A SURVEY OF FERTILIZER USE FROM 2001-2003 FOR GRASSLAND AND ARABLE CROPS

END OF PROJECT REPORT

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EXECUTIVE SUMMARY

1. Farm management data for the years 2001-2003 from the Teagasc National Farm Survey (NFS) were used as the basis for this fertilizer use survey. The farms which took part in the survey were randomly selected to represent the major farm systems and sizes using information from the CSO Census of Agriculture 2000. Farms were classified into 6 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.

2. The data from 1275 farms were analysed using the SAS statistical package. Two and three-way tables were produced relating N, P and K fertilizer use for different crops to geographic region, farm enterprise, farm size, stocking rate and soil suitability class. The mean values obtained for different crops were weighted according to the area of the crop on the farm in question.

3. The survey was carried out following the definitions of terms appropriate to the national farm survey. Some of these, for example livestock units (LU), farm area, stocking rates and N usage are not calculated in the same way as those used in other contexts such as national area-aid schemes, and thus cannot be compared with them. A glossary of terms is included in Appendix 3 in order to avoid misunderstandings of the meanings of such farm parameters.

4. An overall validation procedure for the survey results was performed by comparing annual sales of N, P and K fertilizer for 2003 with the amount calculated from the survey results for N, P and K usage for different crops, taken together with the published national areas under these crops. The agreement between the calculated fertilizer consumption from the survey and the nationally published figures of 388,080 tonnes of N, 43,832 tonnes of P and 111,136 tonnes of K was remarkably good with errors of only -1.3%, 2% and 0.2% for the three elements. The excellent agreement proves that the results of this fertilizer use survey are valid.

5. Results from 40,000 soil samples submitted to Teagasc for soil analysis from mid 2002 to mid 2004 together with the fertilizer advice given by the laboratory allowed the mean Teagasc fertilizer recommendation to be calculated for different crops. The mean advice levels were compared with the survey mean rates for N, P and K on the assumption that the soils in the Survey farms had the same distribution of soil analysis levels and soil Index levels as the 88,900 laboratory samples.

6. *Grazing:* The average usage of fertilizer nutrients applied to grazed grassland was estimated at 104, 8 and 18 kg/ha for N, P and K respectively. The nutrient usage, particularly N, was much greater in the southeast and south of the country than that used in the other regions. The mean N usage for grazing was 5% lower than that estimated for 2000. This is in line with the 5% drop in national sales of N. The 11% decrease in mean P since 2000 was in good agreement with the national drop in P sales; the drop of 14% in K was much greater than the national decrease of 9%. At stocking rates of 2.25 LU/ha and above, the dairy N usage agreed with or was lower than Teagasc advice. With lower stocking rates, dairy N usage was considerably higher than the advised rates, the difference increasing with stocking rate up to 2.25 LU/ha.

At stocking rates of 2.1 LU/ha and below there was excellent agreement between the P usage on the dairy farms and Teagasc advice; above this stocking rate the surveyed usage of P was lower than the rates advised by Teagasc for optimal animal production. The K rates were below Teagasc advice and may give some cause for concern. The N, P and K usage on cattle, mainly sheep and tillage farms was considerably lower than the usage on dairy farms. This was also found in the fertilizer use surveys for 2000 and 1995.

7. *Silage:* The N, P and K application rates were higher for silage on dairy farms than on farms which are mainly cattle, sheep or tillage, although the differences were not as great as the differences for various farm enterprises under grazing. Calculated Teagasc N advice for the mixture of one and two cuts of silage found in a statistical analysis of the Survey farms was 122 kg/ha assuming slurry use and 52 kg/ha assuming no slurry. Actual usage was 120 kg/ha (Table 15) which is in line with Teagasc advice assuming all slurry is applied to the silage crop. The mean N, P and K usage for 2003 declined by 11, 15 and 20% from the means for 2000, these are much greater decreases than those in national fertilizer sales of 4.8, 11 and 9.4% for N, P and K respectively. Comparison between the Teagasc calculated advice and the nutrient usage for the Survey farms shows that the N and P rates were between the slurry and no-slurry advice. This suggests that greater economy in chemical fertilizer for silage would be possible by more farmers taking into account the nutrient value of P and K nutrients in slurry.

8. *Hay:* The mean N application rate for the Survey farms was 53 kg/ha which is consistent with good use of slurry N on the farms. Comparison between the calculated N advice for hay and the mean nutrient applications for the Survey farms suggested that where organic manure was applied to hay, full account of its P and K nutrients were taken into account. Where slurry was not used it is likely that fertilizer rates were low. The usage in N, P and K usage for hay in 2003 is almost the same as the usage in 2000.

9. *Types of fertilizers:* The types of fertilizers used for grassland changed significantly since 2000. There was a 12-14% increase of high N compounds to supply N, P and K for grazing and a 16-18% increase for silage. This trend was already noted for the period between 1995 and 2000. Thus nutrients are increasingly being applied on a "little and often" basis as opposed to the application of P and K once per season. This environmentally friendly trend facilitates the more effective integration of slurry applications into fertilization programmes on grassland farms.

10. *Forage Maize:* Nitrogen rates in the Survey farms were compatible with Teagasc advice. The P and K rates were well below optimum, unless high levels of organic manure were applied as would be usual for this crop.

11. *Winter Barley:* The mean N application rate of 167 kg/ha for Survey farms was slightly higher than the calculated mean Teagasc advice of 156 kg/ha. Calculated Teagasc P and K advice levels matched almost exactly the rates used on the Survey farms. The mean N usage for winter barley showed an decrease of 8% over the estimate for 2000 compared to the 5% drop in national sales of N.

12. *Spring Barley:* The mean N application rate for Survey farms was 123 kg/ha which corresponds with the calculated Teagasc advice of 122 kg/ha. Calculated Teagasc P

and K advice also matched the rates used on the Survey farms very closely. The N and K usage for spring barley in 2003 was higher than that used in 2000.

