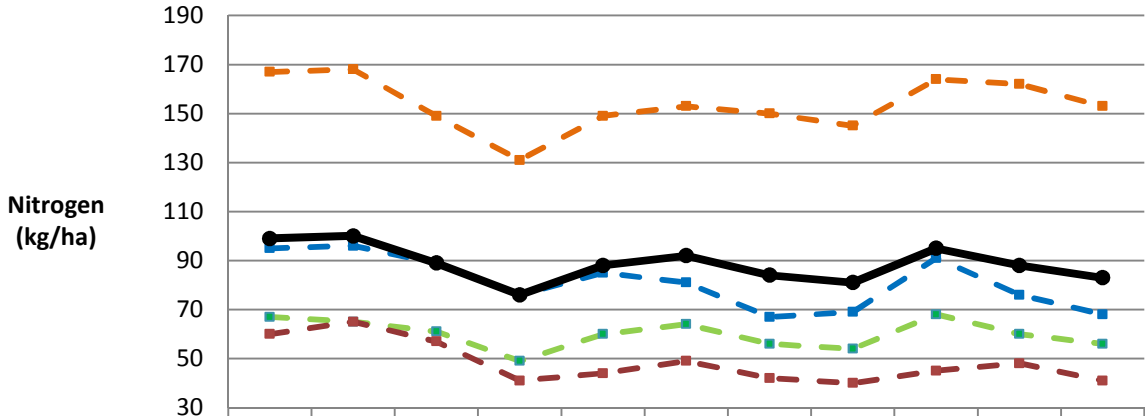
Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Average area (ha) – grassland area											
Cattle	34	33	34	34	34	34	35	35	35	33	33
Dairy	48	48	48	49	50	50	50	51	52	53	53
Sheep	35	35	36	36	35	36	36	37	42	38	38
Tillage	27	30	28	26	26	24	25	25	26	25	25
All Systems	37	37	38	37	38	38	38	39	40	37	37
No. of Teagasc NFS farms with grassland area											
Cattle	368	381	404	421	413	395	386	366	369	365	360
Dairy	447	416	390	378	353	346	355	361	372	353	347
Sheep	144	148	144	125	122	125	123	119	118	120	126
Tillage	70	74	84	90	86	85	88	82	80	70	68
All Systems	1029	1019	1022	1014	974	951	952	928	939	908	901
% of Total farm population with grassland area*											
Cattle	53%	53%	53%	53%	53%	53%	53%	53%	53%	55%	55%
Dairy	26%	26%	26%	26%	26%	25%	25%	25%	25%	21%	22%
Sheep	14%	14%	14%	14%	14%	14%	14%	14%	14%	16%	16%
Tillage	7%	6%	6%	7%	7%	8%	7%	7%	7%	8%	7%

*National population weights applied to Teagasc NFS farms

As with grazing and silage, the highest rates of N on grassland were on dairy farms. Indeed N usage on grassland by dairy farms (131-167 kg ha^{-1}) was 2-4 times higher than on other farm systems over the study period as outlined in Figure 40. The largest decline was on tillage farms at 28% with the smallest on dairy farms at 8%.

Figure 40 illustrates that average N application rates were at their highest across all farm systems at the beginning of the study period (2005/2006) but declined by between 7-23% during the 2008-2012 period. There was a recovery in 2013 to near starting period levels, especially on dairy and cattle farms, but N application rates declined again at the end of the study period (2013-2015) and were 11-16% lower in 2015 compared to 2005. The largest decline was on tillage farms at 28% with the smallest on dairy farms at 8%.

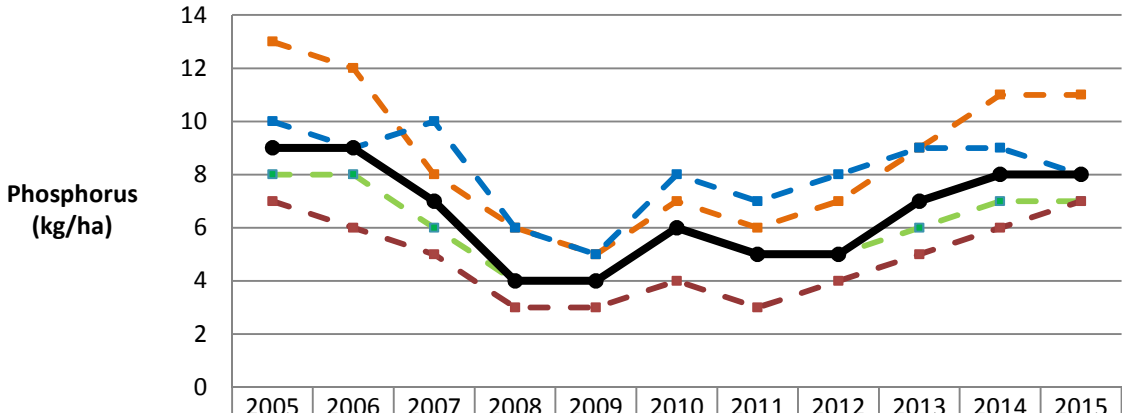
Figure 40: N use on Total Grassland Area by Farm System



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Cattle	67	65	61	49	60	64	56	54	68	60	56
Dairy	167	168	149	131	149	153	150	145	164	162	153
Sheep	60	65	57	41	44	49	42	40	45	48	41
Tillage	95	96	89	76	85	81	67	69	91	76	68
All Systems	99	100	89	76	88	92	84	81	95	88	83

Application rates of P on grassland by farm system are illustrated in Figure 41. Application rates on dairy farms (5-13 kg ha^{-1}) were 7% greater than on tillage farms, 44% higher than on cattle farms and nearly 80% higher than on sheep farms on average over the study period. Average application rates were highest across all farm systems at the start of the study period (2005/2006), but declined by between 44-56% from 2008-2012. Application rates recovered at the end of the study period (2013-2015), especially on sheep farms, but on average were still 11% lower than at the start.

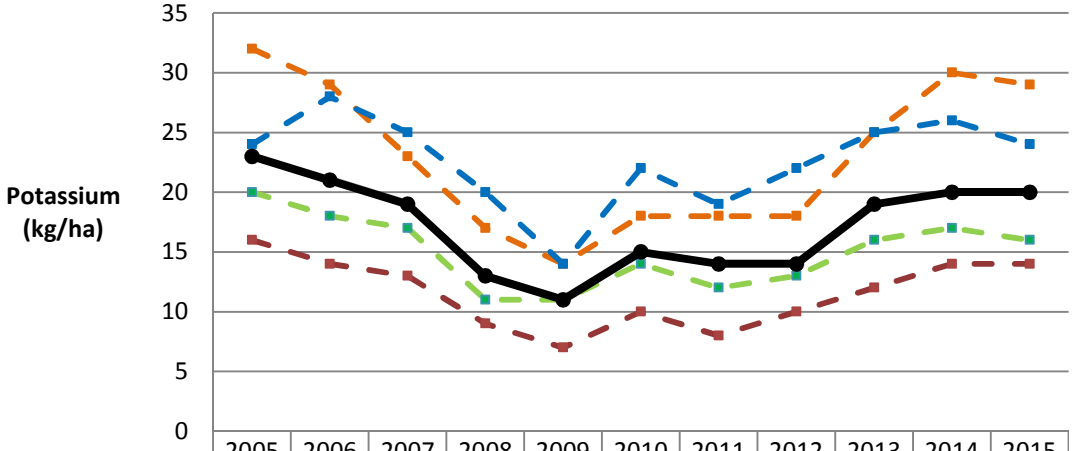
Figure 41: P use on Total Grassland Area by Farm System



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Cattle	8	8	6	4	4	6	5	5	6	7	7
Dairy	13	12	8	6	5	7	6	7	9	11	11
Sheep	7	6	5	3	3	4	3	4	5	6	7
Tillage	10	9	10	6	5	8	7	8	9	9	8
All Systems	9	9	7	4	4	6	5	5	7	8	8

K application rates over the period were on average similar across dairy and tillage farms at 23 kg ha^{-1}, this was 53% greater than average application rates across cattle farms and was nearly double that of sheep farms. Application rates were highest at the start of the study period (2005/2006) and declined by between 35-52% during 2008-2012 across all farm systems. The average decline over the period was 13%, tillage farms were back to 2005 levels in 2015 but all others were still below where they were at the outset of the study period. Although K use on dairy farms in 2015 was still 9% below that of 2005 rates were still relatively higher than for the other farm systems. The largest decline in usage (of 20%) is reported on cattle farms over the period. In line with Teagasc advice a large increase in K usage is evident from 2011 particularly for dairy farms (up 61%) and sheep farms (up 75%).

Figure 42: K use on Grassland Area by Farm System



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Cattle	20	18	17	11	11	14	12	13	16	17	16
Dairy	32	29	23	17	14	18	18	18	25	30	29
Sheep	16	14	13	9	7	10	8	10	12	14	14
Tillage	24	28	25	20	14	22	19	22	25	26	24
All Systems	23	21	19	13	11	15	14	14	19	20	20

3.4.4 Fertiliser Use on Total Grassland Area by Organic N Stocking rate

Table 17 outlines grassland area, sample and population statistics across a range of Organic N stocking rate bands. The largest average area over the study period was associated with farms in the 170-210 kg ON ha^{-1} category at nearly 46 hectares, followed by the 130-170 and >210 kg ON ha^{-1} categories at 41 and 40 hectares respectively. The 85-130 and <85 kg ON ha^{-1} categories had a similar average grassland area over the study period averaging 35-36 hectares. On average over the study period 28%, 37%, 22%, 9%, 4% of the population fell into the <85, 85-130, 130-170, 170-210 and >210 kg Organic N ha^{-1} categories respectively.

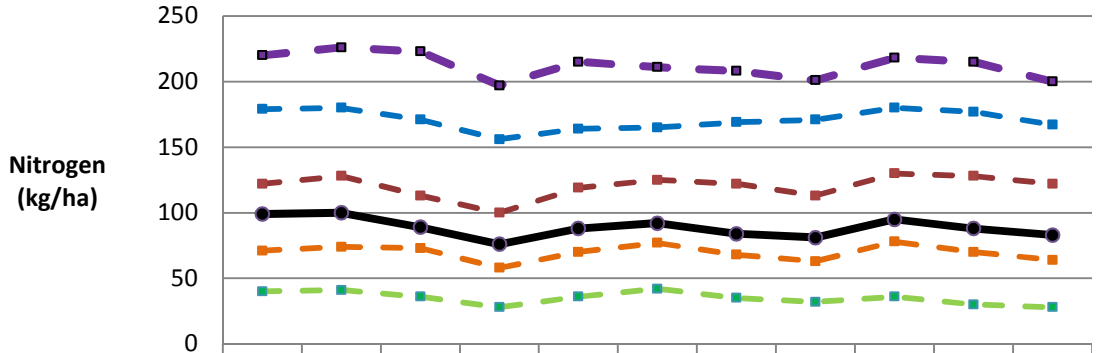
Table 17: Average farm size, NFS farms and farm population by Org. N stocking rate – Grassland

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Average Area (ha) - grassland											
< 85 kg ON ha^{-1}	34	35	36	35	34	35	35	37	39	35	36
85-130 kg ON ha^{-1}	34	35	35	36	35	35	37	37	36	34	33
130-170 kg ON ha^{-1}	43	42	42	40	42	41	42	41	42	40	41
170-210 kg ON ha^{-1}	41	40	43	44	50	45	44	48	48	50	49
> 210 kg ON ha^{-1}	33	39	35	41	40	44	46	40	42	41	43
All Farms	37	37	38	37	38	38	38	39	40	37	37
No. of Teagasc NFS farms with grassland											
< 85 kg ON ha^{-1}	162	195	224	226	236	250	271	235	224	230	232
85-130 kg ON ha^{-1}	332	331	342	349	338	317	295	291	289	275	265
130-170 kg ON ha^{-1}	277	281	261	269	225	218	220	229	222	211	204
170-210 kg ON ha^{-1}	166	138	133	103	113	107	106	121	131	126	125
> 210 kg ON ha^{-1}	92	75	62	67	62	60	61	53	73	66	75
All Farms	1029	1020	1022	1014	974	952	953	929	939	908	901
% of Total farm population*											
< 85 kg ON ha^{-1}	20%	23%	25%	26%	28%	30%	33%	29%	28%	31%	31%
85-130 kg ON ha^{-1}	39%	38%	39%	39%	39%	37%	35%	38%	36%	35%	37%
130-170 kg ON ha^{-1}	23%	23%	22%	24%	21%	21%	20%	21%	21%	21%	19%
170-210 kg ON ha^{-1}	12%	11%	10%	7%	8%	8%	8%	9%	9%	8%	8%
> 210 kg ON ha^{-1}	6%	5%	4%	4%	4%	4%	4%	4%	5%	4%	5%

*National population weights applied to Teagasc NFS farms

Figure 43 outlines average N application rates on total grassland area by organic N stocking rate. As might be expected, N application rates were highest for the most intensively stocked category of >210 kg ON ha^{-1}, with application rates ranging from 197-226 kg ha^{-1} over the study period. This was over 6 and 3 times higher than the two lowest stocked categories (<85, 85-130 kg ON ha^{-1}) respectively and was 77% and 24% higher than the 130-170, 170-210 kg ON ha^{-1} categories. Application rates tended to peak at the start of the study period and then followed a general declining trend with a period low in 2008 across all categories. Application rates increased somewhat in 2010 and 2013 on average across all stocking densities, before declining toward the end of the study period. Average application rates were 16% lower at the end of the period compared to starting period levels across all stocking rate bands.

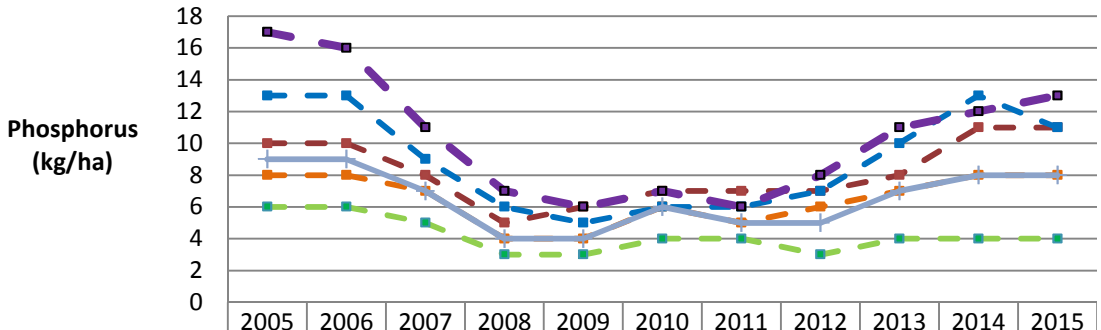
Figure 43: N use on Total Grassland Area by Organic N stocking rate



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
< 85	40	41	36	28	36	42	35	32	36	30	28
85-130	71	74	73	58	70	77	68	63	78	70	64
130-170	122	128	113	100	119	125	122	113	130	128	122
170-210	179	180	171	156	164	165	169	171	180	177	167
> 210	220	226	223	197	215	211	208	201	218	215	200
All Rates	99	100	89	76	88	92	84	81	95	88	83

Average P application rates on total grassland area by organic N stocking rate over the period are presented in Figure 44. P application rates were highest for the most intensively stocked category of >210 kg ON ha^{-1} ranging from 6-17 kg ha^{-1} over the study period. This was 2.4 and 1.6 times higher than the two lowest stocked categories (<85, 85-130 kg ON ha^{-1}) respectively and was 27% and 15% higher than the 130-170, 170-210 kg ON ha^{-1} categories. Application rates again peaked at the start of the study period (2005/2006) and then declined by 33-56% across all rates mid-study period (2008-2012) before recovering at the end of the period (except for the highest and lowest stocking rate bands).

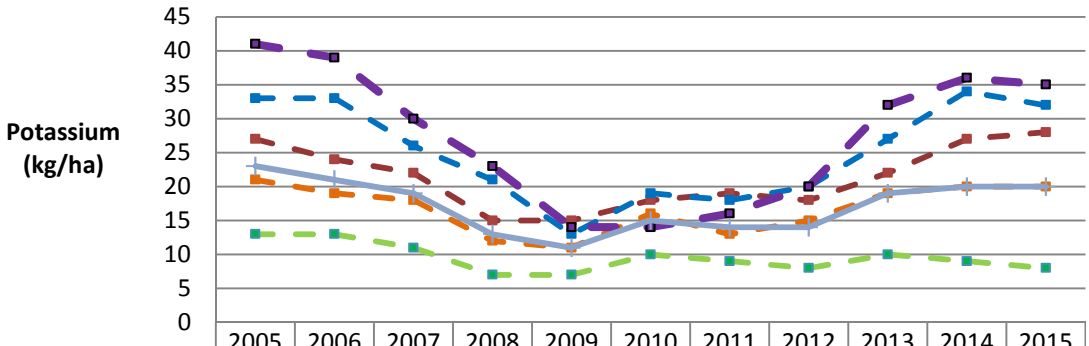
Figure 44: P use on Total Grassland Area by Organic N stocking rate



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
< 85	6	6	5	3	3	4	4	3	4	4	4
85-130	8	8	7	4	4	6	5	6	7	8	8
130-170	10	10	8	5	6	7	7	7	8	11	11
170-210	13	13	9	6	5	6	6	7	10	13	11
> 210	17	16	11	7	6	7	6	8	11	12	13
All Rates	9	9	7	4	4	6	5	5	7	8	8

Average K application rates across total grassland area were again highest for the most intensively stocked category of >210 kg ON ha^{-1} ranging from 14-41 kg ha^{-1} over the study period. This was 2.8 and 1.6 times higher than the two lowest stocked categories (<85, 85-130 kg ON ha^{-1}) respectively and was 28% and 9% higher than the 130-170, 170-210 kg ON ha^{-1} categories. Applications of K generally peaked at the start of the study period (2005) and then declined by 35-52% across all levels of intensity mid-study period (2008-2012), before recovering at the end of the period (except for the highest and lowest stocking rate bands).

Figure 45: K use on Total Grassland Area by Organic N stocking rate



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
< 85	13	13	11	7	7	10	9	8	10	9	8
85-130	21	19	18	12	11	16	13	15	19	20	20
130-170	27	24	22	15	15	18	19	18	22	27	28
170-210	33	33	26	21	13	19	18	20	27	34	32
> 210	41	39	30	23	14	14	16	20	32	36	35
All Rates	23	21	19	13	11	15	14	14	19	20	20

3.4.5 Fertiliser Compounds use on Grassland

3.4.6 Percentage of N applied to Grassland by Fertiliser type

Table 18 outlines the percentage of N applied to grassland through various fertilisers over the study period. Six main fertilisers accounted for the majority of N applied to grassland (>8% in all cases). CAN based fertilisers (27.5-0-0 and 27-0-0) were dominant, accounting for between 30-49% of the total N applied over the study period. The next most important was 27-2.5-5, this accounted for between 14-28% of total N applied between 2005-2015, however the relative importance of this fertiliser in percentage terms declined towards the end of the study period. A similar trend was observed for 24-2.5-10, this accounted for between 8-15% of total N applied over the period. The importance of this fertiliser declined during the middle of the study period, but recovered towards the end. Urea (46-0-0) accounted for between 11-17% of total N applied; application rates peaked in 2008/2009 at 17%, but declined to below starting period level at the end of the period (10-12%). The only other fertiliser averaging over 2% of total N applied was 18-6-12, this accounted for between 3-9% over the study period, with major increases observed in this fertiliser at the end of the study period (2014-2015).

Table 18: N Fertiliser Compounds applied to grassland (%)

Fertiliser Type	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
27.5 - 0 - 0	23.7	28.5	28.2	27.6	29.8	26.6	25.9	26.1	24.9	22.1	20.2
27 - 2.5 - 5	27.3	25.4	23.6	18.9	14.4	12.7	12.8	16.3	15.7	15.2	15.3
27 - 0 - 0	6.3	5.1	8.9	13.6	18.9	19.8	19.8	17.0	16.4	14.7	14.9
24 - 2.5 - 10	14.6	13.0	12.6	11.4	8.3	9.8	9.8	10.4	12.2	11.2	12.4
46 - 0 - 0	13.4	12.5	11.8	17.0	17.0	15.9	16.6	13.6	10.7	12.0	12.1
18 - 6 - 12	5.5	5.5	5.3	4.0	3.5	4.4	3.7	4.0	5.6	7.8	8.2
23 - 0 - 0	0.5	0.6	0.6	0.9	0.5	0.7	1.5	1.6	1.8	1.6	2.2
23 - 2.5 - 5	1.4	1.5	1.1	0.7	0.5	1.1	1.4	2.0	1.8	1.5	2.0
24 - 2.2 - 4.5	0.3	0.5	0.6	0.3	1.1	2.1	2.5	2.2	2.5	2.1	1.5
10 - 10 - 20	0.8	0.7	0.4	0.3	0.2	0.6	0.7	0.5	0.7	1.2	1.2
19 - 0 - 15	0.1	0.2	1.1	0.9	0.5	0.7	0.7	0.5	0.6	1.1	0.9
26 - 0 - 0	-	0.1	0.2	0.2	0.3	0.4	0.4	0.7	1.0	0.9	0.6
24 - 2 - 5	-	-	-	0.1	-	-	0.1	0.7	0.3	1.3	0.5
42 - 0 - 0	-	-	-	-	-	-	-	-	-	0.1	0.5
20 - 2 - 12	-	-	-	-	-	-	-	-	0.1	0.1	0.4
20 - 4 - 10	0.5	0.4	0.4	0.2	0.1	0.2	0.2	0.2	0.1	0.2	0.4
23 - 2.5 - 10	0.2	0.1	0.1	0.1	0.1	0.1	0.1	-	0.2	0.3	0.4
24 - 0 - 0	0.2	-	0.2	-	-	-	-	-	0.2	0.2	0.4
26.5 - 0 - 0	0.2	0.2	0.4	0.1	0.8	0.4	0.4	0.4	0.5	0.4	0.4
21 - 0 - 0	-	-	-	-	0.1	0.2	0.2	0.1	-	0.4	0.3
Other	5.0	5.7	4.5	3.7	3.9	4.3	3.2	3.7	4.7	5.6	5.2
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

3.4.7 Percentage of P applied to Grassland by Fertiliser type

Table 19 outlines the percentage of P applied to grassland through various fertilisers over the study period. Four main fertilisers were responsible for the majority of P applied to grassland. On average 18-6-12 accounted for between 21-32% of total P applied to grassland, this fertiliser grew in importance over the course of the study period. The next largest contribution of total P was associated with 27-2.5-5 which accounted for between 16-33% over the study period, the importance of this fertiliser declined significantly over time from approximately 30% of total P in 2005 to 17% in 2015. The third most important P based fertiliser was 24-2.5-10, which accounted for between 14-22% of total P applied during 2005-2015. Again the importance of this fertiliser declined at the end of the study period. The last major fertiliser was 10-10-20, this accounted for between 6-15% over the period, peaking in the final two years of the study period.

Table 19: P Fertiliser Compounds applied to grassland (%)

Fertiliser Type	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
18 - 6 - 12	21.0	22.2	25.3	24.9	26.4	26.5	22.9	22.2	28.0	31.3	32.1
27 - 2.5 - 5	29.2	28.7	31.5	32.6	30.4	21.2	22.2	25.2	21.7	16.8	16.5
24 - 2.5 - 10	17.6	16.5	19.0	22.1	19.6	18.5	19.0	18.1	19.0	14.0	15.1
10 - 10 - 20	9.3	8.5	6.0	4.7	5.6	10.3	13.1	8.9	10.5	14.6	13.9
23 - 2.5 - 5	1.7	1.9	1.8	1.4	1.2	2.2	2.9	3.7	2.9	1.9	2.6
0 - 7 - 30	4.6	4.2	2.8	3.1	1.5	2.9	3.5	2.6	1.9	3.0	2.5
24 - 2.2 - 4.5	0.3	0.6	0.7	0.5	2.2	3.4	4.3	3.3	3.4	2.3	1.6
18 - 20 - 0	-	-	-	-	-	-	-	-	0.1	0.1	1.1
20 - 21 - 0	-	-	-	-	-	-	-	-	-	-	0.9
20 - 4 - 10	1.1	1.1	1.2	0.8	0.4	0.7	0.6	0.5	0.3	0.5	0.9
0 - 10 - 20	3.1	3.3	2.8	1.2	0.8	2.0	2.4	2.0	1.2	0.9	0.8
0 - 16 - 0	0.9	0.9	-	-	0.2	0.7	0.2	0.6	0.4	0.5	0.6
0 - 27 - 0	-	-	-	-	-	-	-	-	-	0.3	0.6
10 - 5 - 25	-	-	-	-	-	-	0.1	0.1	0.1	0.2	0.6
14 - 16 - 0	-	-	-	-	-	-	-	0.4	0.2	2.0	0.6
25 - 4 - 0	1.0	0.5	1.1	1.1	0.6	1.1	0.1	0.3	0.6	0.6	0.6
0 - 11 - 0	-	-	-	-	-	-	-	-	-	-	0.5
22 - 4 - 8	0.4	-	0.4	0.1	0.1	-	0.5	-	0.7	0.4	0.5
23 - 2.5 - 10	0.2	0.1	0.2	0.3	0.1	0.1	0.2	-	0.2	0.4	0.5
24 - 2 - 5	-	-	-	0.1	-	-	0.2	1.0	0.3	1.3	0.5
Other	9.6	11.5	7.2	7.1	10.9	10.4	7.8	11.1	8.5	8.9	7.0
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

3.4.8 Percentage of K applied to Grassland by Fertiliser type

There were only four main fertilisers with application rates consistently averaging over 5% of total K applied over the study period. Except for the final two years of the study period, 24-2.5-10 was the most popular K based fertiliser applied averaging between 21-31% of total K. For the final two years of the study period, 18-6-12 was the most common K based fertiliser applied. This accounted for between 16-25% of total K applied to grassland over the study period. At the start of the study period (2005-2009) 27-2.5-5 was responsible for the second highest levels of K applied (23-24%) but this declined to approximately 13% at the end of the study period. Finally, 10-10-20 averaged between 3-12% of total K applied over the study period, peaking during the final years of the study period as outlined in Table 20.

Table 20: K Fertiliser Compounds applied to grassland (%)

Fertiliser Type	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
18 - 6 - 12	17.0	18.4	18.6	17.2	20.0	20.2	16.6	16.9	21.0	24.3	24.7
24 - 2.5 - 10	28.5	27.4	27.9	30.5	29.8	28.2	27.6	27.6	28.5	21.8	23.2
27 - 2.5 - 5	23.6	23.8	23.2	22.5	23.0	16.2	16.1	19.2	16.3	13.1	12.7
10 - 10 - 20	7.5	7.0	4.4	3.2	4.2	7.9	9.5	6.8	7.9	11.4	10.7
0 - 0 - 50	1.1	1.6	2.2	3.7	1.4	1.9	3.8	3.8	4.2	4.0	4.8
0 - 7 - 30	8.0	7.5	4.4	4.5	2.4	4.8	5.5	4.3	3.0	5.0	4.2
19 - 0 - 15	0.3	0.8	4.7	4.8	3.4	3.6	3.5	2.4	2.6	4.2	3.3
23 - 2.5 - 5	1.4	1.6	1.3	1.0	0.9	1.7	2.1	2.8	2.2	1.5	2.0
24 - 2.2 - 4.5	0.2	0.5	0.5	0.3	1.7	2.7	3.2	2.6	2.6	1.8	1.2
10 - 5 - 25	-	-	-	-	-	-	0.1	0.2	0.2	0.5	1.1
20 - 2 - 12	-	-	-	-	-	-	-	-	0.2	0.2	1.0
20 - 4 - 10	1.1	1.1	1.1	0.7	0.4	0.6	0.5	0.5	0.3	0.5	0.8
13.5 - 0 - 12.5	-	-	-	-	-	-	-	-	-	-	0.7
18 - 2.5 - 14	0.4	1.0	1.2	1.1	2.0	1.3	0.8	0.9	0.8	0.8	0.7
23 - 2.5 - 10	0.4	0.2	0.3	0.4	0.2	0.2	0.3	0	0.4	0.6	0.7
0 - 10 - 20	2.5	2.8	2.1	0.8	0.6	1.5	1.8	1.5	0.9	0.7	0.6
10 - 6 - 26	-	-	-	-	-	-	-	-	-	-	0.5
13 - 6 - 20	0.1	-	-	-	-	0.2	0.2	0.4	0.3	0.7	0.5
24 - 2 - 5	-	-	-	0.1	-	-	0.2	1.0	0.3	1.2	0.5
21 - 2.2 - 10	-	0.2	-	-	0.2	-	0.7	1.1	0.9	0.9	0.4
Other	7.9	6.1	8.1	9.2	9.8	9.0	7.5	8.0	7.4	6.8	5.7
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

3.4.9 Percentage of total fertiliser applied to Grassland by Fertiliser type

Table 20 outlines the percentage of total fertiliser applied to grassland in volume terms by fertiliser type. In all, six main fertilisers accounted for the majority of fertiliser applied. CAN based fertilisers (27.5-0-0 and 27-0-0) were dominant and accounted for between 28-50% of the total quantity of fertilisers applied over the study period. CAN application rates peaked in 2010 at close to 50%. The next largest fertiliser in quantity terms was 27-2.5-5, which accounted for between 12-26% of total fertiliser applied over the period. The importance of this fertiliser declined over the study period. Next largest in quantity terms was 24-2.5-10, this accounted for between 9-16% of total fertiliser applied over the study period. The other two fertilisers that were responsible for volumes of 10% or greater over the study period were 18-6-12 and urea (46-0-0). The 18-6-12 fertiliser volumes ranged from 5-12% and urea volumes ranged from 6-11% over the study period.

Table 21: Top 20 ranked fertilisers applied to Grassland by quantity

Fertiliser	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
27.5 - 0 - 0	22.2	27.2	26.7	27.1	29.9	25.9	25.3	25.1	23.4	20.3	18.5
27 - 2.5 - 5	26.0	24.7	22.8	18.9	14.7	12.6	12.7	16.0	15.0	14.1	14.2
27 - 0 - 0	6.0	5.0	8.6	13.6	19.4	19.7	19.7	16.7	15.7	13.7	13.9
24 - 2.5 - 10	15.7	14.2	13.7	12.8	9.5	11.0	10.9	11.5	13.2	11.8	13.0
18 - 6 - 12	7.8	8.0	7.6	6.0	5.3	6.5	5.5	5.9	8.1	11.0	11.5
46 - 0 - 0	7.5	7.2	6.7	10	10.2	9.3	9.7	7.9	6.0	6.6	6.6
10 - 10 - 20	2.1	1.8	1.1	0.7	0.7	1.5	1.9	1.4	1.8	3.1	3.0
23 - 0 - 0	0.6	0.7	0.6	1.0	0.6	0.8	1.7	1.8	2.0	1.8	2.4
23 - 2.5 - 5	1.5	1.7	1.3	0.8	0.6	1.3	1.6	2.3	2.0	1.6	2.2
24 - 2.2 - 4.5	0.3	0.6	0.6	0.3	1.2	2.3	2.8	2.4	2.7	2.2	1.5
19 - 0 - 15	0.1	0.3	1.6	1.3	0.7	0.9	0.9	0.7	0.8	1.5	1.2
0 - 7 - 30	1.5	1.3	0.7	0.6	0.3	0.6	0.7	0.6	0.5	0.9	0.8
26 - 0 - 0	-	0.1	0.2	0.2	0.4	0.4	0.4	0.7	1.0	0.9	0.6
0 - 0 - 50	0.1	0.2	0.2	0.3	0.1	0.1	0.3	0.3	0.4	0.4	0.5
20 - 2 - 12	-	-	-	-	-	-	-	-	0.1	0.1	0.5
20 - 4 - 10	0.6	0.6	0.6	0.3	0.1	0.2	0.2	0.2	0.1	0.3	0.5
24 - 2 - 5	-	-	-	0.1	-	-	0.1	0.8	0.3	1.3	0.5
21 - 0 - 0	0.1	-	-	-	0.1	0.2	0.3	0.1	-	0.5	0.4
23 - 2.5 - 10	0.2	0.1	0.1	0.2	0.1	0.1	0.1	-	0.2	0.3	0.4
Other	7.7	6.3	6.9	5.8	6.1	6.6	5.2	5.6	6.7	7.6	7.8
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

3.5 Fertiliser Use on Main Cereal Crops 2005-2015

Results are presented in this section for the main cereal crops namely wheat, barley and oats.

3.5.1 Fertiliser Use on Main Cereal Crops by Nitrate Zone

Table 22 illustrates that the growing of cereals is most prevalent in zone A where the area under cereals ranged between 19-29 hectares over the period 2005-2015, with the average area increasing over the study period. The area dedicated to cereal crops was smallest in zone C at between 8-14 hectares. The area under cereals in zone B ranged between 19-27 hectares. Given variation in both cereal area and the composition of cereals grown, one would assume differing patterns of fertiliser usage across the respective nitrate zones. Overall, the majority of farms with cereal area were in zone A (71%) with 21% in zone B and 8% in zone C on average.

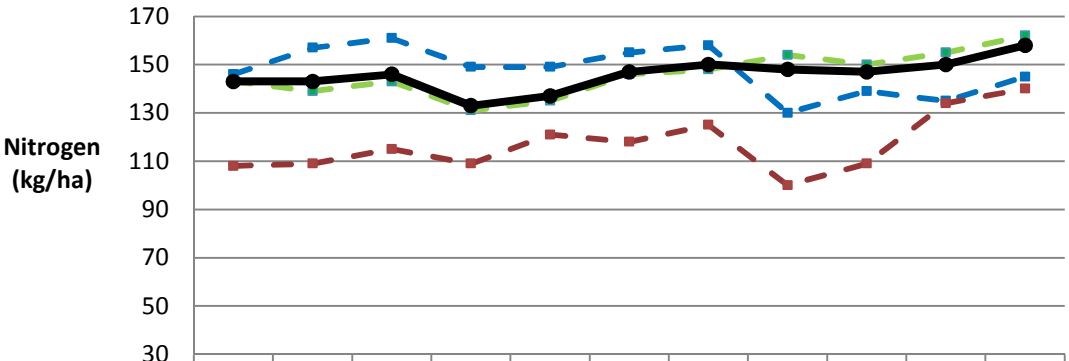
Table 22: Average farm size and NFS farm numbers by Nitrate Zone – Main Cereal Crops

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Average Area (ha) – main cereals											
Zone A	19	22	22	24	24	26	27	28	28	28	29
Zone B	20	24	19	20	22	23	26	20	20	27	26
Zone C	8	11	9	8	11	7	8	8	7	14	10
All Zones	18	22	20	22	23	23	25	24	24	27	27
No. of Teagasc NFS farms with main cereals											
Zone A	144	138	153	167	137	123	137	129	118	108	101
Zone B	46	39	40	43	40	40	43	39	34	30	30
Zone C	22	14	18	20	17	24	21	17	16	12	11
All Zones	212	191	211	230	194	187	201	185	168	150	142
% of Total farm population with main cereals*											
Zone A	68%	73%	73%	72%	72%	65%	67%	69%	70%	74%	73%
Zone B	24%	22%	20%	20%	20%	23%	24%	21%	21%	19%	20%
Zone C	8%	5%	7%	8%	8%	12%	9%	11%	9%	6%	7%

*National population weights applied to Teagasc NFS farms

Figure 46 outlines N application rates across the main cereals by nitrate zone. Results indicate similar application rates across zones A and B on average (146-148 kg ha^{-1}), with application rates higher in zone B at the start and in zone A at the end of the study period. Average N application rates on cereal area were 20% lower (117 kg ha^{-1}) in zone C compared to the other zones. However, application rates in zone C did increase significantly (24-30%) at the end of the study period (2014/2015) compared to the start of the period. As approximately 70% of cereal farms are located in zone A, the trend in this zone tends to determine the trend across all zones. Application rates in zone A increased by 13% from 2005 to 2015.