13. *Malting Barley:* The mean N usage was 10% higher than the calculated Teagasc advice levels for the survey farms. Estimated Teagasc P and K advice for the Survey farms was reasonably close to the application rates for malting barley.

14. *Winter Wheat:* The surveyed N usage of 203 kg/ha exceeded the calculated Teagasc advice of 172 kg/ha, which applies to normal crop yields on medium textured soils. The usage was appropriate for very high yielding crops. The surveyed farm P usage matched very well the calculated mean Teagasc P advice for winter wheat of 25 kg/ha but the K usage was low. The mean N usage for winter wheat decreased by 2% over that estimated for 2000, despite a 5% drop in national sales of N. The mean P and K usage dropped by 17% and 31% which are much greater decreases the national drop in P and K sales of 11 and 9% respectively.

15. *Spring Wheat:* The N usage on the Survey farms of 152 kg/ha is higher than calculated Teagasc advice. Fertilizer use of P and K for spring wheat was consistent with Teagasc advice. The drop in N use since 2000 was in line with national sales but the increase in P and K usage of 33 and 26% is difficult to explain as there was a national drop in P and K sales over the period.

16. *Winter Oats:* The N usage on the Survey farms was much higher than Teagasc advises. The fertilizer use of P on tillage farms was higher than Teagasc advice but K levels appear to be well below optimum, particularly on dairy farms.

17. *Spring Oats:* Fertilizer usage of each nutrient for spring oats appears to be slightly above optimum for N. Mean P and K use was somewhat below advised rates.

18. *Sugar Beet:* The calculated mean Teagasc N recommendation for sugar beet is 139 kg/ha assuming normal summer rainfall and 149 kg/ha with high summer rainfall. Thus the N usage of 159 kg/ha on the Survey farms was higher than Teagasc advises. The calculated Teagasc advice for P and K were 39 and 170 kg/ha. Phosphorus fertilizer use at 43 kg/ha was optimal but K levels appears to be somewhat low at 157 kg/ha The mean N, P and K usage for sugar beet in 2003 were 1%, 14% and 5% respectively below the estimated usage for 2000. Thus, as between 1995-2000, P usage for sugar beet decreased considerably more than the drop in sales of these nutrients would suggest.

19. *Potatoes:* The surveyed N usage was lower, P was higher and K usage was broadly in line with calculated Teagasc N, P and K fertilizer advice for potatoes *viz* 134, 86 and 219 kg/ha. However, standard errors were high so differences were not significant. The usage for potatoes since the 2000 survey showed a decrease of 9, 5 and 4% for N, P and K respectively.

20. Nitrogen usage for grassland increased from 1995 to 1999 but decreased steadily from 1999 to 2003, this is broadly in line with the changes in the national N fertilizer consumption The P and K usage closely mirrored the changes in national consumption of these elements.

21. Nitrogen use for cereals increased over the period 1995-2003 but P remained static and K usage decreased. For root crops, N, P and K usage all decreased markedly over

the period and there was a large increase in farm size. These decreases were much greater than the changes in the national N fertilizer sales.

22. *REPS:* The fertilizer N, P and K application rates for grassland and tillage crops on REPS farms, were considerably below the rates used on non-REPS farms. For grazing, REPS farms used 55% of the N rate and 56% of the P rate of non-REPS farms, for silage the comparison was 78% and 79% for N and P and for hay it was 85% and 91% respectively. These favourable ratios were found for P and K for all cereal and root crops with the exception of potatoes.

TABULAR SUMMARY OF RESULTS

Table 1: Fertilizer Use for Grassland in 2003

Grassland	N (kg/ha)	P (kg/ha)	K (kg/ha)	Mean Farm Area (ha)	No of Farms
Grazing	104	8	18	32.8	1240
Silage	120	13	41	12	1152
Hay	53	11	25	3.6	406
Total Grassland	123	11	27	39.4	1254
Forage Maize	117	27	61	6	56

Table 2: Fertilizer Use for Tillage in 2003

Tillage	N (kg/ha)	P (kg/ha)	K (kg/ha)	Mean Farm Area (ha)	No of Farms
Winter Barley	167	30	71	19	36
Spring Barley	123	26	55	14	184
Malting Barley	112	20	53	16	44
Winter Wheat	203	23	55	40	51
Spring Wheat	152	24	53	17	52
Winter Oats	138	26	48	16	15
Spring Oats	113	25	49	8	35
Cereal Crops Overall	152	25	56	30	247
Sugar Beet	159	43	157	10	68
Fodder Beet	129	48	162	2	36
Potatoes	115	102	225	15	20
Root Crops Overall	139	58	168	9	117

Table 3: Mean Fertilizer Nutrient Use for grassland from 1995-2003

Year	N (kg/ha)	P (kg/ha)	K (kg/ha)	Mean Farm Area (ha)	No of Farms
1995	123	16	39	32.9	1207
1999	145	13	34	36.9	1097
2000	136	13	33	39.1	1112
2001	133	11	30	40.7	1207
2002	126	11	28	39.4	1224
2003	123	11	27	39.5	1251

Table 4: Mean Fertilizer Nutrient Use for Tillage Crops from 1995-2003

Cereals	N	P	K	Mean Farm Area (ha)	No of Farms
	(kg/ha)				
1995	137	26	69	18	262
1999	127	25	56	23	210
2000	160	25	60	28	214
2001	147	24	53	27	240
2002	157	25	56	28	255
2003	152	25	56	30	247
Root Crops	**N**	**P**	**K**	**Area (ha)**	**Farms**
1995	161	76	199	5	211
1999	154	62	190	7	126
2000	146	70	187	8	112
2001	151	74	208	9	120
2002	142	57	169	9	123
2003	139	58	168	9	117

INTRODUCTION

The National Farm Survey (NFS) is carried out each year by the Teagasc NFS Unit in order to determine the financial situation on Irish farms and to measure the current levels of farm performance. It provides a database for agricultural economics and rural development research projects.

The NFS is Ireland's contribution to the Farm Accountancy Data Network of the European Union (FADN) which has as its objective, the determination of income on farm holdings across the EU. A subset of the data from the NFS was made available to Johnstown Castle Research Centre in order to conduct a Fertilizer Use Survey (FUS).

This survey uses NFS data on the amount and types of chemical fertilizer used by the farmers for different crops together with data on areas under grassland and agricultural crops, livestock numbers, land use class and animal numbers. The aim is to determine the amounts of N, P and K nutrients and types of fertilizer used on grassland and arable crops and to measure the relationships between fertilizer use and such factors as geographic region, farm size, stocking rate and soil use class.

Comparisons are also made between fertilizer use and Teagasc fertilizer advice for the different crops and the report points to possible explanations for the findings. In order to allow comparison with fertilizer use data for the years since 1995, the FUS for the years 1995, 1999, 2000, 2001, 2002 and 2003 year were repeated using exactly the same table categories and statistical methods and many comparison tables are presented in this report.

The report uses metric measurements throughout, and in the tables, usages of P and K are presented in elemental form. To facilitate comparisons with different surveys and reports in this and other countries, a range of conversion factors for metric, imperial and popular units and for conversion between elemental P and K and their oxide forms is listed in Appendix 5.

SURVEY METHODS

National Farm Surveys have as their basis, a random selection of farms to represent the major farm systems and sizes. These are selected using information from the CSO Census of Agriculture 2000 (Connolly et al, 2004). Farms are classified into major farming system according to the standardised EU typology used by FADN. This is then further simplified so that 8 EU farm types are reduced to the following 6 main farm types namely: dairying, dairying with other enterprises, cattle rearing, cattle with other, mainly sheep and mainly tillage systems. These systems refer to the dominant enterprise in each group. However, in order to simplify the large number of tables in this document, the farm types were further reduced to four namely dairying, cattle, sheep and tillage.

The estimated farm distribution used in the NFS 2003 is shown in Table 5 in this simplified classification.

Table 5: Percentage distribution of Irish farms according to farm system and size

	Farm Size (ha)						
System	< 10	10-20	20-30	30-50	50-100	> 100	Total
Dairying	1.3	3.5	5	8.7	7.3	1.2	27
Cattle	7.8	16.1	10.8	9.9	4.7	0.9	50.2
Sheep	2.5	4	3	3.6	2.4	0.9	16.4
Tillage Systems	0.7	1	0.9	1.4	1.4	0.8	6.2
All Systems	12.3	24.6	19.7	23.6	15.8	3.8	100

Thus 27% of farms are classified as mainly in dairying while over 50% are mainly involved in cattle enterprises. Almost 40% of Irish farms have an area of 20 ha or less.

Survey Method

The raw data used in this fertilizer survey consisted of a database record of farm management information and fertilizer use for each of 1275 farms. There were 170 items of information which consisted of a numeric farm reference, fertilizer usage data and codes for the farm system, soil suitability class and for the county in which the farm is situated. The utilized agricultural area (UAA), the area of forage, the area of total feed and the number of livestock units on the farm are also given. Definitions for these terms are given in Appendix 3.

The fertilizer usage information supplied by the NFS Unit for this survey consisted of a large number of farm records, each containing the area under each of 16 tillage crops, together with the area under hay, silage and grazing and total grassland. For each crop, the types and quantities of up to 6 fertilizer applications (up to 11 applications for grazing) is also given. The fertilizer type is coded into one of 91 different compounds of known composition. These compounds cover all the fertilizer types likely to be used by Irish farmers including several types imported from Northern Ireland, Great Britain and other European countries.

The data were tabulated using the data management/statistical package from the SAS Institute into two- and three-way tables. These related N, P and K fertilizer use to geographic regions and farm management factors such as farm enterprise, farm size, stocking rate, soil use class etc. The procedures used were based on those used by Murphy *et al* (1997) and Coulter *et al* (2002) in the fertilizer use survey for 1995 and 2000. The mean values quoted for different crops are weighted according to the area of the crop on the farm in question.

In addition to mean fertilizer application rates, standard errors (S.E.) are also obtained. These give a measure of the variability of the mean in question. Statistically speaking, one can be 95% confident that the true value of the mean lies within the band of two standard errors on either side of the mean. Furthermore, if the difference between two means is greater than 2.8 times their S.E. then this is significant at the 5% level. Thus in Table 7, the difference between the N use in the south and south-west is highly significant because the difference between the mean N rates is 89 kg/ha, this is more than 13 times the S.E. of 6.6.

Results of this fertilizer use survey must be interpreted according to the definitions of terms appropriate to the FUS. Thus it cannot be assumed that stocking density, for example, is calculated in the same way as it would be calculated within the context of REPS or other national area-aid schemes. In order to avoid misunderstandings of this nature, the NFS glossary of terms from the Farm Management Survey 2003 is reprinted in Appendix 3.

Land Use Classes

The categorisation of farms into different 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. In this report they are amalgamated into four by combining the bottom three classes into a single range called limited. The extent of land use class is regional distributed within the country. The extent of each class varies throughout the country, overall, 35% of land is in class 1 or 2 (wide and moderately wide); in Leinster, 54% of soils are in classes 1 or 2, in Munster the percentage is 39%, in Ulster it is 12% and in Connacht 17%.

Validation Procedure

The survey results were validated by comparing the nationally published annual sales of N, P and K with the amount calculated from the survey results for N, P and K usage for different crops together with the published national areas under these crops using the appropriate weightings from the NFS to calculate weighted means.