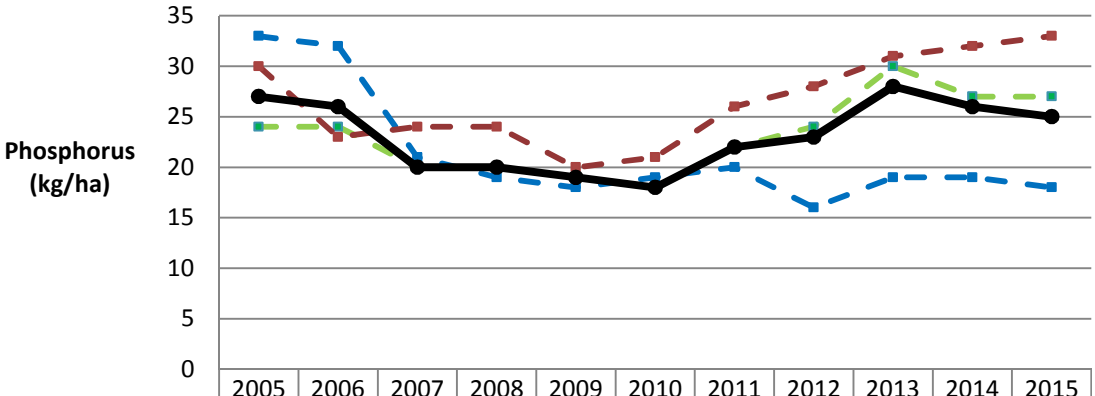
Figure 46: N use on Cereals by Nitrate Zone



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Zone A	143	139	143	131	135	146	148	154	150	155	162
Zone B	146	157	161	149	149	155	158	130	139	135	145
Zone C	108	109	115	109	121	118	125	100	109	134	140
All Zones	143	143	146	133	137	147	150	148	147	150	158

P application rates across the main cereals by nitrate zone are outlined in Figure 47. Application rates were highest across zone C, ranging from between 24-33 kg ha^{-1}. This was on average 15% higher than in zone A (18-30 kg ha^{-1}) and 25% higher than in zone B (16-33 kg ha^{-1}). Compared to the start of the study period, there was a decline of between 19-33% across all zones mid-study period (2007-2011). There was a recovery in application rates in zones A and C at the end of the study period such that they were above starting period levels. This was in contrast to zone B which was 42-52% below starting period levels over the years 2012 to 2015.

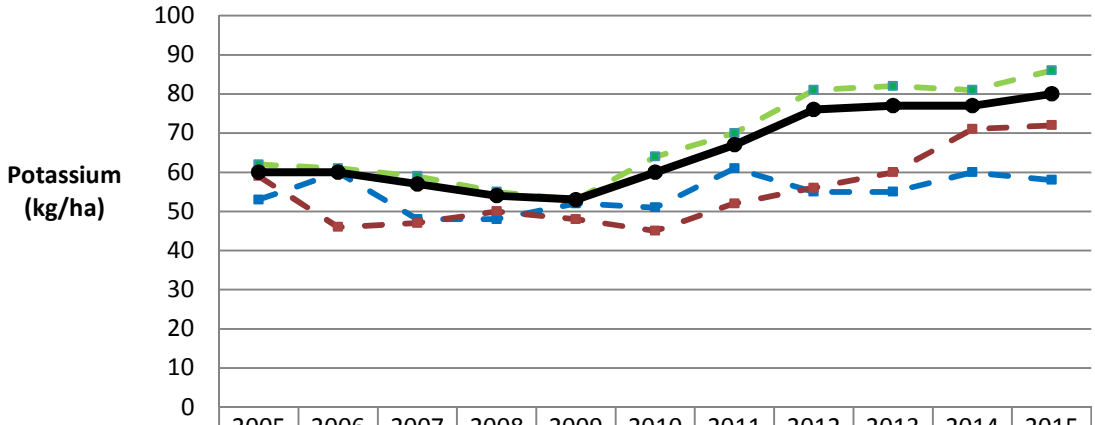
Figure 47: P use on Cereals by Nitrate Zone



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Zone A	24	24	20	20	19	18	22	24	30	27	27
Zone B	33	32	21	19	18	19	20	16	19	19	18
Zone C	30	23	24	24	20	21	26	28	31	32	33
All Zones	27	26	20	20	19	18	22	23	28	26	25

Results for K applications rates on cereal area by nitrate zone are presented in Figure 48. Application rates in zone A (53-86 kg ha^{-1}) were on average 24-25% higher than in both zones B and C over the study period. Application rates across all zones declined by between 5-12% during 2007-2009 compared to the start of the study period but recovered and were on average 28-33% higher at the end (2013-2015). Again, as approximately 70% of cereal farms are located in zone A, the trend in this zone tends to determine the trend across all zones. Application rates in zone A increased by 39% between the start and end of the study period.

Figure 48: K use on Cereals by Nitrate Zone



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Zone A	62	61	59	55	53	64	70	81	82	81	86
Zone B	53	60	48	48	52	51	61	55	55	60	58
Zone C	59	46	47	50	48	45	52	56	60	71	72
All Zones	60	60	57	54	53	60	67	76	77	77	80

3.5.2 Fertiliser Use on Main Cereal Crops by Land Use Class

Table 23 illustrates that the growing of cereals is most prevalent on soil of wide land use class, as one would expect, with the area under cereals averaging 25 hectares over the period 2005 to 2015. The area dedicated to cereals was smallest on soils of limited land use class averaging 17 hectares over the study period. The majority of farms with cereals were in the wide land use potential category (53% on average), 33% were on soils of somewhat limited potential, 10% were on soils classed as moderately wide and finally 4% were on soils of limited land use potential. Data for nutrient use on farms of limited land use class with cereal area are not presented here due to a limited number of observations (N<10).

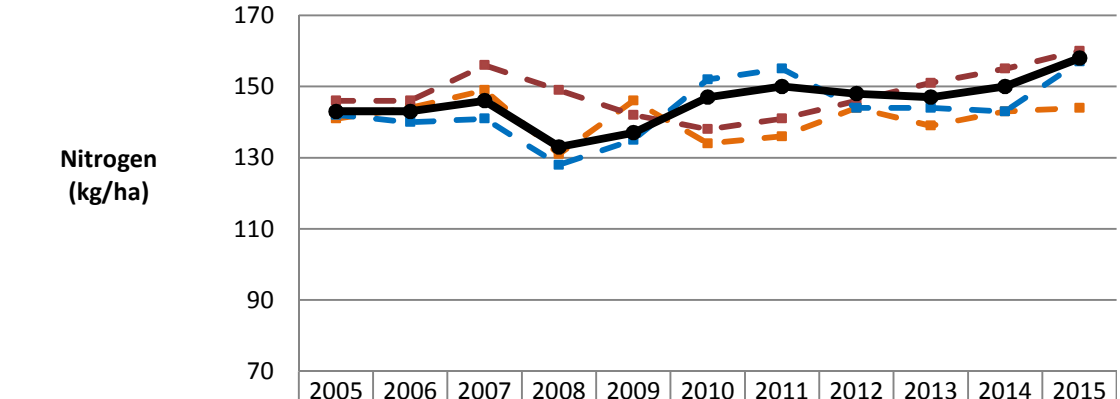
Table 23: Average farm size and NFS farm numbers by Land Use Class – Main Cereal Crops

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Average area (ha) – main cereals											
Limited	10	17	13	17	15	12	11	20	23	28	26
Somewhat Limited	16	12	17	24	23	19	13	16	25	26	27
Moderately Wide	18	23	19	20	19	17	20	22	21	26	24
Wide	19	22	22	23	25	28	31	25	25	26	27
All Land Use Classes	18	22	20	22	23	23	25	24	24	27	27
No. of Teagasc NFS farms with main cereals											
Limited	11	8	10	10	7	9	10	8	7	5	6
Somewhat Limited	23	20	23	20	20	18	21	18	15	13	15
Moderately Wide	65	55	63	69	64	64	67	63	55	45	48
Wide	113	108	115	131	103	96	103	96	91	85	73
All Soils	212	191	211	230	194	187	201	185	168	148	142
% of Total farm population with main cereals*											
Limited	6%	4%	5%	4%	4%	5%	5%	4%	3%	3%	4%
Somewhat Limited	12%	13%	10%	8%	10%	10%	10%	8%	8%	8%	9%
Moderately Wide	30%	28%	32%	32%	35%	38%	36%	36%	33%	30%	34%
Wide	52%	55%	53%	55%	51%	47%	49%	53%	56%	60%	54%

*National population weights applied to Teagasc NFS farms

Results for N application rates on cereal area by land use potential are presented in Figure 49. Application rates across the different land use classes were broadly similar over the study period (averaging between 141-148 kg ha^{-1}). N application rates on farms of moderately wide land use class (141-160 kg ha^{-1}) were on average 3% higher than on those of wide land use class and 5% higher than on farms of somewhat limited land use class. Average application rates declined by between 4-7% across all soils during 2008/2009 but recovered and were 5-10% higher in 2014/2015.

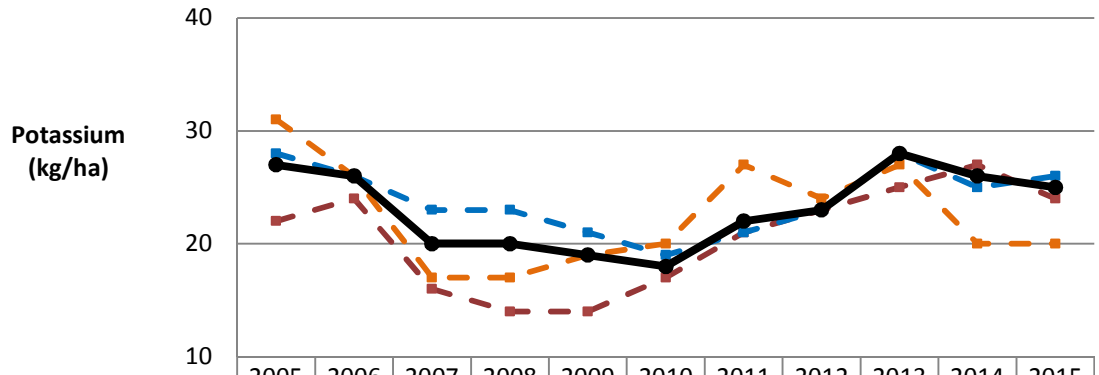
Figure 49: N use on Cereals by Land Use Class



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Somewhat Limited	141	144	149	131	146	134	136	144	139	143	144
Moderately Wide	146	146	156	149	142	138	141	146	151	155	160
Wide	142	140	141	128	135	152	155	144	144	143	157
All Soils	143	143	146	133	137	147	150	148	147	150	158

Figure 50 presents results for P application rates on cereal area by land use potential. P application rates were highest on soils of wide land use class (19-28 kg ha^{-1}), which were on average 6% higher than on farms of somewhat limited land use class and 16% higher than on farms of moderately wide land use class. Average application rates declined by between 15-33% over the 2007-2012 period compared to starting period levels but recovered towards the end of the study period (except for those farms in the somewhat limited category).

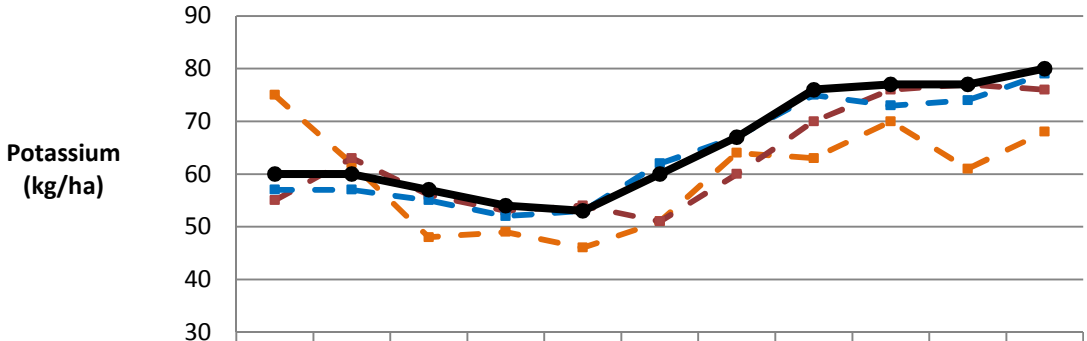
Figure 50: P use on Cereals by Land Use Class



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Somewhat Limited	31	26	17	17	19	20	27	24	27	20	20
Moderately Wide	22	24	16	14	14	17	21	23	25	27	24
Wide	28	26	23	23	21	19	21	23	28	25	26
All Soils	27	26	20	20	19	18	22	23	28	26	25

A 35% decline in P application rates is evident on soils of somewhat limited use over the period. Similarly, on soils of wide use potential there was a 32% decline in use from 2005 to 2010 with recovery to 2015 where the average amount applied stood at 26 kg ha^{-1} only 2kg ha^{-1} less than in 2005. Figure 51 indicates a 33% increase in K use over the period with an average application rate across all soil groups of 66 kg ha^{-1} in 2015. A steady increase is evident from 2009 in particular with average usage 51% higher in 2015 than 2009. Across the individual groups, K use on soils of wide use class increased by 39% over the period to 79 kg ha^{-1} with a similar increase evident (38%) on soils of moderately limited use where the average rate applied was 76 kg ha^{-1}. K usage was typically 12% lower on soils of limited use compared to all others but an 87% increase is evident from 2009. A 9% decline in usage is reported on soils of somewhat limited use where the average application rate reported in 2015 was 68 kg ha^{-1}.

Figure 51: K use on Cereals by Land Use Class



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Somewhat Limited	75	62	48	49	46	51	64	63	70	61	68
Moderately Wide	55	63	56	53	54	51	60	70	76	77	76
Wide	57	57	55	52	53	62	67	75	73	74	79
All Soils	60	60	57	54	53	60	67	76	77	77	80

3.5.3 Fertiliser use on individual Main Cereal Crops

Results on the number of farms in the sample and the respective tillage areas cultivated between 2005 and 2015 are outlined in Table 24. The data indicates a one-third decline in the proportion of farms with cereal area over the study period. In terms of the number of farms with cereal area, the most commonly grown cereal was Spring Barley with 78% of farms with cereals on average growing this crop over the study period. The next most important crop was Winter Wheat with 23% of farms on average growing this crop between 2005 and 2015. The number of farms growing Winter Barley increased almost threefold over the study period. On the other hand, the proportion of farms with area dedicated to Spring Wheat declined by more than two-thirds. Similarly, the number of farms growing Malting Barley more than halved over the study period. Spring Oats and Winter Oats were grown by 9% and 11% of tillage farms on average over the period.

Table 24: Number of farms and average cereal area grown of main cereal crops - by cereal type

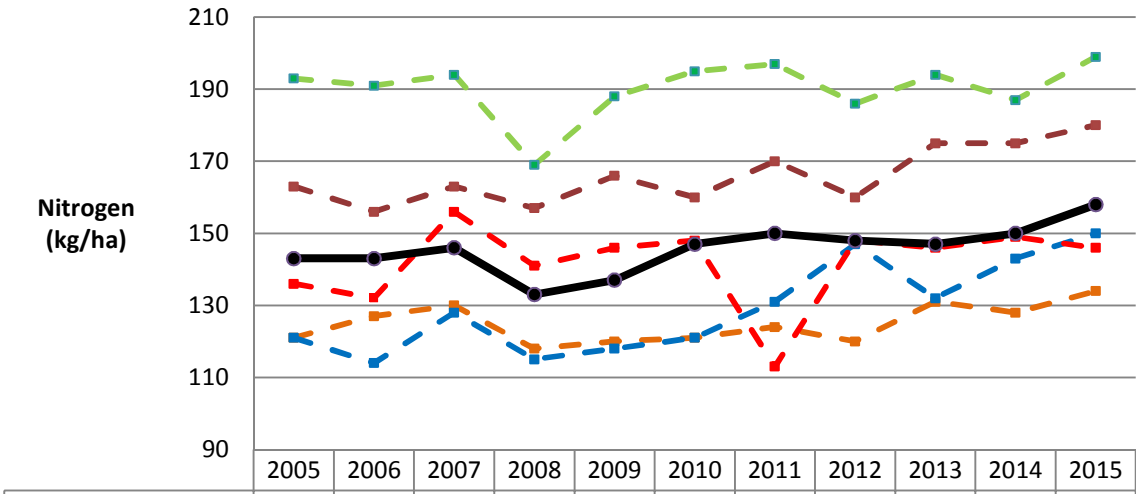
Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Average area (ha) – main cereal crops											
Winter Wheat	27	31	28	23	30	35	36	33	27	30	22
Spring Barley	11	13	12	14	15	14	14	13	15	16	13
Spring Wheat	8	10	9	8	9	9	10	8	10	4	6
Winter Barley	13	16	16	15	12	14	15	19	18	17	15
Malting Barley	11	14	19	19	19	18	22	23	25	20	16
Winter Oats	17	10	10	13	9	8	10	8	9	13	14
Spring Oats	4	6	7	3	9	8	10	5	9	16	8
All Cereals	18	22	20	22	23	23	25	24	24	27	27
No. of Teagasc NFS Farms with main cereal crops											
Winter Wheat	36	35	41	64	38	46	58	50	35	37	34
Spring Barley	166	148	163	176	154	146	153	143	138	114	107
Spring Wheat	39	37	33	38	22	21	21	24	14	7	12
Winter Barley	21	19	20	20	27	34	40	33	27	40	59
Malting Barley	36	31	33	28	27	14	17	14	15	16	16
Winter Oats	16	16	19	27	15	22	22	14	14	12	16
Spring Oats	28	29	18	11	18	17	28	23	23	12	25
All Cereals	212	191	211	230	194	187	201	185	168	150	142

In terms of the area dedicated to growing cereals on these farms, the largest area was dedicated to Winter Wheat at 29 hectares on average over the study period. However, it should be noted that the average area utilised for Winter Wheat actually declined by 19% between 2005 and 2015. The area utilised for Malting Barley was second largest averaging 19 hectares, the area under Malting Barley doubled over the study period (before declining somewhat in 2015). The area on which Spring Barley was grown also increased over the study period with the average area grown standing at 14 hectares across all years. The area dedicated to Spring Wheat (which was relatively small averaging 8 hectares) declined from the start to the end of the study period (by approximately 25%).