The National Farm Survey (Connolly et al, 2003) gave information on sample numbers and representation for the NFS (Table 6). The upper part of the Table shows the number of farms of different sizes and farming systems in the survey; the lower part shows the survey representation, i.e. the number of farms in the national population represented by one NFS participating farm. Note that Table 6 gives details of 1210 Survey farms but the fertilizer use survey was applied to 1275 farms. The difference is due to the inclusion of a number of farms to the NFS sample after Table 6 was compiled and to the exclusion of a number of small farms from the NFS 2003 report. The discrepancy does not affect the calculation of N, P and K usage, as means are weighted by area of the crop.

Table 6: Farm sample numbers and representation for survey 2003

	Number of Farms in the Survey[1] with Different Total Area						
Farm Size (ha)	2 – 10	10 - 20	20 - 30	30 - 50	50 -100	> 100	Total
Dairy	3	17	48	140	131	14	353
Dairy & Other	0	5	6	43	74	26	154
Cattle Rearing	15	58	65	63	36	5	242
Cattle Finishing	10	44	43	62	48	5	212
Mainly Sheep	1	19	26	40	34	17	137
Tillage	0	5	9	23	34	41	112
Total Sample	29	148	197	371	357	108	1210
	Survey Representation[2] of the National Population of Farms						
Farm Size (ha)	2 - 10	10 - 20	20 - 30	30 - 50	50 -100	> 100	Overall
Dairy	259	151	83	47	32	35	52
Dairy & Other	0	311	303	82	59	37	79
Cattle Rearing	303	183	111	100	70	60	130
Cattle Finishing	455	182	124	82	61	141	126
Mainly Sheep	2945	248	136	104	84	60	140
Tillage	0	241	113	70	49	24	58
Total Sample	442	194	116	73	52	41	95

[1] The 1210 farms in the NFS sample represent a farming population of 114,457
[2] Number of farms in the national population represented each farm participating in the survey

In this fertilizer use survey, the grassland and tillage areas represented by each farm in each category were calculated from Table 6, together with information about the national areas under grassland and each tillage crop. These national CSO estimated areas were obtained from "Irish Agriculture in Figures 2000" (Fingleton, 2002). For each crop, a table was prepared giving the total area of all farms of each given size and farm system. These areas were multiplied by the fertilizer use per hectare of crop, obtained in the survey, to give an estimate of total consumption for each crop, farm size and farm system. Summing all these values weighted by crop area gave a survey estimate of total annual consumption.

The results were 382,983; 44,725 and 111,313 tonnes/year for N P and K respectively. The agreement between the calculated consumption from the survey and the nationally published fertilizer sales figures of 388,080; 43,832 and 111,136 tonnes for 2003 was very good with deviations of only -1.3%, 2.0% and 0.2% for the three elements. Some minor errors could have been expected because (i) rough grazing is not included, (ii) the national statistics do not distinguish between malting barley and spring feeding barley and (iii) certain minor crops are omitted. Also, national fertilizer statistics are compiled on the basis of an October 1st to September 30th year but the NFS was compiled on a Jan 1st to December 31st year. Possible errors from this time difference would be expected to be low because farmers are advised not to apply fertilizers during this winter period. The excellent agreement between fertilizer use and official national statistics of fertilizer consumption proves that the results of this fertilizer use survey are valid.

Comparison with Teagasc Advice

A statistical analysis of the Johnstown Castle soil analysis results for agricultural samples submitted in the two years from mid 2002 to mid 2004 was undertaken to find out the percentage of soil samples which were at Index 1, Index 2, Index 3 and Index 4 for N, P and K. The N Index depends on the crop to be grown, the previous cropping and the fertilization history of the soil. The P and K Indices depend on the available levels of these nutrients determined by soil analysis. There were 88,900 samples in all, and from other work it has been deduced that these samples were received from about 5% of the farms in the country. Thus, they are reasonably representative of the soils of the country.

Teagasc gives fertilizer advice depending on the crop, the nutrient Index of the soil and other factors relevant to the crop. For example, N advice for grazed grassland depends on the stocking rate. The P and K advice depends on the Index and whether the livestock are cows or cattle (Coulter, 2004). For silage, advice depends on the nutrient indices, the number of cuts and the amount of organic nutrients to be recycled. Advice for hay is similar to that for silage. Advice for tillage crops depends mainly on the soil index but for some crops, the fertilizer advice is modified according to the expected yield, the soil texture or the expected summer rainfall amount.

Taking the appropriate factors into account, the mean fertilizer recommendations were calculated from the survey table of percentages of soils in each Index point for N, P and K. It was assumed that the Survey farms had the same distribution of soil analysis levels as the laboratory samples. This is a reasonable assumption and furthermore, they represent the only available estimates of national fertility. In the following sections of this report, the calculated Teagasc mean advice levels are compared with the N, P and K use for each crop as determined by the fertilizer use survey.

FERTILIZER USE ON GRASSLAND

Grazing

In the farm management survey the application of nutrients to grassland is recorded according to the use made of the sward at the different periods throughout the year. Thus when a sward is to be used for silage, the nutrients applied are recorded under the silage crop, and when the same sward is used later in the year for grazing, the nutrient use is recorded under the grazing heading. Thus, in the field records, the area used for grazing only is recorded as the grazing area, and the areas under hay or silage are recorded as hay or silage areas even when they are grazed for part of the year. There is thus an underestimation of the grazing area and there would be therefore an over estimation of the rates of N, P & K per ha used for the grazing land if the area of aftermath grazing was not taken into account. However the estimates of the total amounts of N, P & K used on the total area of grassland are unbiased.

An attempt has been made in this survey to estimate more accurately the use of nutrients on grazing land. The procedure used was as follows: The amounts of N, P & K for silage and hay are recorded correctly. The use of nutrients for grazing the silage and hay aftermaths are

assumed to be at the same rates as those used for the grazing only areas but in proportion to the yields. The aftermath yield of spring grown silage is assumed to be approximately 50 percent of the total annual yield. Spring growths plus aftermaths of hay and midsummer silage are assumed to total 25 percent and aftermath of two-cut silage is assumed to be 10 percent of total annual yield.