The area under Winter Barley increased slightly over the study period and averaged 15 hectares across all years. Winter Oats were grown on an average area of 11 hectares, the area declining in the middle of the study period but recovering to near initial levels towards the end. The area utilised for Spring Oats averaged 8 hectares over the study period with the area utilised increasing significantly (2-4 times) in the final years of the study period compared to starting levels.

N use across selected individual cereals over the eleven year period is illustrated in Figure 52. It is evident that application rates on Winter crops were significantly higher than on Spring crops. The highest application rates on average over the period were associated with Winter Wheat (190 kg ha^{-1}), Winter Barley (166 kg ha^{-1}) and Winter Oats (146 kg ha^{-1}) respectively. Of the spring crops, the highest average application rates were associated with Malting Barley (129 kg ha^{-1}), Spring Barley (125 kg ha^{-1}) and Spring Oats (105 kg ha^{-1}) respectively. Over the course of the study period average application rates across all cereals initially declined by 4-7% (2008/2009) but recovered and were 5-10% higher at the end of the period (2014/2015) compared to starting levels.

Figure 52: N use on individual cereal crops

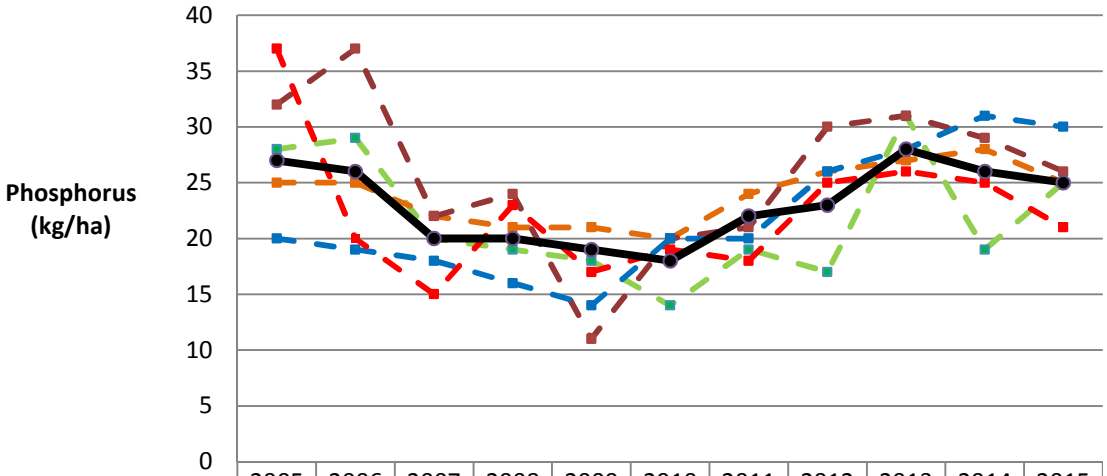


	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Winter Wheat	193	191	194	169	188	195	197	186	194	187	199
Spring Barley	121	127	130	118	120	121	124	120	131	128	134
Winter Barley	163	156	163	157	166	160	170	160	175	175	180
Malting Barley	121	114	128	115	118	121	131	147	132	143	150
Winter Oats	136	132	156	141	146	148	113	148	146	149	146
All Cereals	143	143	146	133	137	147	150	148	147	150	158

Average applications rates of P over the study period were highest on Winter and Spring Barley at 26 and 24 kg ha^{-1} respectively. The other cereal crops detailed in Table 20 averaged 21-22 kg ha^{-1} over

the period. Results indicate that P use across selected cereals declined by between 19-33% during 2007-2011 compared to starting period levels. There was a recovery in application rates in 2013 (except for Winter Oats) followed by a decline in 2014/2015 (4-7% lower on average compared to starting period levels). Malting Barley went against the general trend showing an increase of between 30-55% between 2012 and 2015 compared to starting period levels. On the other hand, application rates on Winter Oats (at 20 kg ha^{-1}) were down 43% in 2015 compared to 2005.

Figure 53: P use on individual cereals crops

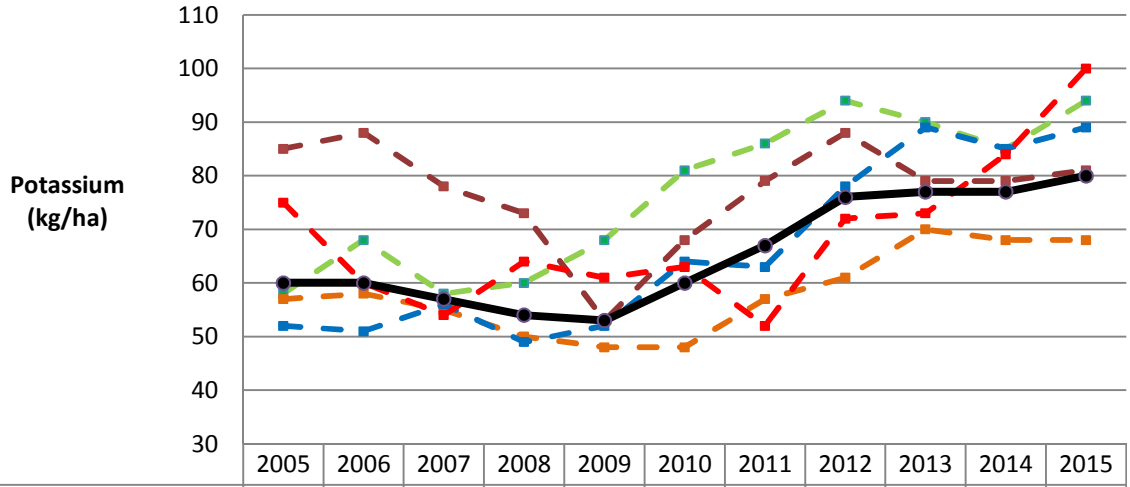


	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Winter Wheat	28	29	20	19	18	14	19	17	31	19	25
Spring Barley	25	25	22	21	21	20	24	26	27	28	25
Winter Barley	32	37	22	24	11	20	21	30	31	29	26
Malting Barley	20	19	18	16	14	20	20	26	28	31	30
Winter Oats	37	20	15	23	17	19	18	25	26	25	21
All Cereals	27	26	20	20	19	18	22	23	28	26	25

Average K application rates were highest across winter crops as illustrated by Figure 54. Winter Wheat and Barley had similar average applications rates over the study period at 77 kg ha^{-1}, followed by Winter Oats at 69 kg ha^{-1}. Of the spring crops, average application rates were highest on Malting Barley (66 kg ha^{-1}) followed by Spring Barley (58 kg ha^{-1}) and Spring Oats (55 kg ha^{-1}). Winter Wheat and Malting Barley showed consistent increases in application rates over the study period, indeed application rates for these crops were over 50% higher towards the end of the period (2012-2015) compared to at the outset. Application rates of K on Spring and Winter Barley declined by between 12-38% during the middle of the study period (2008-2010) before a recovery was seen for Spring Barley with K application rates 19% higher at the end of the study period. This was in contrast to Winter Barley where K application rates were 5-7% lower at the end of the period (2013-2015) compared to the start. K application rates on Spring and Winter Oats declined by between 5-40%

during 2006-2011 (except for Spring Oats in 2007). K application rates across both crops recovered at the end of the study period and were between 28-44% higher in 2014-2015.

Figure 54: K use on individual Cereals crops



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Winter Wheat	58	68	58	60	68	81	86	94	90	85	94
Spring Barley	57	58	55	50	48	48	57	61	70	68	68
Winter Barley	85	88	78	73	53	68	79	88	79	79	81
Malting Barley	52	51	56	49	52	64	63	78	89	85	89
Winter Oats	75	60	54	64	61	63	52	72	73	84	100
All Cereals	60	60	57	54	53	60	67	76	77	77	80

3.5.4 Fertiliser Compounds use on Main Cereal crops

3.5.5 Percentage of N applied to Main Cereals by Fertiliser type

Table 25 outlines the percentage of N applied to the main cereal crops through various fertiliser compounds over the study period. CAN based fertilisers (27.5-0-0 and 27-0-0) on average accounted for over 60% of total N fertiliser applied to the main cereal crops over the study period, with 27-0-0 growing in importance over time. The third largest total N contribution to the main cereal crops came from 18-6-12, however the relative importance of this fertiliser declined from 19-21% at the start of the period to 8% of total N at the end (2014/2015). The 10-10-20 fertiliser accounted for just over 4% of total N applied on average over the period. Finally, other N based fertilisers 26.5-0-0 contributed significantly in some years (8-9% in 2013/2014), but averaged less than 4% across the study period overall.

Table 25: N Fertilisers compounds applied to main cereals (%)

Fertiliser Type	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
27.5 - 0 - 0	55.3	52.7	44.0	41.0	32.9	33.2	36.6	27.3	26.2	34.8	35.6
27 - 0 - 0	8.8	8.8	17.0	18.6	22.5	28.1	27.2	36.9	31.3	21.8	24.0
18 - 6 - 12	19.0	20.8	17.6	18.6	18.4	15.2	11.4	9.3	8.6	8.0	8.1
10 - 10 - 20	4.6	4.8	3.1	3.6	2.6	3.7	5.2	6.8	5.7	4.8	4.2
26.5 - 0 - 0	0.2	0.2	1.1	0.6	0.4	1.9	0.7	0.7	1.6	1.8	3.7
26 - 0 - 0	0.4	0.3	2.3	1.4	2.5	2.8	2.5	4.2	7.9	9.1	2.6
26.6 - 0 - 0	-	-	0.4	0.7	-	0.1	0.1	0.6	-	-	2.2
10 - 5 - 25	-	-	-	0.3	-	0.3	0.4	0.9	1.0	1.3	1.9
25 - 0 - 0	-	-	-	-	-	-	-	-	0.9	-	1.9
13 - 6 - 20	-	-	0.5	0.1	1.1	0.3	1.4	2.4	2.2	2.2	1.6
38 - 0 - 0	-	-	-	-	-	-	-	-	-	0.5	1.3
12 - 8 - 20	-	-	-	-	-	-	-	0.2	0.6	0.3	1.2
10 - 6 - 26	-	-	-	-	-	-	-	-	-	-	1.1
10 - 8 - 20	-	-	-	-	-	-	-	0.1	0.5	0.7	1.1
15 - 3 - 20	0.3	0.8	1.2	1.0	0.8	1.2	1.0	1.7	0.9	0.4	1.0
10 - 7 - 25	-	-	-	-	-	-	0.9	1.9	0.6	1.9	0.9
18 - 20 - 0	-	-	-	-	-	-	-	-	2.0	-	0.8
14 - 7 - 14	1.1	1.9	2.5	1.0	1.6	1.7	1.0	0.8	0.8	0.8	0.6
22 - 2.5 - 12	-	-	0.1	-	-	-	0.1	0.1	-	0.2	0.6
10 - 7 - 23	-	-	-	-	-	-	-	0.2	1.2	0.9	0.5
8 - 10 - 20	1.7	0.1	0.6	0.3	-	-	-	-	0.5	1.2	0.5
Other	8.6	9.6	9.6	12.8	17.2	11.5	11.5	5.9	7.5	9.3	4.6
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

3.5.6 Percentage of P applied to Main Cereals by Fertiliser type

Table 26 outlines the percentage of P applied to the main cereal crops through various fertiliser compounds over the study period. On average 60% of total P applied to the main cereal crops was derived from two fertilisers 18-6-12 (31%) and 10-10-20 (29%). The importance of 18-6-12 declined over the study period, from nearly 47% mid-study period to 17% at the end. Applications of 10-10-20 peaked in 2011/2012 (38-43%) before returning to initial levels (27%) at the end of the period. Other fertilisers with a significant P component (10-8-20, 18-20-0, 12-8-20, 13-6-20, 10-7-25, 8-10-20) increased in importance towards the end of the study period and accounted for over 5% of total P in 2015.

Table 26: P Fertiliser compounds applied to main cereals (%)

Fertiliser Type	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
10 - 10 - 20	23.9	27.0	21.8	25.0	20.1	29.6	38.4	43.1	30.9	28.3	26.7
18 - 6 - 12	33.2	38.6	41.9	43.3	46.6	40.5	27.8	19.6	15.5	15.7	16.9
10 - 5 - 25	-	-	-	1.0	-	1.2	1.4	3.0	2.7	3.7	6.0
10 - 8 - 20	-	-	-	-	-	-	-	0.6	2.3	3.1	5.6
18 - 20 - 0	-	-	-	-	-	-	-	-	12.3	-	5.3
12 - 8 - 20	-	-	-	-	-	-	-	0.8	2.3	1.1	5.2
13 - 6 - 20	-	-	1.7	0.4	3.7	1.2	4.6	6.9	5.6	6.1	4.6
10 - 6 - 26	-	-	-	-	-	-	-	-	-	-	4.0
10 - 7 - 25	-	-	-	-	-	-	4.6	8.3	2.1	7.8	3.8
8 - 10 - 20	10.8	0.8	5.0	2.4	-	-	-	-	3.3	8.5	3.6
10 - 7 - 23	-	-	-	-	-	-	-	0.8	4.4	3.6	2.3
8 - 8 - 23	-	-	-	-	-	-	-	-	2.2	2.8	2.2
14 - 7 - 14	2.8	5.3	9.0	3.4	6.0	6.8	3.7	2.5	2.2	2.4	1.9
0 - 16 - 0	0.1	-	0.1	-	-	-	1.2	2.8	0.4	1.3	1.6
0 - 10 - 20	5.3	8.3	2.1	3.3	-	0.2	0.4	2.7	3.1	2.7	1.4
15 - 3 - 20	0.4	0.8	1.6	1.3	1.2	1.9	1.4	2.1	1.0	0.5	1.3
10 - 8 - 23	-	-	-	-	-	-	-	-	-	0.6	1.2
0 - 7 - 30	3.0	1.4	3.5	3.4	2.9	1.8	2.5	2.8	1.3	0.8	1.0
11 - 7 - 23	-	-	-	-	-	-	-	-	1.0	0.5	0.9
10 - 8 - 21	-	-	-	-	-	-	-	-	-	-	0.8
Other	20.5	17.8	13.3	16.5	19.5	16.8	14.0	4.0	7.4	10.5	3.7
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

3.5.7 Percentage of K applied to Main Cereals by Fertiliser type

Table 27 outlines the percentage of K applied to the main cereal crops through various fertiliser compounds over the study period. Three main fertilisers accounted for over 50% of total K applied. The 18-6-12 fertiliser averaged nearly 23% of total K over the period but there was a significant decline in the quantity of this fertiliser applied between the start (31-33%) and the end of the study period (11%). The 10-10-20 fertiliser averaged over 20% of total K over the study peaking at 25-26% in 2011/2012 but declined to 17% at the end of the period. The fertiliser that experienced the most significant increase in volume was 0-0-50, rising from 1-2% of total K at the start to 15-17% at the end of the study period. Other fertilisers with a significant K component (10-5-25, 10-6-26, 13-6-20, 10-7-25) also increased in importance towards the end of the study period and accounted for over 5% of total K applied in one of the final years of the study period.

Table 27: K Fertilisers compounds applied to main cereals (%)

Fertiliser type	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
10 - 10 - 20	22.5	23.3	15.9	18.5	14.1	18.9	24.4	26.8	22.9	19.0	17.2
0 - 0 - 50	1.4	2.0	4.9	4.5	3.8	14.6	13.6	17.4	13.4	17.1	14.9
18 - 6 - 12	31.3	33.3	30.6	32.0	32.6	25.8	17.7	12.2	11.5	10.5	10.9
10 - 5 - 25	-	-	-	1.9	-	1.9	2.2	4.6	5.0	6.2	9.7
10 - 6 - 26	-	-	-	-	-	-	-	-	-	-	5.5
13 - 6 - 20	-	-	2.1	0.4	4.3	1.3	4.9	7.2	6.9	6.8	5.0
10 - 8 - 20	-	-	-	-	-	-	-	0.4	2.1	2.6	4.5
10 - 7 - 25	-	-	-	-	-	-	-5.2	9.2	2.8	9.3	4.3
12 - 8 - 20	-	-	-	-	-	-	-	0.6	2.2	0.9	4.1
15 - 3 - 20	1.1	2.4	4.0	3.3	2.9	4.1	3.0	4.4	2.5	1.1	2.8
10 - 7 - 23	-	-	-	-	-	-	-	0.8	5.4	3.9	2.5
8 - 10 - 20	10.2	0.7	3.7	1.7	-	-	-	-	2.5	5.7	2.3
8 - 8 - 23	-	-	-	-	-	-	-	-	2.4	2.7	2.1
0 - 7 - 30	6.1	2.6	5.5	5.4	4.3	2.5	3.4	3.8	2.1	1.2	1.4
5 - 6 - 35	2.7	3.8	3.5	2.6	0.7	-	-	-	-	0.9	1.4
13 - 0 - 31	-	-	-	-	-	-	-	-	-	-	1.2
14 - 7 - 14	2.6	4.6	6.5	2.5	4.2	4.3	2.3	1.6	1.6	1.6	1.2
10 - 8 - 23	-	-	-	-	-	-	-	-	-	0.6	1.1
0 - 10 - 20	5.0	7.1	1.5	2.4	0.0	0.1	0.3	1.7	2.3	1.8	0.9
11 - 7 - 23	-	-	-	-	-	-	-	-	1.3	0.6	0.9
Other	17.1	20.2	21.8	24.8	33.1	26.5	23.0	9.3	13.1	7.5	6.1
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

3.5.8 Percentage of total fertiliser applied to Main Cereals by Fertiliser type

Table 28 outlines the percentage of total fertiliser applied to the main cereal crops in volume terms by fertiliser type. On average, four fertilisers accounted for over 70% of the total applied over the study period. The CAN based fertilisers (27.5-0-0 and 27-0-0) accounted for over 45% of total fertilisers applied between 2005 and 2015. The 18-6-12 fertiliser on average accounted for over 16% of total fertiliser applied over the period, however this declined from 22-24% at the start to just below 9% at the end. Finally, 10-10-20 averaged over 9% of total volume of fertiliser applied between 2005 and 2015, peaking at 11-14% from 2011 to 2013.

Table 28: Top 20 fertilisers use on cereals ranked on quantity (%)

Fertiliser Type	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
27.5 - 0 - 0	41.2	39.1	33.6	31.6	25.8	25.8	27.7	19.6	18.5	24.6	25.8
27 - 0 - 0	6.7	6.7	13.3	14.6	18.0	22.2	20.9	27.0	22.6	15.7	17.7
18 - 6 - 12	21.7	23.6	20.6	21.9	22.0	18.1	13.2	10.2	9.3	8.7	8.9
10 - 10 - 20	9.4	9.9	6.4	7.6	5.7	7.9	10.9	13.4	11.1	9.4	8.5
10 - 5 - 25	-	-	-	0.6	-	0.6	0.8	1.8	1.9	2.4	3.8
0 - 0 - 50	0.2	0.3	0.8	0.7	0.6	2.5	2.4	3.5	2.6	3.4	2.9
26.5 - 0 - 0	0.2	0.2	0.8	0.4	0.3	1.5	0.6	0.5	1.2	1.4	2.8
13 - 6 - 20	-	-	0.9	0.2	1.8	0.5	2.2	3.6	3.4	3.3	2.4
10 - 8 - 20	-	-	-	-	-	-	-	0.2	1.0	1.3	2.2
10 - 6 - 26	-	-	-	-	-	-	-	-	-	-	2.1
12 - 8 - 20	-	-	-	-	-	-	-	0.3	1.0	0.5	2.0
26 - 0 - 0	0.4	0.3	1.8	1.2	2.0	2.3	2.0	3.2	6.0	6.8	2.0
10 - 7 - 25	-	-	-	-	-	-	1.9	3.7	1.1	3.7	1.7
26.6 - 0 - 0	-	-	0.3	0.5	0	0.1	0.1	0.4	-	-	1.6
25 - 0 - 0	-	-	-	-	-	-	-	-	0.7	-	1.5
15 - 3 - 20	0.5	1.0	1.6	1.4	1.2	1.7	1.3	2.2	1.2	0.5	1.4
10 - 7 - 23	-	-	-	-	-	-	-	0.3	2.3	1.7	1.1
8 - 10 - 20	4.2	0.3	1.5	0.7	-	-	-	-	1.2	2.8	1.1
14 - 7 - 14	1.5	2.8	3.8	1.5	2.5	2.6	1.5	1.1	1.1	1.1	0.9
8 - 8 - 23	-	-	-	-	-	-	-	-	1.0	1.2	0.9
Other	14.0	15.8	14.6	17.1	20.1	14.2	14.5	9.0	12.8	11.5	8.7
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

3.6 Fertiliser Use on Other Tillage Crops 2005-2015

The number of farms growing other tillage crops such as Fodder Beet, Maize, Oilseed Rape and Peas/Beans declined by approximately 30% between the start/middle and end of the study period. The number of farms growing Maize declined significantly (by 55%) over the period, while Fodder Beet growers also declined (by about 15%) between the start and end of the period. The number of farms growing Oilseed Rape and Peas/Beans was quite volatile over the study period as illustrated by Table 29. The average areas dedicated to Fodder Beet, Maize, Oilseed Rape and Peas/Beans were 4, 7, 13 and 10 hectares respectively. The average area dedicated to Oilseed Rape increased significantly over the period (from 3 to 26 hectares), Fodder Beet also experienced a significant increase in area (from 2 to 5 hectares) with the area dedicated to Maize and Peas/Beans fluctuating over the study period but tending to be relatively similar at the start and end of the study period.

Table 29: Average farm size and NFS farm numbers growing other tillage crops

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Average area (ha) – other tillage crops											
Fodder Beet	2	4	4	4	5	4	4	4	5	5	5
Maize	5	6	7	7	8	8	8	7	7	6	6
Oilseed Rape	3	8	8	9	9	13	16	12	15	21	26
Peas & Beans	11	9	7	8	8	11	8	12	16	10	9
Total other crops	21	27	26	28	30	36	36	35	43	42	47
No. of NFS farms with other tillage crop area											
Fodder Beet	40	47	42	49	45	39	38	34	38	36	34
Maize	58	51	60	64	56	52	48	28	31	27	26
Oilseed Rape	-	-	14	-	-	12	21	24	17	11	-
Peas & Beans	14	17	-	-	-	12	-	14	10	-	19
Total other crops	119	123	124	127	117	115	116	100	96	83	87

Table 30 reports average N application rates across other tillage crops. In the event of there being less than ten holdings collected in the NFS sample results are not presented. Application rates for Fodder Beet ranged from 138-172 kg ha^{-1} over the study period with application rates comparable at the start and end of the period (138-139 kg ha^{-1}) and higher during the intervening years.

Table 30: Average N applications on other tillage crops (kg ha^{-1})

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Fodder Beet	138	138	168	141	141	161	160	172	142	168	139
Maize	153	137	129	130	147	135	157	165	143	141	120
Oilseed Rape	-	-	161	-	-	137	173	179	167	169	-
Peas & Beans	5	0	-	-	-	0	-	3	8	-	5

Application rates for maize ranged from 120-165 kg ha^{-1} over the period, with highest rates recorded in 2011/2012 (157-165 kg ha^{-1}) and lowest at the end of the period (120 kg ha^{-1}). N applied to Oilseed Rape ranged from 137-179 kg ha^{-1} for reported years. Finally, application rates of N for Peas/Beans ranged from 0 to 33 kg ha^{-1} for reported years as outlined in Table 31.

P applications across other tillage crops are reported in Table 31. Application rates for Fodder Beet ranged from 43-54 kg ha^{-1} over the study period with application rates comparable at the start and end of the period and generally lower during the intervening years. P application rates for Maize ranged from 27-39 kg ha^{-1} with highest rates recorded at the start and end of the study period. P applied to Oilseed Rape ranged from 11-32 kg ha^{-1} for reported years. Finally, application rates of P for Peas and Beans ranged from 14 to 24 kg ha^{-1} over the period 2005-2015 as outlined in Table 31.

Table 31: Average P applications on other tillage crops (kg ha^{-1})

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Fodder Beet	54	49	43	44	48	47	51	45	45	50	53
Maize	38	36	32	39	34	33	31	27	38	36	37
Oilseed Rape	-	-	27	-	-	11	23	24	32	18	-
Peas & Beans	14	18	-	-	-	20	-	24	18	-	19

Table 32 reports K application rates across other tillage crops with rates for Fodder Beet ranging from 153-210 kg ha^{-1}, comparable at the start and end of the study period. Application rates for Maize ranged from 75-95 kg ha^{-1} over the period with highest rates recorded for 2013/2014 (94-95 kg ha^{-1}) and lowest rates for 2006/2007 (75 kg ha^{-1}). K rates applied to Oilseed Rape ranged from 40-84 kg ha^{-1} for reported years. Finally, application rates for Peas and Beans ranged from 53 to 88 kg ha^{-1} over the study period, with higher rates evident in later years.

Table 32: Average K applications other tillage crops (kg ha^{-1})

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Fodder Beet	180	153	161	164	166	172	188	178	170	210	185
Maize	80	75	75	91	78	88	90	78	94	95	85
Oilseed Rape	-	-	71	-	-	40	62	60	79	84	-
Peas & Beans	53	57	-	-	-	68	-	74	88	-	65

3.7 Fertiliser Use on Selected Root Crops 2005-2015

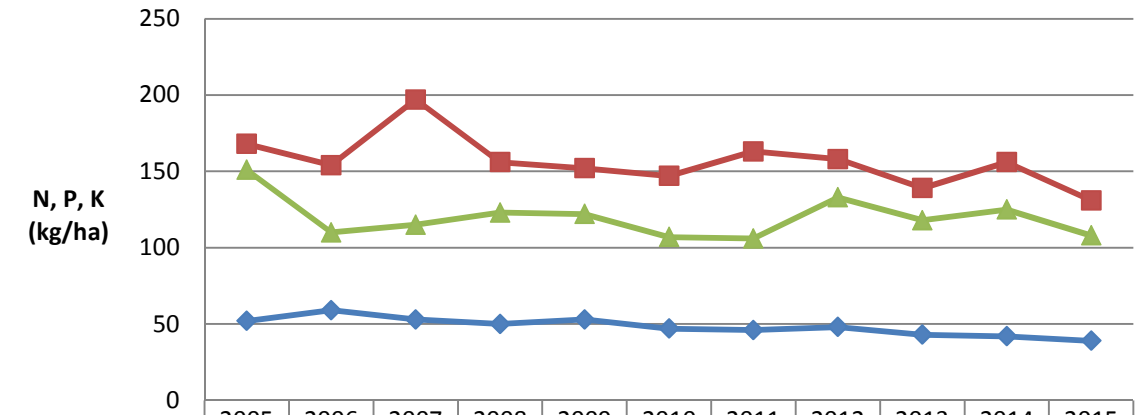
The root crops described here are Potatoes, Sugar Beet, Fodder Rape, Turnips and Kale. As the land area occupied is relatively small across the sample the data is discussed across all farms for these various crops. The average area utilised for root crops over the period ranged from 4 to 6 hectares. More than three quarters of farms with root crops were located in zone A with 13% in zone B and 9% in zone C.

Table 33: Average farm size, NFS farm numbers and farm population – selected Roots Crops

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Average Area (ha) – selected root crops											
All Farms	6	6	5	4	5	5	5	4	4	4	5
No. of Teagasc NFS Farms with selected root crops											
All Farms	126	95	84	86	78	75	78	59	70	65	55

N application rates on root crops ranged from 106-151 kg ha^{-1} over the study period, N application rates were at their highest at the start of the period (151 kg ha^{-1}) and were between 17-30% lower thereafter. P application rates ranged between 39-59 kg ha^{-1} over the study period, the peak application rate was in 2006 (59 kg ha^{-1}) and this declined by 34% to a period low of 39 kg ha^{-1} at the end of the study period. K application rates ranged from 131-197 kg ha^{-1} over the period, the peak application rate was in 2007 (197 kg ha^{-1}) and this declined by 34% to a period low of 131 kg ha^{-1} at the end of the study period in 2015.

Figure 55: N, P, K use for selected Root Crops



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Nitrogen	151	110	115	123	122	107	106	133	118	125	108
Phosphorus	52	59	53	50	53	47	46	48	43	42	39
Potassium	168	154	197	156	152	147	163	158	139	156	131

3.8 Fertiliser use by Agri-Environmental Scheme participation 2005-2015

3.8.1 Fertiliser applications on Grassland by Agri-Environmental Scheme participation

Table 34 provides an overview of farm numbers with grazing, silage, hay and grassland area by agri-environmental scheme participation from 2005 to 2015. Results for the NFS indicate that participation rates in an agri-environmental scheme halved between the start and end of the study period. However, it should be noted that more recent agri-environmental schemes such as AEOS and GLAS were not open to as many participants as the earlier REPS scheme.

Table 34: Number of farms with Grassland by Agri-Environmental Scheme participation

	Agri -Environmental scheme participants					Non Agri-Environmental scheme participants				
Year	**Grazing**	**Silage**	**Hay**	**Grassland**	**Total**	**Grazing**	**Silage**	**Hay**	**Grassland**	**Total**
2005	405	379	149	405	405	624	584	212	624	624
2006	502	465	196	502	502	518	489	184	518	518
2007	490	460	126	490	490	532	504	137	532	532
2008	478	437	121	478	478	536	508	121	536	536
2009	493	458	122	493	493	481	456	101	481	481
2010	433	404	121	433	433	519	488	147	519	519
2011	365	342	89	365	365	588	553	132	588	588
2012	350	333	44	350	350	579	552	80	579	579
2013	336	320	115	336	336	603	575	199	603	603
2014	310	292	98	310	310	598	577	177	598	598
2015	242	224	52	242	242	659	635	109	659	659

Those participating in agri-environmental schemes tended to have slightly smaller total grassland area on average at 37 hectares compared to non-participants, who averaged 39 hectares over the study period. Table 35 shows that total grassland area for agri-environmental scheme participants was on average higher at the end of the study period 39-41 hectares (2014/2015), compared to non-participants for whom it averaged 36-37 hectares.

Table 35: Average Area (ha) by Agri-Environmental Scheme participation

	Agri -Environmental scheme participants				Non Agri-Environmental scheme participants			
Year	**Grazing**	**Silage**	**Hay**	**Grassland**	**Grazing**	**Silage**	**Hay**	**Grassland**
2005	29	9	3	35	32	12	4	39
2006	29	9	4	35	33	12	4	40
2007	30	10	4	35	33	12	4	40
2008	31	10	4	36	33	12	4	39
2009	30	10	4	36	33	12	3	39
2010	30	11	3	36	32	11	4	39
2011	31	11	4	38	32	12	4	39
2012	33	11	5	39	32	11	3	39
2013	32	11	4	39	33	12	4	40
2014	34	11	4	41	29	12	4	36
2015	34	9	5	39	30	12	4	37

Across both groups the silage and hay areas remained relatively stable over the period. Table 34 indicates that silage area is larger on non-agri environmental scheme participant farms at 11-12 hectares compared to 9-11 hectares for agri-environmental scheme participants. The average area utilised for hay over the period was the same for both groups, averaging 4 hectares.

Table 36 confirms that N application rates on grassland area are lower for those farms participating in an agri-environmental scheme. Application rates on grassland area were almost 35% lower on average for agri-environmental scheme participants (49-79 Kg Ha^{-1}) compared to non-participants (87-123 Kg Ha^{-1}). The differential was higher across grazing area with application rates 45% lower across scheme participants (34-70 Kg Ha^{-1}) compared to non-participants (67-104 Kg Ha^{-1}). Finally, application rates were 13% and 8% lower across silage and hay area for agri-environmental scheme participants over the study period. It should be noted that application rates at the end of the study period tended to be significantly lower across both cohorts compared to initial starting period levels. The decline in usage is larger on participant farms where a 34% decline in N application rates on grassland is reported compared to 17% for non-participants. The relevant usage figures in 2015 on grassland for both groups were 49 Kg Ha^{-1} and 99 Kg Ha^{-1} respectively.

Table 36: N (kg per ha) applied by Agri-Environmental Scheme participation

	Agri -Environmental scheme participants				Non Agri-Environmental scheme participants			
Year	**Grazing**	**Silage**	**Hay**	**Grassland**	**Grazing**	**Silage**	**Hay**	**Grassland**
2005	56	102	49	74	103	120	55	120
2006	61	101	56	79	104	127	62	123
2007	55	92	54	72	90	113	62	108
2008	41	88	44	58	74	106	61	93
2009	60	102	54	79	80	117	59	100
2010	66	114	65	87	76	122	57	98
2011	62	112	52	84	67	107	49	87
2012	58	99	58	76	68	105	58	87
2013	70	122	49	93	76	123	54	99
2014	54	108	50	74	77	115	52	99
2015	34	82	39	49	78	113	48	99

Application rates of P on total grassland area were on average nearly 38% lower for agri-environmental schemes participants (4-7 Kg Ha^{-1}) compared to non-participants (5-11 Kg Ha^{-1}). The differential was higher across grazing area with application rates 45% lower across scheme participants (3-5 Kg Ha^{-1}) compared to non-participants (3-9 Kg Ha^{-1}). The data indicates that P use on grazing area fell for both groups, the decline larger on non agri-environmental scheme farms at 33% compared to 20% for scheme participants. Finally, application rates were on average 16% and 7% lower across silage and hay area for agri-environmental scheme participants over the study

period. However, P usage on silage and hay area in 2015 was broadly similar for participant and non-participant farms. Application rates declined significantly during the middle of the study period across both cohorts across all grassland area before recovering towards the end of the study period. Average application rates were on average 14-18% lower across all grassland area for both groups at the end of the study period compared to the start as illustrated by Table 37.