In calculating the N, P & K per grazed ha, the amount recorded by the NFS for grazing was divided by the grazing area plus 50% of spring grown silage plus hay areas plus 25% of the 2nd cut silage area and 10 % of any area cut three times.

The average amount of fertilizer nutrients applied to grazed grassland was estimated from the fertilizer used on 1248 survey farms which contained grassland. The mean overall values were 104, 8 and 18 kg/ha for N, P and K respectively. Table 7 shows the distribution of nutrient use classified by national region. It is clear that the amount of nutrients, particularly N, used in the southeast and south of the country was very much greater than that used in the other regions. The Dublin and west regions were very low. However, Dublin represented less than 1% of the survey area and can be disregarded; this lack of representation and variability is also shown by the very high standard error of estimates for Dublin.

Table 7: Regional distribution of N, P and K application rates for grazing (kg/ha)

Region	N	s.e	P	s.e	K	s.e	Area	Farms
South-East	120	5.8	9	0.5	21	1.4	36	189
Dublin	66	26.1	3	1	6	2.1	38.9	10
Mid-East	92	7.5	6	0.7	13	1.3	47.5	119
Midlands	92	7.4	8	0.7	19	1.5	36.3	122
Border	84	5.4	7	0.5	14	0.9	28.8	218
South-West	78	6.2	8	0.6	17	1.3	30.6	141
South	167	6.8	11	0.6	25	1.4	32.4	251
West	55	4	7	0.4	15	1	24.6	190
Overall	104	2.6	8	0.2	18	0.5	32.8	1240

The geographic distribution of N and P application rates is shown in Figure 1. The higher usage of N in the south and south-east would reflect the type of farming and stocking rates in these regions but may be influenced by the longer grass-growth season in the south and east; this is illustrated in Figure 2 (*from* Coulter, 2004 p. 24).

Figure 1: N and P for grazing

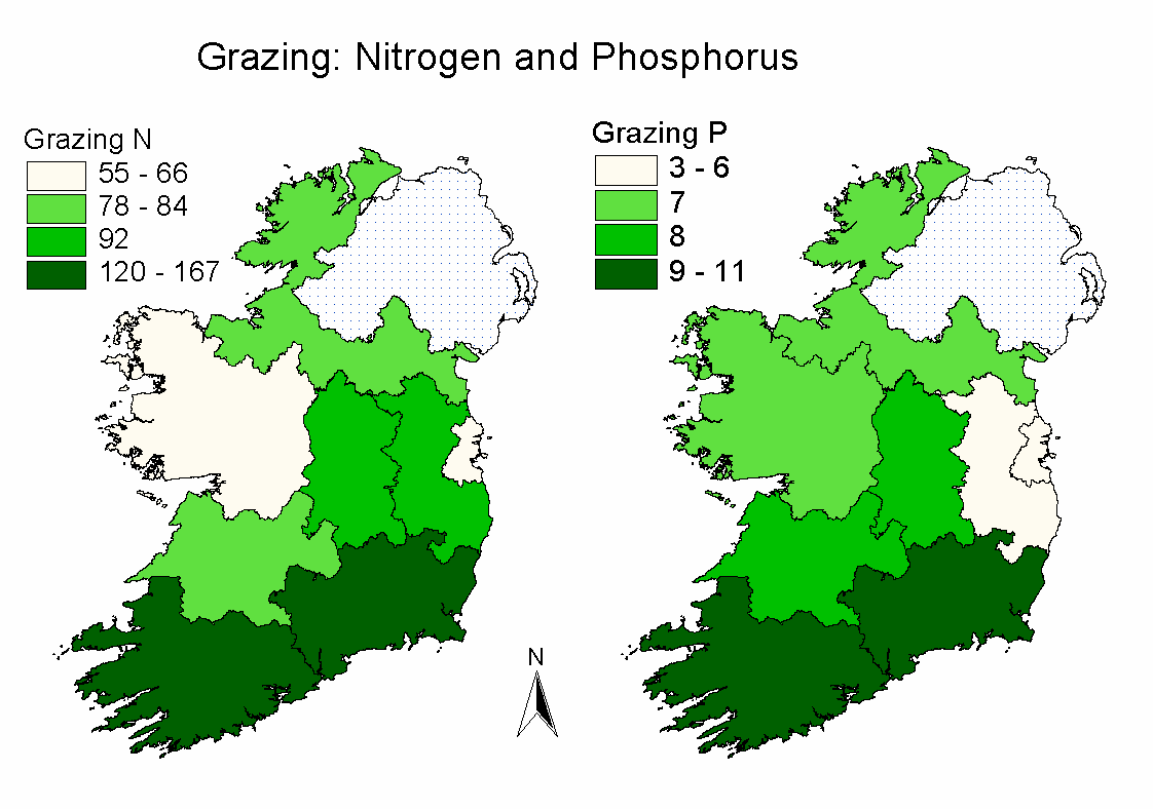
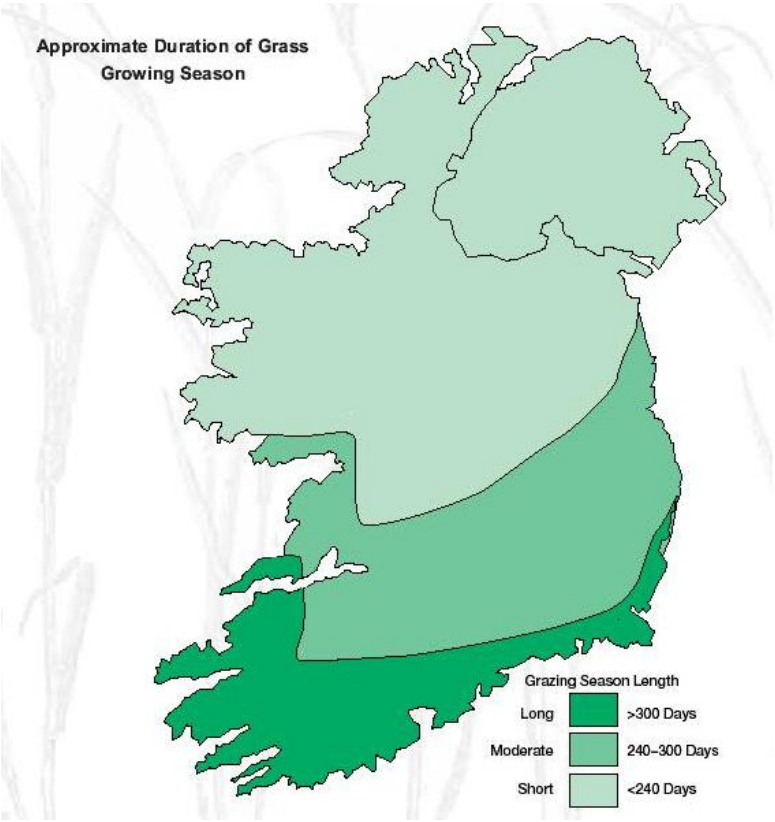