Table 37: P (kg per ha) applied by Agri-Environmental Scheme participation

	Agri -Environmental scheme participants				Non Agri-Environmental scheme participants			
Year	**Grazing**	**Silage**	**Hay**	**Grassland**	**Grazing**	**Silage**	**Hay**	**Grassland**
2005	5	10	9	7	9	13	10	11
2006	5	10	9	7	8	12	9	11
2007	4	8	8	6	6	11	9	8
2008	2	7	6	4	4	8	8	5
2009	2	7	7	4	3	7	7	5
2010	3	8	10	5	4	9	11	6
2011	3	7	7	4	3	9	7	6
2012	3	8	8	5	4	9	8	6
2013	4	10	8	6	5	12	8	8
2014	5	11	8	7	6	12	10	9
2015	4	11	10	6	6	11	9	9

Average K application rates across total grassland area were 34% lower for those participating in an agri-environmental scheme (12-18 Kg Ha^{-1}) compared to non-participants (12-27 Kg Ha^{-1}) over the study period. The differential was higher across grazing area with application rates 40% lower across agri-environmental scheme participants (5-12 Kg Ha^{-1}) compared to non-participants (7-19 Kg Ha^{-1}).

Table 38: K (kg per ha) applied by Agri-Environmental Scheme participation

	Agri -Environmental scheme participants				Non Agri-Environmental scheme participants			
Year	**Grazing**	**Silage**	**Hay**	**Grassland**	**Grazing**	**Silage**	**Hay**	**Grassland**
2005	11	32	23	18	19	40	26	27
2006	12	29	23	18	17	37	23	25
2007	10	27	22	17	14	32	21	21
2008	5	22	14	10	9	25	20	15
2009	6	20	18	11	7	21	17	12
2010	8	25	24	14	10	26	25	16
2011	7	22	18	12	8	25	18	15
2012	7	22	19	12	9	27	20	16
2013	10	27	18	16	12	35	20	20
2014	10	32	19	17	14	34	24	23
2015	9	29	21	14	14	34	21	23

Finally, application rates were 17% and 7% lower across silage and hay area for agri-environment scheme participants on average over the study period. K application rates declined significantly during the middle of the study period across both cohorts (30-50% between 2008 and 2012) for all grassland areas before recovering towards the end of the study period. Application rates were on average 15-22% lower across all grassland area for both groups at the end of the study period compared to initial levels as illustrated by Table 38.

3.8.2 Fertiliser applications on main cereals by Agri-Environmental Scheme participation

Table 39 reports the number of farms growing the main cereal crops by agri-environmental scheme participation. Farms with cereal area participating in an agri-environmental scheme declined by 52% compared to a 23% decline for non-scheme participants. Of the three main cereal crops, Spring Barley is most prevalent; however this has experienced a decline over the study period especially across agri-environmental scheme participants (where the number has more than halved). On the other hand, an increase in the number of farms with Winter Barley is apparent (although the numbers are small) across agri-environmental scheme participants. The number of farms with Winter Wheat is higher on non-participant versus participant farms.

Table 39: Number of cereal farms by Agri-Environmental Scheme participation

	Agri -Environmental scheme participants				Non Agri-Environmental scheme participants			
Year	**Winter Wheat**	**Spring Barley**	**Winter Barley**	**All Cereals**	**Winter Wheat**	**Spring Barley**	**Winter Barley**	**All Cereals**
2005	4	58	4	70	32	108	17	142
2006	8	77	8	90	27	71	11	101
2007	8	70	6	89	33	93	14	122
2008	21	79	5	98	43	97	15	132
2009	15	74	13	91	23	80	14	103
2010	13	64	6	79	33	82	28	108
2011	20	53	11	73	38	100	29	128
2012	15	41	8	57	35	102	25	128
2013	8	41	5	51	27	97	22	117
2014	8	31	9	45	29	83	31	105
2015	5	24	10	33	29	83	49	109

Table 40 reflects the fact that cereal area on non-participant farms was generally larger averaging 26 hectares compared to 18 hectares for agri-environmental scheme participating farms. The average area utilised for the most popular crop, Spring Barley, was similar at 13-14 hectares.

Table 40: Average area (ha) under cereals by Agri-Environmental Scheme participation

	Agri -Environmental scheme participants				Non Agri-Environmental scheme participants			
Year	Winter Wheat	Spring Barley	Winter Barley	All Cereals	Winter Wheat	Spring Barley	Winter Barley	All Cereals
2005	-	10	-	11	28	12	16	22
2006	-	11	-	14	33	15	20	28
2007	-	11	-	14	28	13	16	26
2008	15	14	-	17	26	15	17	25
2009	18	13	9	17	39	17	17	28
2010	46	14	-	19	28	14	15	25
2011	35	14	11	22	35	13	17	27
2012	14	15	-	20	37	12	18	24
2013	-	15	-	20	29	16	16	25
2014	-	15	-	26	24	16	17	26
2015	-	11	11	18	23	14	16	28

Average N application rates across both groups for the main cereals are contained in Table 41. The average annual application rate for non-participants over the period was 1.15 times higher at 150 Kg Ha^{-1} compared to scheme participants where the average rate applied was 130 Kg Ha^{-1}.

Table 41: N (kg per ha) applied to main cereals by Agri-Environmental Scheme participation

	Agri -Environmental scheme participants				Non Agri-Environmental scheme participants			
Year	Winter Wheat	Spring Barley	Winter Barley	All Cereals	Winter Wheat	Spring Barley	Winter Barley	All Cereals
2005	-	111	-	111	200	129	166	153
2006	-	118	-	115	196	135	151	156
2007	-	123	-	128	196	133	160	155
2008	128	115	-	118	183	123	150	143
2009	167	112	169	124	195	125	162	145
2010	191	118	-	136	196	126	159	151
2011	191	123	170	147	201	125	167	149
2012	187	113	-	136	178	124	152	146
2013	-	131	-	138	194	131	161	147
2014	-	116	-	146	169	130	166	146
2015	-	129	160	127	199	134	177	160

N application rates on cereal area for scheme participants tended to increase over the study period and were 14% higher at the end compared to at the outset. This contrasts to non-scheme participants where N application rates tended to be lower across the study period compared to initial starting levels (except for the final year which was 5% higher). Given the decline in the number of farms with cereal area participating in agri-environmental schemes over the period, limited data is available for Winter Wheat and Winter Barley in particular.

P usage on cereal area is broadly similar across scheme participants and non-participants with the average application rates over the period marginally higher for non-participants at 23 Kg Ha^{-1}

compared to 21 Kg Ha^{-1} for scheme participants. The average rate applied to Spring Barley was the same for both groups at 24 Kg Ha^{-1}. Interestingly, P usage actually increased by 14% from the start to end of the period for those farms involved in agri-environmental schemes, whereas an 11% decline is reported for non-scheme participants.

Table 42: P (kg per ha) applied to main cereals by Agri-Environmental Scheme participation

	Agri -Environmental scheme participants				Non Agri-Environmental scheme participants			
Year	**Winter Wheat**	**Spring Barley**	**Winter Barley**	**All Cereals**	**Winter Wheat**	**Spring Barley**	**Winter Barley**	**All Cereals**
2005	-	22	-	21	29	27	33	28
2006	-	23	-	21	29	28	36	27
2007	-	21	-	19	20	22	26	21
2008	20	20	-	19	19	20	26	20
2009	21	18	8	17	18	22	12	19
2010	6	19	-	16	21	21	19	20
2011	15	24	18	19	23	24	19	23
2012	25	26	-	26	16	25	23	22
2013	-	31	-	29	32	25	25	27
2014	-	28	-	23	20	27	29	26
2015	-	27	28	24	24	25	26	25

Finally, K usage on cereal area over the period was also broadly similar where the average rate applied for non-scheme participants was 64 Kg Ha^{-1} compared to 62 Kg Ha^{-1} for scheme participants. Likewise, it is clear that K usage on cereal area increased by a similar magnitude (28-29%) across both groups between the start and end of the study period.

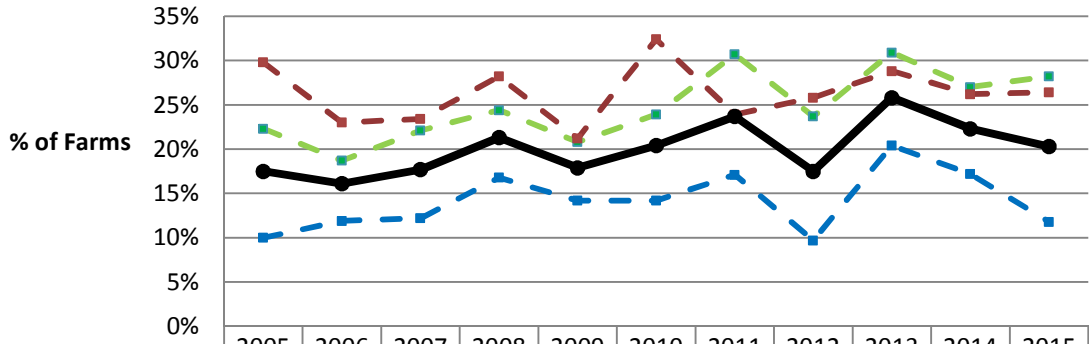
Table 43: K (kg per ha) applied to main cereals by Agri-Environmental Scheme participation

	Agri -Environmental scheme participants				Non Agri-Environmental scheme participants			
Year	**Winter Wheat**	**Spring Barley**	**Winter Barley**	**All Cereals**	**Winter Wheat**	**Spring Barley**	**Winter Barley**	**All Cereals**
2005	-	55	-	55	60	56	84	61
2006	-	57	-	54	71	57	86	63
2007	-	56	-	55	54	51	76	55
2008	57	51	-	51	58	46	66	53
2009	73	47	34	51	65	47	58	53
2010	82	48	-	56	74	47	61	58
2011	91	56	79	69	77	56	71	63
2012	92	60	-	70	89	59	77	73
2013	-	77	-	78	86	66	69	72
2014	-	66	-	73	73	68	88	75
2015	-	66	82	71	91	67	78	78

3.9 Lime usage

Figure 56 presents the percentage of farms using lime by nitrate zone. Just over 20% of farms across all zones were using lime over the study period on average. The proportion of farms liming was highest in zone C (27%) followed by zone A (25%), while the lowest proportion of farms apply lime was associated with zone B at 14% on average.

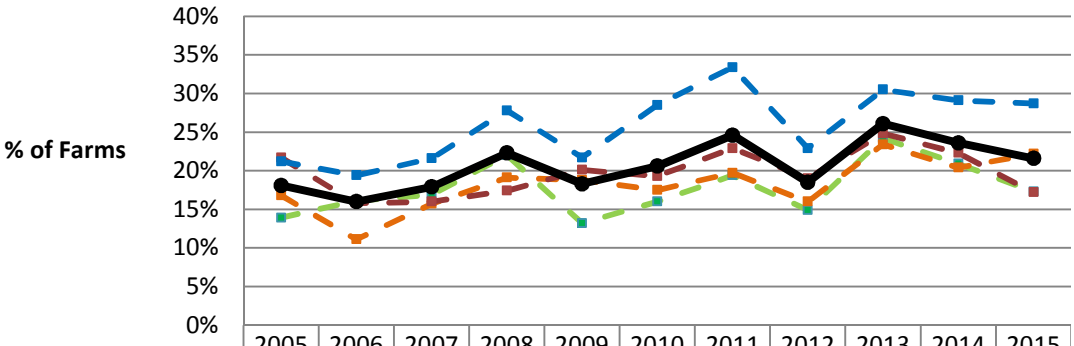
Figure 56: Percentage of farms using Lime by Nitrate Zone



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Zone A	22%	19%	22%	24%	21%	24%	31%	24%	31%	27%	28%
Zone B	10%	12%	12%	17%	14%	14%	17%	10%	20%	17%	12%
Zone C	30%	23%	23%	28%	21%	32%	24%	26%	29%	26%	26%
All Zones	18%	16%	18%	21%	18%	20%	24%	18%	26%	22%	20%

Results on the use of lime by land use class are presented in Figure 57. The proportion of farms liming was highest on soils of a wide land use potential, averaging 26% over the study period. There was a general upward trend in the percentage of farms using lime use amongst this cohort over the study period.

Figure 57: Percentage of farms using Lime by Land Use Class

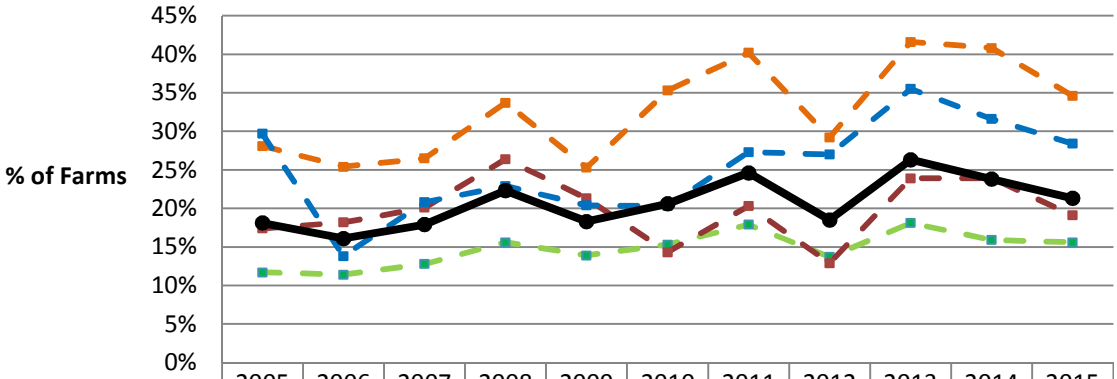


	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Limited	14%	16%	17%	22%	13%	16%	19%	15%	24%	21%	17%
Somewhat Limited	17%	11%	16%	19%	19%	18%	20%	16%	23%	20%	22%
Moderately Wide	22%	16%	16%	17%	20%	19%	23%	19%	25%	22%	17%
Wide	21%	19%	22%	28%	22%	29%	33%	23%	31%	29%	29%
All Soils	18%	16%	18%	22%	18%	21%	25%	19%	26%	24%	22%

The percentage of farms applying lime across the moderately wide, somewhat limited and limited soil class was 20%, 17% and 18% respectively on average over the period. Generally, liming rates were higher at the end of the study period than at the outset.

Figure 58 presents the percentage of farmers using lime by farm system. Dairying was associated with the highest level of liming on average, with 32% of dairy farms applying lime over the study period (tending to increase over the period). Tillage farms had the second highest level of liming with 25% of tillage farms applying lime on average (again tending to increase over the period). On average, 15 and 20% of cattle and sheep farms respectively tended to apply lime over the study period, with the proportion again increasing from the beginning to the end of the period in question.

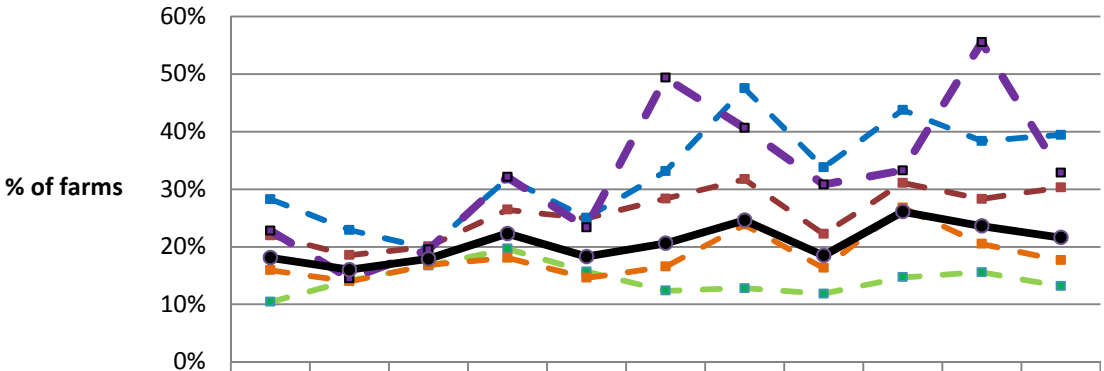
Figure 58: Percentage of farms using Lime by Farm System



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Cattle	12%	11%	13%	16%	14%	15%	18%	14%	18%	16%	16%
Dairy	28%	25%	27%	34%	25%	35%	40%	29%	42%	41%	35%
Sheep	17%	18%	20%	26%	21%	14%	20%	13%	24%	24%	19%
Tillage	30%	14%	21%	23%	20%	20%	27%	27%	36%	32%	28%
All Systems	18%	16%	18%	22%	18%	21%	25%	19%	26%	24%	21%

Figure 59 illustrates the percentage of farmers using lime by organic N stocking rate and indicates that lime usage is correlated to stocking intensity, with only 10-16% of farms in the <85 Kg ON Ha^{-1} stocking rate band applying lime over the period, compared to 14-55% of farms at the other end of the spectrum (>210 Kg ON Ha^{-1}). There is some variation year-on-year across groups, with between 19% and 22% of farms in the 85-130 Kg ON Ha^{-1} category applying lime from 2005 to 2015, 19-32% in the 130-170 Kg ON Ha^{-1} category and 20-48% in the 30-170 Kg ON Ha^{-1} category.