Figure 2: Length of typical grass growing season



The estimated amount of N, P and K applied to grazing land in the different farm systems is given in table 8.

Table 8: Estimated N, P and K fertilizer applied to grazed grassland (kg/ha)

Farm System	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
Dairy	159	4	10	0.4	23	0.8	39.0	522
Cattle	44	1.9	6	0.3	13	0.6	25.6	484
Sheep	51	4.1	5	0.5	11	1.2	32.5	142
Tillage	84	6.8	6	0.8	16	2.1	35.5	89
All	104	2.6	8	0.2	18	0.5	32.8	1237

Not surprisingly, the N, P and K application rates are much higher for grazing land on dairy farms than on farms which are mainly cattle sheep or tillage enterprises. The nutrient rates also depend on the size of the farm; Table 9 shows that on dairy farms, the rates appear to be larger farms of 30 ha or greater but there appears to be no significant difference between the rates for 30-50 ha farms and for farms larger than this. The errors of estimation are high on the smaller farms indicating marked variability between fertilizer practices.

Table 9: Relationship between farm size and nutrient application rates for dairy grassland

Farm Size ha	N	s.e.	P	s.e.	K	s.e.	Mean Area	No of Farms
10 - 20	135	18.9	9	1.2	21	2.8	11.6	22
20 - 30	143	14.5	9	1.1	20	2.5	18.7	56
30 - 50	161	7.6	10	0.6	23	1.4	29.1	187
50 -100	161	6	11	0.6	24	1.2	47.3	209
> 100	155	12.3	11	1.4	24	2.9	82.2	45

The effect of soil quality on nutrient applications to grazed grass is shown in Table 10. The highest rates of N and K were applied to the best soils.

Table 10: Effect of soil use class on nutrients for grazing

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	Mean Area	No of Farms
1	Wide	137	5.3	9	0.4	20	1	36.8	384
2	Moderately Wide	98	5.7	7	0.5	16	1	34.9	227
3	Somewhat Limited	79	4.8	7	0.4	16	1	31.7	219
4	Limited	85	3.9	8	0.4	18	0.9	28.5	410
	All	104	2.6	8	0.2	18	0.5	32.8	1240

The fertilizer application rates for different stocking rates are given in tables 11-13 for farms in which the main enterprise is dairying, cattle and sheep respectively. The highest nutrient levels are found in dairy systems with much lower levels for cattle and lower again for sheep farms.

Table 11: Dairy fertilizer application rates for grazing (kg/ha)

Stocking Rate	N	s.e	P	s.e	K	s.e	Area	Farms
< 1.2	77	12.6	6	1.3	16	2.8	33.5	37
1.2 - 1.5	100	7.9	10	1	23	2.5	38.4	58
1.5 - 1.9	134	5.3	9	0.6	21	1.2	42.9	153
2.0 - 2.25	177	6.8	11	0.7	26	1.6	40	140
2.25 - 2.6	216	10.4	13	1	26	2.2	36	88
2.6 - 2.9	258	20.9	12	1.4	29	4.4	34.6	31
> 2.9	229	31.8	15	4.1	26	5.4	31.1	15

Table 12: Fertilization rates for grazing cattle (kg/ha)

Stocking Rate	N	s.e	P	s.e	K	s.e	Area	Farms
< 1.2	29	2.5	5	0.5	11	1	25.5	219
1.2 - 1.5	59	3.5	8	0.6	17	1.4	24.7	119
1.5 - 1.9	69	5.2	9	1	21	2	28.4	88
2.0 - 2.25	112	12.1	10	1.6	26	4.1	22.3	36
2.25 - 2.6	171	32.6	19	3	44	9.1	19	11

Table 13: Fertilization rates for grazing sheep (kg/ha)

Stocking Rate	N	s.e	P	s.e	K	s.e	Area	Farms
< 1.2	29	6.7	4	1.1	9	2.1	31	47
1.2 - 1.5	47	10	7	1.5	15	3.3	37.2	20
1.5 - 1.9	66	10.6	7	1	14	1.9	35.4	31
2.0 - 2.25	75	11	8	1.2	16	2.6	29.3	21
2.25 - 2.6	67	9.2	4	1.5	11	4.5	29.6	14

The N rates for cattle (Table 12) are well below Teagasc rates thus reflecting the much lower margins for cattle enterprises and consequently the lower economic optimum N rate.

The application rates for sheep (Table 13) are very low and difficult to interpret, as the quantity of clover in the sward of the FUS survey farms is unknown.

The Teagasc N usage and corresponding N advice for grazed grassland are compared in Table 14. At stocking rates above 2 LU/ha, the actual dairy N usage do not differ significantly from Teagasc advice, but below this stocking rate, actual N usage is significantly higher than the advised rates, the percentage difference decreasing with stocking rate.