Figure 59: Percentage of farms using Lime by Organic N Stocking Rate



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
< 85	10%	14%	17%	20%	16%	12%	13%	12%	15%	16%	13%
85-130	16%	14%	17%	18%	15%	17%	24%	16%	27%	20%	18%
130-170	22%	19%	20%	26%	25%	28%	32%	22%	31%	28%	30%
170-210	28%	23%	20%	32%	25%	33%	48%	34%	44%	38%	39%
>210	23%	14%	20%	32%	23%	49%	41%	31%	33%	55%	33%
All Rates	18%	16%	18%	22%	18%	21%	25%	19%	26%	24%	22%

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Appendix 1: Units of Measurement

Metric	Imperial
1 kg	2 units
1kg/ha	0.81 units/acre
1kg/ha	0.91 lb/acre
1 tonne/ha	0.4 tons/acre
$1m^3$/ha	89.0 gallons/acre
1 kg/m^3	9.09 units/1000 gallons
Imperial	**Metric**
1 ton/acre	2.51 tonnes/ha
1 unit/acre	1.24 kg/ha
1 lb/acre	1.1 kg/ha
1 unit/ton	0.492 kg/tonne
1000 gallons/acre	11.2 m^3/ha
1 unit/1000 gallons	0.110 kg/m^3
Element to Oxide	
P to P_2O_5	Multiply by 2.291
K to K2O	Multiply by 1.205
Oxide to Element	
P_2O_5 to P	Multiply by 0.436
K_2O to K	Multiply by 0.830

Appendix 2: Report Methodology

Methodological Notes

The CSO conducts a Census of Agriculture every 10 years to record the population of farms and the structure of farming in Ireland. Farm Structure Surveys (FSS) are conducted in the intervening periods to produce estimates of the farm population. The 2013 FSS estimated the farming population falling within the sampling frame of the NFS to be 84,259. The 2015 population estimates reported here are based on this updated population figure.

Methodological change: In 2012 the minimum size threshold for participation in the NFS was increased from €4,000 to €8,000 which resulted in very small farms being excluded. Those farms were representative of 18% of the total farm population but contribute only about 5% of the sector's gross output. This change must be taken account of in comparing data across years and so the data was reweighted from 2005 to 2012 and only farms above €8,000 standard output over the period are included. The tables below reflect the farm population distribution in both 2015 and 2005 and illustrate the growth in larger farms over the study period.

Table 44a: Estimated 2015 Farm Population Distribution

Size (ha)	<10	10-20	20-30	30-50	50-100	>100	Total
			% of Farms				
Dairy	0	0.8	2	6	7.3	1.4	18.5
Cattle Rearing	0	3.2	7.4	7.6	2.4	0.2	23.4
Cattle Other	0	6.8	6.4	8.5	5.5	1	30.6
Sheep	0	2.7	2.6	3.8	2.5	0.3	15.1
Tillage	0.2	0.8	0.9	1.4	1.6	1	6
Mixed Livestock	0	0.3	0.7	1.2	2.2	0.7	6.1
All	0.2	14.6	20	28.5	21.5	4.6	100

Source: Central Statistics Office

Table 44b: Estimated 2005 Farm Population Distribution

Size (ha)	<10	10-20	20-30	30-50	50-100	>100	Total
			% of Farms				
Dairy	0.5	1.9	2.8	6.1	4.4	0.6	16.3
Cattle Rearing	0.7	1.1	1.0	2.3	3.3	0.9	9.4
Cattle Other	2.9	8.1	5.7	5.6	2.2	0.3	24.6
Sheep	4.2	8.1	5.1	5.5	3.2	0.8	26.9
Tillage	2.2	3.8	2.9	3.9	2.6	0.9	16.3
Mixed Livestock	0.5	1.0	0.8	1.4	1.7	1.2	6.6
All	11.0	24.0	18.2	24.7	17.4	4.6	100.0

Source: Central Statistics Office

Appendix 3: Results by NUTS 3 regions and Organic N stocking rate

Table 45: Average farm size, NFS farms and farm population by Region – Grazing Area

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Average Area (ha)											
Border	28	28	28	28	28	28	28	30	29	26	26
Mid East	37	38	38	36	36	37	36	38	35	33	33
Midlands	33	32	33	33	35	34	35	36	34	33	33
South	30	30	31	31	31	31	31	33	34	33	33
South East	35	35	35	35	35	34	34	35	33	33	33
South West	34	34	34	35	34	34	34	35	34	34	33
West	26	26	27	26	26	26	27	27	27	25	25
All Regions	31	31	31	31	32	31	32	33	32	31	31
No. Teagasc NFS Farms											
Border	162	166	160	169	164	171	166	154	155	155	154
Mid East	108	107	120	128	122	120	123	103	104	108	106
Midlands	96	99	111	115	114	116	119	114	117	124	124
South	244	240	231	230	213	182	185	204	195	164	157
South East	171	164	165	162	159	170	183	180	184	176	178
South West	110	107	103	86	81	74	68	69	71	73	75
West	138	137	132	124	121	119	109	105	113	108	107
All Regions	1029	1020	1022	1014	974	952	953	929	939	908	901
% of Population											
Border	16%	16%	16%	16%	16%	16%	16%	16%	16%	18%	17%
Mid East	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
Midlands	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
South	18%	19%	19%	19%	18%	18%	18%	18%	18%	17%	17%
South East	15%	15%	15%	15%	15%	16%	16%	16%	16%	15%	15%
South West	13%	13%	13%	13%	13%	13%	13%	13%	13%	12%	12%
West	19%	19%	19%	19%	18%	19%	19%	19%	19%	20%	20%

Table 46: N, P, K on Grazing Area by Region

N (kg/ha)	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Border	61	63	56	44	53	50	45	49	59	49	43
Mid East	73	66	64	52	60	62	55	58	63	60	60
Midlands	63	69	61	46	65	64	51	47	64	55	51
South	130	125	105	85	92	96	95	95	103	104	87
South East	111	103	91	76	91	89	87	82	100	93	90
South West	59	77	60	48	62	67	59	59	75	66	75
West	50	48	47	35	45	52	39	37	44	44	40
All Regions	82	81	72	57	68	70	63	62	72	67	63
Phosphorous (kg/ha)	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Border	6	6	4	2	3	4	3	3	4	4	5
Mid East	7	4	4	2	2	3	3	4	4	6	7
Midlands	7	6	4	3	3	4	3	3	4	5	5
South	9	9	7	4	4	4	3	4	5	7	6
South East	9	9	5	3	3	5	4	5	6	8	8
South West	6	5	4	3	3	3	3	3	4	4	5
West	6	6	5	2	3	4	3	3	4	5	4
All Regions	7	7	5	3	3	4	3	4	5	5	5
K (kg/ha)	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Border	13	11	9	5	6	7	6	6	9	9	10
Mid East	13	10	9	6	5	8	6	9	12	13	12
Midlands	16	16	13	7	7	12	8	9	10	13	12
South	19	18	16	10	10	8	9	10	13	16	15
South East	19	18	12	9	7	11	10	11	13	18	18
South West	13	11	10	8	6	7	9	7	10	11	12
West	14	13	12	5	7	9	8	7	10	11	9

Table 47: Average farm size, NFS farms and farm population by Region – Silage Area

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Average Area (ha)											
Border	9	9	9	9	9	9	9	9	11	9	9
Mid East	13	12	13	13	13	13	13	13	13	12	13
Midlands	12	10	12	12	13	12	12	12	13	12	11
South	11	11	11	11	11	11	13	12	13	12	12
South East	13	14	13	13	13	13	14	14	14	15	14
South West	11	11	12	12	11	12	13	12	14	13	14
West	8	7	9	8	9	8	8	9	9	9	9
All Regions	11	11	11	11	11	11	12	11	12	11	11
No. Teagasc NFS Farms											
Border	152	156	153	161	159	163	152	148	150	146	145
Mid East	97	98	114	119	111	109	114	99	101	103	102
Midlands	91	92	109	111	110	112	117	109	115	123	120
South	232	226	217	209	198	171	172	194	181	156	151
South East	158	155	153	150	148	159	170	170	173	169	168
South West	108	101	97	79	76	70	65	64	67	69	71
West	125	126	121	116	112	108	105	101	108	103	102
All Regions	963	954	964	945	914	892	895	885	895	869	859
% of Population											
Border	16%	17%	16%	17%	17%	17%	16%	17%	17%	18%	17%
Mid East	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
Midlands	11%	10%	11%	11%	11%	11%	11%	10%	11%	11%	11%
South	18%	18%	18%	18%	18%	18%	18%	18%	18%	17%	17%
South East	15%	15%	15%	15%	15%	15%	15%	15%	15%	14%	14%
South West	14%	13%	13%	13%	14%	13%	13%	13%	13%	12%	12%
West	18%	19%	18%	19%	18%	18%	19%	18%	19%	20%	20%

Table 48: N, P, K on Silage Area by Region

N (kg/ha)	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Border	97	97	89	89	96	100	98	99	109	107	97
Mid East	120	115	105	96	112	125	108	107	135	122	105
Midlands	108	114	103	100	114	119	115	105	127	110	107
South	131	133	127	117	126	143	121	122	132	117	125
South East	131	124	114	106	117	125	112	101	137	131	119
South West	97	130	84	87	104	110	107	95	105	118	99
West	84	85	74	69	74	76	74	69	87	68	66
All Regions	111	114	101	96	109	118	107	102	121	111	104
Phosphorous (kg/ha)	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Border	10	11	10	7	8	9	8	8	11	11	11
Mid East	14	11	10	7	8	9	10	11	13	13	14
Midlands	15	16	11	9	8	10	10	10	13	13	12
South	12	12	10	7	5	7	6	7	9	9	9
South East	12	11	10	6	6	8	7	7	10	13	12
South West	13	11	9	7	9	10	9	9	11	13	10
West	12	9	8	7	6	9	11	9	12	11	11
All Regions	12	11	9	7	7	9	8	9	11	11	11
K (kg/ha)	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Border	30	31	29	22	20	24	21	24	30	29	30
Mid East	41	34	31	24	22	28	27	32	40	38	40
Midlands	45	46	36	33	26	31	33	32	38	38	36
South	38	34	30	25	17	21	18	22	28	30	29
South East	33	31	29	20	17	23	19	21	29	33	35
South West	38	31	27	23	25	29	28	30	33	40	35
West	37	27	27	21	19	26	28	27	35	32	31
All Regions	37	33	29	23	21	25	24	25	32	33	33

Table 49: Average farm size, NFS farms and farm population by Region – Grassland Area

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Average Area (ha)											
Border	33	34	33	33	33	33	34	36	36	31	31
Mid East	44	46	45	43	43	45	43	45	44	41	40
Midlands	41	39	41	41	42	42	43	43	43	41	41
South	36	36	37	37	38	37	38	40	42	40	40
South East	42	43	42	42	42	42	42	42	42	41	41
South West	41	41	41	41	41	41	42	42	43	41	41
West	30	30	31	30	30	30	31	32	32	30	29
All Regions	37	37	38	37	38	38	38	39	40	37	37
No. Teagasc NFS Farms											
Border	162	166	160	169	164	171	166	154	155	155	154
Mid East	108	107	120	128	122	120	123	103	104	108	106
Midlands	96	99	111	115	114	116	119	114	117	124	124
South	244	240	231	230	213	182	185	204	195	164	157
South East	171	164	165	162	159	170	183	180	184	176	178
South West	110	107	103	86	81	74	68	69	71	73	75
West	138	137	132	124	121	119	109	105	113	108	107
All Regions	1029	1020	1022	1014	974	952	953	929	939	908	901
% of Population											
Border	16%	16%	16%	16%	16%	16%	16%	16%	16%	18%	17%
Mid East	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
Midlands	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
South	18%	19%	19%	19%	18%	18%	18%	18%	18%	17%	17%
South East	15%	15%	15%	15%	15%	16%	16%	16%	16%	15%	15%
South West	13%	13%	13%	13%	13%	13%	13%	13%	13%	12%	12%
West	19%	19%	19%	19%	18%	19%	19%	19%	19%	20%	20%

Table 50: N, P, K on Grassland Area by Region

N (kg/ha)	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Border	77	79	71	60	70	70	63	67	81	70	62
Mid East	94	86	83	71	82	88	78	80	92	86	82
Midlands	83	88	82	68	88	88	76	68	90	78	73
South	145	143	125	105	113	120	117	115	124	121	109
South East	130	123	111	95	109	111	106	99	123	118	109
South West	76	100	75	65	81	88	81	76	94	89	93
West	63	63	60	47	58	64	53	50	61	57	53
All Regions	99	100	89	76	88	92	84	81	95	88	83
Phosphorous (kg/ha)	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Border	8	8	6	4	4	6	4	5	7	7	7
Mid East	10	7	6	4	4	6	5	7	8	9	10
Midlands	10	10	7	5	5	6	5	6	7	8	8
South	11	11	8	6	5	5	4	6	7	8	8
South East	11	11	8	5	4	6	5	6	8	11	10
South West	9	8	6	5	5	5	5	5	7	7	7
West	8	7	7	4	4	5	6	5	7	7	7
All Regions	9	9	7	4	4	6	5	5	7	8	8
K (kg/ha)	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Border	19	18	15	10	10	13	10	12	16	16	16
Mid East	23	19	17	12	10	15	14	18	22	23	23
Midlands	26	26	22	16	14	19	17	16	20	22	20
South	26	26	22	16	13	13	13	15	19	22	21
South East	26	24	20	14	11	17	15	15	20	26	26
South West	21	18	17	13	12	14	16	15	19	21	21
West	22	18	18	10	11	15	14	13	18	18	17
All Regions	23	21	19	13	11	15	14	14	19	20	20

Table 51: Average farm size, NFS farms and farm population by Region – Cereal Area

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Average Area (ha)											
Border	15	20	16	15	17	12	17	12	12	19	17
Mid East	37	42	34	37	34	40	41	40	37	43	38
Midlands	15	17	16	19	20	17	19	18	19	25	24
South	14	18	14	17	20	20	12	14	20	13	14
South East	18	20	24	22	22	29	28	29	31	29	29
South West	9	4	8	44	60	17	17	36	36	24	37
West	2	5	2	1	1	1	2	2	0	0	0
All Regions	18	22	20	22	23	23	25	24	24	27	27
No. Teagasc NFS Farms											
Border	43	34	37	39	37	44	43	38	35	30	29
Mid East	36	34	39	42	40	35	39	33	32	28	31
Midlands	28	28	34	36	30	32	34	35	34	30	29
South	33	30	27	37	24	18	17	18	17	12	-
South East	60	58	67	69	57	52	62	58	49	48	43
South West	-	-	-	-	-	-	-	-	-	-	-
West	-	-	-	-	-	-	-	-	-	-	-
All Regions	212	191	211	230	194	187	201	185	168	150	142
% of Population Rep.											
Border	14%	10%	12%	10%	12%	17%	16%	19%	18%	13%	14%
Mid East	17%	17%	15%	16%	16%	15%	16%	15%	16%	16%	19%
Midlands	14%	15%	17%	16%	14%	16%	14%	16%	16%	12%	14%
South	18%	14%	13%	18%	15%	14%	11%	11%	15%	14%	11%
South East	28%	39%	35%	35%	37%	32%	36%	36%	34%	43%	40%
South West	2%	1%	1%	2%	2%	1%	1%	1%	1%	2%	1%
West	7%	5%	7%	3%	3%	5%	5%	2%	0%	0%	0%

Table 52: N, P, K on Cereal Area by Region

N (kg/ha)	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Border	139	142	146	137	143	146	149	120	125	137	145
Mid East	167	160	172	164	161	164	170	166	163	165	168
Midlands	151	130	129	113	105	114	108	122	117	128	129
South	118	126	106	113	129	163	107	106	142	93	-
South East	128	133	141	123	127	149	149	156	164	171	175
South West	-	-	-	-	-	-	-	-	-	-	-
West	-	-	-	-	-	-	-	-	-	-	-
All Regions	143	143	146	133	137	147	150	148	147	150	158
Phosphorous (kg/ha)	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Border	32	30	23	22	19	19	23	21	19	22	22
Mid East	18	21	17	14	18	22	23	25	27	26	26
Midlands	29	22	18	21	17	21	24	26	27	24	27
South	21	22	18	20	15	21	21	27	39	31	-
South East	27	24	23	20	19	15	22	24	34	30	28
South West	-	-	-	-	-	-	-	-	-	-	-
West	-	-	-	-	-	-	-	-	-	-	-
All Regions	27	26	20	20	19	18	22	23	28	26	25
K (kg/ha)	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Border	55	59	48	52	50	49	63	57	51	64	68
Mid East	63	68	65	56	68	70	77	89	90	89	85
Midlands	69	58	57	54	50	51	60	65	71	62	68
South	44	52	47	41	36	44	47	61	79	64	-
South East	55	50	53	49	44	59	64	78	80	73	86
South West	-	-	-	-	-	-	-	-	-	-	-
West	-	-	-	-	-	-	-	-	-	-	-
All Regions	60	60	57	54	53	60	67	76	77	77	80

Table 53: Fertiliser application rates for grazing on dairy farms at different stocking rates