Table 14: Teagasc N usage and Teagasc advice for grazed grassland (kg/ha)

Stocking Rate	N Usage	N Advice
< 1.2	77	45
1.2 - 1.5	100	60
1.8	134	100
2.1	177	160
2.4	216	225
2.7	258	300
3.0	229	390

Comparison between the P and K usage and the corresponding Teagasc advice for grazing cannot be done precisely because of the unavailability of soil analysis data for the Survey farms. However examination of the Johnstown Castle soil analysis results for the year 2000 shows that of 20,000 soil samples received from grazing land, the percentage with soil P levels in Index 1, Index 2, Index 3 and Index 4 were 20%, 36%, 24% and 20% respectively. For potassium, the corresponding percentages for soil K in grazed grassland were 8%, 33%, 30% and 29%.

Teagasc fertilizer advice for grazed grassland depends on the stocking rate and on the livestock system (Coulter, 2004). Thus, if one assumes that the Survey farms had the same distribution of soil analysis levels as the laboratory samples and takes into account the distribution of dairy and cattle farms in the survey, one can calculate the likely P and K advice for the Survey farms. This is discussed in the section on Survey Methods. Table 15 gives the results of the calculation for a range of stocking rates. At stocking rates of 2.1 LU/ha and below there is excellent agreement between the P usage on farms with mainly dairying and Teagasc advice; above this stocking rate the surveyed usage of P is lower than the rates advised by Teagasc for optimal animal production . In general, the K rates are below Teagasc advice.

Table 15: P and K usage and Teagasc P & K advice for grazing on mainly dairy farms by stocking rate

Stocking Rate (LU/ha)	P Usage (kg/ha)	P Advice (kg/ha)	K Usage (kg/ha)	K Advice (kg/ha)
< 1.2	6	6	16	23
1.2 - 1.5	10	9	23	25
1.8	9	10	21	27
2.1	11	12	26	29
2.4	13	15	26	31
2.8	12	14	29	33
3.0	15	21	26	35

The usage of different fertilizer compounds for grazing over all farms is summarised in Table 16. It shows the percentage of the N, P and K applications supplied by the different compounds, the area receiving the compound expressed as a percentage and the number of farms involved. CAN, high N compounds (e.g. 23:2.5:5) and urea supplied over 91% of the N with 18:6:12 supplying the bulk of the remainder. High N compounds, 18:6:12 0:10:20 and 10:10:20 supplied 90% of the P with 0:7:30 supplying much of the remainder. The K distribution mirrored the P distribution almost exactly. There was a 12-14% increase in the use of high N compounds to supply N, P and K for grazing; thus nutrient are increasingly being applied on a “little and often” basis.

Table 16: Main sources of N, P and K for grazing (%)

Compound	N	P	K	Area %	No of Farms
	Percentage for Each Source				
CAN	37.3	-	-	27.3	311
UREA	16	-	-	8.2	87
SUPER 16% P	-	1.9	-	0.4	6
POTASH 50% K	-	-	1.4	0.4	3
0:7:30	-	3.5	6.6	1.3	18
0:10:20	-	5.3	4.8	1.2	13
7:6:17	-	0.1	0.2	0.4	4
10:10:20	1.1	13.6	12.1	6.9	88
14:7:14	0.1	0.4	0.4	0.5	4
18:6:12	5.4	23.3	20.8	16.5	221
High N Compounds	38	48.1	48.5	32.1	357
22:2.5:10	1.2	1.8	3.2	1.4	15
18:2.5:14	0.1	0.1	0.3	0.3	4
20:3:6	0.1	0.3	0.3	0.5	4
Unclassified	0.4	-	-	2.2	22