Year	Org N	No of Farms	Pop.	% Pop.	N	P	K	Area
2005	< 85 kg ON ha^{-1}	17	923	5%	44	4	8	42
2005	85-130 kg ON ha^{-1}	74	4022	20%	90	8	18	34
2005	130-170 kg ON ha^{-1}	165	7087	36%	135	9	20	42
2005	170-210 kg ON ha^{-1}	124	5079	25%	192	11	24	39
2005	> 210 kg ON ha^{-1}	67	2847	14%	260	17	35	30
2006	< 85 kg ON ha^{-1}	16	1029	5%	38	3	8	34
2006	85-130 kg ON ha^{-1}	70	3638	18%	89	7	14	38
2006	130-170 kg ON ha^{-1}	173	7770	39%	136	9	17	43
2006	170-210 kg ON ha^{-1}	99	4932	25%	193	12	24	35
2006	> 210 kg ON ha^{-1}	58	2588	13%	266	16	35	31
2007	< 85 kg ON ha^{-1}	24	1860	9%	36	3	8	33
2007	85-130 kg ON ha^{-1}	69	4088	20%	84	5	11	37
2007	130-170 kg ON ha^{-1}	149	7150	36%	119	6	15	41
2007	170-210 kg ON ha^{-1}	102	4667	23%	175	7	18	41
2007	> 210 kg ON ha^{-1}	46	2191	11%	246	11	26	32
2008	< 85 kg ON ha^{-1}	18	1623	8%	22	1	3	32
2008	85-130 kg ON ha^{-1}	69	4070	20%	68	4	10	39
2008	130-170 kg ON ha^{-1}	156	7839	39%	100	4	9	41
2008	170-210 kg ON ha^{-1}	80	3762	19%	155	5	13	42
2008	> 210 kg ON ha^{-1}	55	2663	13%	201	6	16	34
2009	< 85 kg ON ha^{-1}	15	1583	8%	33	2	4	30
2009	85-130 kg ON ha^{-1}	61	3573	18%	80	2	5	40
2009	130-170 kg ON ha^{-1}	133	7266	36%	120	4	9	43
2009	170-210 kg ON ha^{-1}	92	4655	23%	156	4	10	43
2009	> 210 kg ON ha^{-1}	52	2880	14%	225	6	12	32
2010	< 85 kg ON ha^{-1}	18	1811	9%	39	2	5	30
2010	85-130 kg ON ha^{-1}	66	4306	22%	82	4	10	39
2010	130-170 kg ON ha^{-1}	130	7107	36%	127	5	12	41
2010	170-210 kg ON ha^{-1}	83	4244	21%	163	5	13	38
2010	> 210 kg ON ha^{-1}	49	2489	12%	203	5	9	39
2011	< 85 kg ON ha^{-1}	15	1218	6%	34	2	4	36
2011	85-130 kg ON ha^{-1}	62	4075	21%	71	3	8	41
2011	130-170 kg ON ha^{-1}	142	7334	38%	120	5	14	41
2011	170-210 kg ON ha^{-1}	85	4373	22%	171	5	15	37
2011	> 210 kg ON ha^{-1}	51	2521	13%	216	5	11	38
2012	< 85 kg ON ha^{-1}	15	1149	6%	36	2	5	40
2012	85-130 kg ON ha^{-1}	66	4476	23%	68	4	11	41
2012	130-170 kg ON ha^{-1}	139	6964	36%	119	5	13	42
2012	170-210 kg ON ha^{-1}	98	4862	25%	177	6	14	40
2012	> 210 kg ON ha^{-1}	43	2071	11%	198	6	13	37
2013	< 85 kg ON ha^{-1}	16	1913	10%	30	2	5	30
2013	85-130 kg ON ha^{-1}	59	3210	16%	90	6	13	44
2013	130-170 kg ON ha^{-1}	131	6381	33%	132	7	15	43
2013	170-210 kg ON ha^{-1}	107	5040	26%	183	8	21	39
2013	> 210 kg ON ha^{-1}	59	2978	15%	207	9	24	36
2014	< 85 kg ON ha^{-1}	11	880	5%	20	2	4	52
2014	85-130 kg ON ha^{-1}	58	3358	18%	78	6	15	39
2014	130-170 kg ON ha^{-1}	122	6106	33%	133	8	19	45
2014	170-210 kg ON ha^{-1}	107	5168	28%	176	11	26	42
2014	> 210 kg ON ha^{-1}	55	2857	16%	213	11	28	32
2015	< 85 kg ON ha^{-1}	10	1073	6%	29	2	4	48
2015	85-130 kg ON ha^{-1}	55	3887	21%	73	6	13	39
2015	130-170 kg ON ha^{-1}	115	5443	29%	130	9	21	44
2015	170-210 kg ON ha^{-1}	104	4942	27%	164	10	27	43
2015	> 210 kg ON ha^{-1}	63	3216	17%	188	10	25	33

Table 54: Fertiliser application rates for grazing on cattle farms at different stocking rates

Year	Org N	No of Farms	Pop.	% Pop.	N	P	K	Area
2005	< 85 kg ON ha^{-1}	95	10649	26%	25	4	8	31
2005	85-130 kg ON ha^{-1}	172	19822	48%	46	5	12	28
2005	130-170 kg ON ha^{-}	65	6926	17%	77	8	17	32
2005	170-210 kg ON ha^{-}	23	2661	6%	109	11	24	21
2005	> 210 kg ON ha^{-1}	13	1324	3%	105	11	27	18
2006	< 85 kg ON ha^{-1}	117	12255	30%	28	4	8	32
2006	85-130 kg ON ha^{-1}	173	19406	47%	48	5	11	28
2006	130-170 kg ON ha^{-}	62	6946	17%	68	7	16	26
2006	170-210 kg ON ha^{-}	22	2225	5%	108	10	21	26
2006	> 210 kg ON ha^{-1}	7	548	1%	-	-	-	-
2007	< 85 kg ON ha^{-1}	130	12874	31%	21	3	6	33
2007	85-130 kg ON ha^{-1}	183	19306	47%	50	5	11	28
2007	130-170 kg ON ha^{-}	61	6243	15%	62	5	15	26
2007	170-210 kg ON ha^{-}	21	2084	5%	100	7	19	22
2007	> 210 kg ON ha^{-1}	9	874	2%	-	-	-	-
2008	< 85 kg ON ha^{-1}	133	12413	30%	16	2	3	33
2008	85-130 kg ON ha^{-1}	194	19943	48%	32	2	6	28
2008	130-170 kg ON ha^{-}	71	6945	17%	58	4	9	27
2008	170-210 kg ON ha^{-}	17	1622	4%	70	6	13	20
2008	> 210 kg ON ha^{-1}	6	458	1%	-	-	-	-
2009	< 85 kg ON ha^{-1}	142	13188	32%	23	2	4	33
2009	85-130 kg ON ha^{-1}	187	20065	48%	45	2	6	27
2009	130-170 kg ON ha^{-}	67	6658	16%	67	4	10	28
2009	170-210 kg ON ha^{-}	13	1221	3%	75	3	6	24
2009	> 210 kg ON ha^{-1}	4	249	1%	-	-	-	-
2010	< 85 kg ON ha^{-1}	153	15379	37%	28	3	6	31
2010	85-130 kg ON ha^{-1}	163	17547	42%	52	4	9	28
2010	130-170 kg ON ha^{-}	56	6353	15%	69	5	14	26
2010	170-210 kg ON ha^{-}	18	1564	4%	78	4	8	26
2010	> 210 kg ON ha^{-1}	5	537	1%	-	-	-	-
2011	< 85 kg ON ha^{-1}	164	17200	42%	22	2	4	31
2011	85-130 kg ON ha^{-1}	151	16386	40%	41	2	6	30
2011	130-170 kg ON ha^{-}	52	5964	14%	67	4	9	26
2011	170-210 kg ON ha^{-}	12	1151	3%	84	3	11	23
2011	> 210 kg ON ha^{-1}	7	679	2%	-	-	-	-
2012	< 85 kg ON ha^{-1}	139	14734	36%	20	2	4	32
2012	85-130 kg ON ha^{-1}	157	18369	44%	39	3	8	30
2012	130-170 kg ON ha^{-}	50	6243	15%	64	5	11	25
2012	170-210 kg ON ha^{-}	18	1653	4%	86	4	9	30
2012	> 210 kg ON ha^{-1}	2	383	1%	-	-	-	-
2013	< 85 kg ON ha^{-1}	136	14130	34%	25	3	6	31
2013	85-130 kg ON ha^{-1}	155	18159	44%	48	4	9	28
2013	130-170 kg ON ha^{-}	56	6944	17%	82	6	12	27
2013	170-210 kg ON ha^{-}	17	1589	4%	84	5	11	30
2013	> 210 kg ON ha^{-1}	5	560	1%	-	-	-	-
2014	< 85 kg ON ha^{-1}	139	17174	37%	18	2	4	29
2014	85-130 kg ON ha^{-1}	160	20546	44%	44	5	11	27
2014	130-170 kg ON ha^{-}	52	7773	17%	87	8	19	25
2014	170-210 kg ON ha^{-}	12	1390	3%	84	6	13	26
2014	> 210 kg ON ha^{-1}	2	94	0%	-	-	-	-
2015	< 85 kg ON ha^{-1}	140	17262	37%	19	2	4	29
2015	85-130 kg ON ha^{-1}	148	20759	44%	40	5	11	25
2015	130-170 kg ON ha^{-}	57	7287	16%	77	8	16	27
2015	170-210 kg ON ha^{-}	11	1459	3%	72	4	10	25
2015	> 210 kg ON ha^{-1}	4	210	0%	-	-	-	-

Table 55: Fertiliser application rates for grazing on sheep farms at different stocking rates

Year	Org N	No of Farms	Pop.	% Pop.	N	P	K	Area
2005	< 85 kg ON ha^{-1}	37	3042	27%	28	7	7	33
2005	85-130 kg ON ha^{-1}	62	4771	43%	46	5	11	32
2005	130-170 kg ON ha^{-1}	29	2354	21%	66	3	10	27
2005	170-210 kg ON ha^{-1}	9	595	5%	-	-	-	-
2005	> 210 kg ON ha^{-1}	7	351	3%	-	-	-	-
2006	< 85 kg ON ha^{-1}	42	3106	28%	22	3	6	35
2006	85-130 kg ON ha^{-1}	60	4774	43%	57	5	10	29
2006	130-170 kg ON ha^{-1}	30	2281	21%	67	5	10	29
2006	170-210 kg ON ha^{-1}	10	636	6%	103	7	15	32
2006	> 210 kg ON ha^{-1}	6	317	3%	-	-	-	-
2007	< 85 kg ON ha^{-1}	45	3322	30%	19	3	5	35
2007	85-130 kg ON ha^{-1}	60	4942	45%	51	4	9	29
2007	130-170 kg ON ha^{-1}	31	2324	21%	65	5	10	34
2007	170-210 kg ON ha^{-1}	5	341	3%	-	-	-	-
2007	> 210 kg ON ha^{-1}	3	145	1%	-	-	-	-
2008	< 85 kg ON ha^{-1}	44	4066	37%	17	1	3	33
2008	85-130 kg ON ha^{-1}	53	4407	40%	38	2	6	35
2008	130-170 kg ON ha^{-1}	23	2238	20%	38	2	5	30
2008	170-210 kg ON ha^{-1}	1	139	1%	-	-	-	-
2008	> 210 kg ON ha^{-1}	4	263	2%	-	-	-	-
2009	< 85 kg ON ha^{-1}	46	4392	40%	17	1	3	33
2009	85-130 kg ON ha^{-1}	56	4971	45%	41	2	5	32
2009	130-170 kg ON ha^{-1}	13	1322	12%	64	2	6	28
2009	170-210 kg ON ha^{-1}	3	148	1%	-	-	-	-
2009	> 210 kg ON ha^{-1}	4	280	3%	-	-	-	-
2010	< 85 kg ON ha^{-1}	47	3973	36%	20	2	4	39
2010	85-130 kg ON ha^{-1}	53	4895	44%	47	4	8	28
2010	130-170 kg ON ha^{-1}	21	2083	19%	61	3	7	27
2010	170-210 kg ON ha^{-1}	2	81	1%	45	-	-	-
2010	> 210 kg ON ha^{-1}	2	81	1%	40	-	-	-
2011	< 85 kg ON ha^{-1}	52	4443	40%	14	1	3	39
2011	85-130 kg ON ha^{-1}	49	4719	42%	44	3	5	28
2011	130-170 kg ON ha^{-1}	16	1496	13%	55	3	9	26
2011	170-210 kg ON ha^{-1}	5	399	4%	-	-	-	-
2011	> 210 kg ON ha^{-1}	1	57	1%	-	-	-	-
2012	< 85 kg ON ha^{-1}	49	4024	36%	17	1	3	46
2012	85-130 kg ON ha^{-1}	45	4903	44%	40	5	9	26
2012	130-170 kg ON ha^{-1}	21	1893	17%	50	3	8	31
2012	170-210 kg ON ha^{-1}	3	243	2%	-	-	-	-
2012	> 210 kg ON ha^{-1}	1	50	0%	-	-	-	-
2013	< 85 kg ON ha^{-1}	46	3838	35%	14	1	3	59
2013	85-130 kg ON ha^{-1}	43	4506	41%	47	6	14	27
2013	130-170 kg ON ha^{-1}	23	2302	21%	65	4	8	28
2013	170-210 kg ON ha^{-1}	5	414	4%	-	-	-	-
2013	> 210 kg ON ha^{-1}	1	53	0%	-	-	-	-
2014	< 85 kg ON ha^{-1}	52	5710	42%	14	2	4	42
2014	85-130 kg ON ha^{-1}	38	4654	34%	40	7	15	26
2014	130-170 kg ON ha^{-1}	23	2534	19%	76	5	9	30
2014	170-210 kg ON ha^{-1}	5	552	4%	-	-	-	-
2014	> 210 kg ON ha^{-1}	2	90	1%	-	-	-	-
2015	< 85 kg ON ha^{-1}	58	5722	42%	11	3	4	44
2015	85-130 kg ON ha^{-1}	40	5032	37%	38	6	12	26
2015	130-170 kg ON ha^{-1}	21	2313	17%	65	8	18	30
2015	170-210 kg ON ha^{-1}	5	330	2%	-	-	-	-
2015	> 210 kg ON ha^{-1}	2	144	1%	-	-	-	-

Table 56: Fertiliser application rates for grazing on all farms at different stocking rates

Year	Org N	No of Farms	Pop.	% Pop.	N	P	K	Area
2005	< 85 kg ON ha^{-1}	162	15769	20%	28	5	8	30
2005	85-130 kg ON ha^{-1}	332	30263	39%	54	6	13	29
2005	130-170 kg ON ha^{-1}	277	17566	23%	105	8	18	35
2005	170-210 kg ON ha^{-1}	166	9068	12%	166	11	24	32
2005	> 210 kg ON ha^{-1}	92	4956	6%	213	15	31	24
2006	< 85 kg ON ha^{-1}	195	17721	23%	28	4	8	31
2006	85-130 kg ON ha^{-1}	331	29579	38%	57	6	12	29
2006	130-170 kg ON ha^{-1}	281	17921	23%	106	8	16	34
2006	170-210 kg ON ha^{-1}	138	8615	11%	165	11	24	31
2006	> 210 kg ON ha^{-1}	75	3662	5%	224	15	33	30
2007	< 85 kg ON ha^{-1}	224	19572	25%	23	3	7	32
2007	85-130 kg ON ha^{-1}	342	29869	39%	56	5	11	30
2007	130-170 kg ON ha^{-1}	261	16841	22%	93	6	14	34
2007	170-210 kg ON ha^{-1}	133	7734	10%	156	7	18	33
2007	> 210 kg ON ha^{-1}	62	3395	4%	216	10	24	26
2008	< 85 kg ON ha^{-1}	226	19958	26%	17	1	3	31
2008	85-130 kg ON ha^{-1}	349	30092	39%	41	3	7	31
2008	130-170 kg ON ha^{-1}	269	18384	24%	79	4	9	33
2008	170-210 kg ON ha^{-1}	103	5733	7%	139	5	13	34
2008	> 210 kg ON ha^{-1}	67	3471	4%	185	5	15	31
2009	< 85 kg ON ha^{-1}	236	21401	28%	23	2	4	30
2009	85-130 kg ON ha^{-1}	338	30546	39%	51	2	6	29
2009	130-170 kg ON ha^{-1}	225	16113	21%	98	4	9	34
2009	170-210 kg ON ha^{-1}	113	6238	8%	142	3	9	39
2009	> 210 kg ON ha^{-1}	62	3495	4%	210	6	11	30
2010	< 85 kg ON ha^{-1}	250	23724	30%	27	2	6	30
2010	85-130 kg ON ha^{-1}	317	29283	37%	57	4	9	30
2010	130-170 kg ON ha^{-1}	218	16096	21%	101	5	12	33
2010	170-210 kg ON ha^{-1}	107	6100	8%	143	5	13	35
2010	> 210 kg ON ha^{-1}	60	3286	4%	195	5	9	32
2011	< 85 kg ON ha^{-1}	271	25738	33%	21	2	4	30
2011	85-130 kg ON ha^{-1}	295	27101	35%	48	3	7	31
2011	130-170 kg ON ha^{-1}	220	15332	20%	98	5	12	33
2011	170-210 kg ON ha^{-1}	106	6088	8%	150	5	14	34
2011	> 210 kg ON ha^{-1}	61	3340	4%	191	5	11	34
2012	< 85 kg ON ha^{-1}	235	22364	29%	20	2	4	33
2012	85-130 kg ON ha^{-1}	291	29196	38%	45	4	9	31
2012	130-170 kg ON ha^{-1}	229	16394	21%	93	5	12	33
2012	170-210 kg ON ha^{-1}	121	7018	9%	153	5	13	37
2012	> 210 kg ON ha^{-1}	53	2845	4%	187	6	13	30
2013	< 85 kg ON ha^{-1}	224	22029	28%	22	2	5	34
2013	85-130 kg ON ha^{-1}	289	28017	36%	56	5	11	30
2013	130-170 kg ON ha^{-1}	222	16623	21%	106	6	13	33
2013	170-210 kg ON ha^{-1}	131	7140	9%	158	7	19	36
2013	> 210 kg ON ha^{-1}	73	3982	5%	198	9	24	31
2014	< 85 kg ON ha^{-1}	230	26645	31%	17	2	4	31
2014	85-130 kg ON ha^{-1}	275	30221	35%	49	5	12	28
2014	130-170 kg ON ha^{-1}	211	17890	21%	107	8	18	32
2014	170-210 kg ON ha^{-1}	126	7236	8%	157	10	23	37
2014	> 210 kg ON ha^{-1}	66	3487	4%	200	10	27	30
2015	< 85 kg ON ha^{-1}	232	26627	31%	17	2	4	32
2015	85-130 kg ON ha^{-1}	265	31543	37%	46	5	12	28
2015	130-170 kg ON ha^{-1}	204	16200	19%	100	9	19	33
2015	170-210 kg ON ha^{-1}	125	7134	8%	145	9	24	38
2015	> 210 kg ON ha^{-1}	75	3971	5%	180	10	24	31