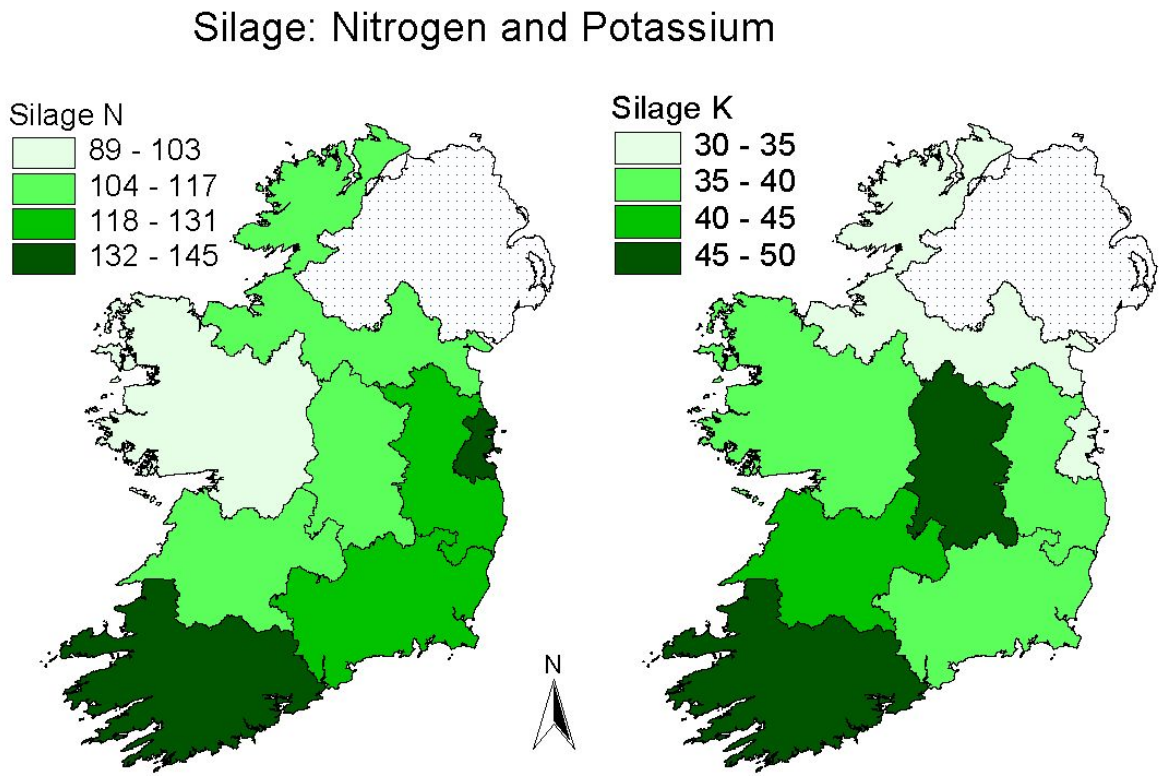
Silage

The nutrients used for silage are given in Table 17 broken down by region. In general, the highest rates of N are found south-east, mid-east and south but the other nutrients are different, with the highest P and K found in the midlands and south. The differences in fertilizer rates are illustrated in Figure 3.

Table 17: N, P and K for silage (kg/ha)

Region	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
South-East	125	3.4	12	0.8	36	2.6	14.1	174
Dublin	138	20	9	3	35	12.7	12.2	10
Mid-East	125	5.7	12	0.9	38	3	17	110
Midlands	114	4.8	15	0.9	49	2.8	13.1	115
Border	107	4	12	0.6	34	1.5	10.2	203
South-West	104	3.9	18	1.5	44	2.6	10.8	129
South	145	4.3	13	0.6	46	2.3	13.2	236
West	89	3.4	13	0.7	37	2.1	7.6	175
All	120	1.7	13	0.3	41	0.9	12	1152

Figure 3: Nutrient usage for silage in different regions



The effect of soil quality on nutrient applications to silage is shown in Table 18. As with grazing, the highest rates of N were applied to the best soils.

Table 18: Effect of soil use class on nutrients for silage

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
1	Wide	132	3	13	0.5	43	1.7	14.3	359
2	Moderately Wide	119	3.4	13	0.8	38	2.2	12.3	215
3	Somewhat Limited	112	4.9	14	0.8	38	1.9	10.4	206
4	Limited	110	2.7	14	0.6	40	1.5	10.6	372

The estimated amount of N, P and K applied to silage land in the different farm systems is given in table 19.

Table 19: Estimated N, P and K fertilizer applied to silage ground (kg/ha)

Farm System	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
Dairy	138	2.5	14	0.5	44	1.5	16.5	516
Cattle	86	2	13	0.5	35	1.3	8.0	441
Sheep	93	3.7	12	0.8	32	2.1	7.7	111
Tillage	109	5.9	13	1.4	36	3.3	11.1	81
All	120	1.7	13	0.3	41	0.9	12.0	1152

Again, the N, P and K application rates are higher for silage on dairy farms than on farms which are mainly cattle sheep or tillage. However these differences are not as great as those for different farm enterprises under grazing (see Table 8). The nutrient rates also depend on the size of the farm; Table 20 shows that the N and K rates for silage tend to be larger on farms of 30 ha or greater and, as with grazing, there appears to be no significant difference between the rates for 30-50 ha farms and for farms larger than this. The standard error for N, P and K rates on the 2-10 and 10-20 ha farms are high, suggesting that the fertilizer use varies widely between the farms.

Table 20: Relationship between farm size and nutrient application rates for silage on mainly dairy farms

Farm Size	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
2 - 10	133	29.7	18	8.3	37	16.6	2.2	2
10 - 20	123	14.5	15	2.6	47	7	5.8	21
20 - 30	110	6.2	14	1.5	47	4.6	8.7	55
30 - 50	135	5.2	14	0.8	46	2.9	12.6	184
50 -100	137	3.6	14	0.8	42	2.1	20.1	209
> 100	152	7.5	15	1.5	47	4.7	31.7	45

The Teagasc N advice for one cut silage is 125 kg/ha including N in the slurry which is assumed to be recycled onto silage land. For multiple cuts, 125 kg/ha is advised for the first cut and a further 100 kg/ha for the second, again without taking account of N in the slurry.

The survey data does not have information on the amount of slurry spread so it is difficult to determine if the average of 120 kg/ha N (Table 19) is in line with Teagasc advice. However, the data showed that 73% of the silage area had one cut of silage and 17% had two silage cuts. Thus it can be assumed that 17% of farms would follow the advice for two cuts. Assuming most of the silage was more than 4 years since reseeding, Teagasc N advice for a composite of 73% of one cut and 17% of two cuts of silage would be 122 kg/ha assuming slurry and 152 kg/ha assuming no slurry. Actual usage was 120 kg/ha (Table 19) which is in line with Teagasc advice assuming all slurry is applied to the silage crop.

Teagasc P and K advice for silage assumes that the slurry or manure produced from the silage ground is returned to the soil (Coulter, 2004). The total nutrients required are also tabulated; a summary of the advice is shown in Table 21 for soils cropped with 1 or 2 cuts of silage.

Table 21: Teagasc P and K fertilizer advice for silage land

	P or K Index	P Advice (kg/ha)		K Advice (kg/ha)	
		Slurry	No Slurry	Slurry	No Slurry
1 cut	1	20	40	33	175
	2	10	30	8	150
	3	0	20	0	120
	4	0	0	0	0
2 cuts	1	20	50	103	245
	2	10	40	58	200
	3	0	30	13	155
	4	0	0	0	0

The percentage of soil samples in a statistical survey of soil analysis samples for silage were 16%, 36%, 25% and 22% in the four Index categories for P and 15%, 47%, 23% and 15% for K respectively. Using information from Table 21, the percentage of Survey farms with 1 cut and 2 cuts of silage and the percentages in the different categories, Teagasc P and K advice can be estimated (Table 22). Comparison between the calculated advice in the Table and the mean nutrient applications for the Survey farms shows that the N and P usage on the Survey farms was between the slurry and no-slurry advice suggesting that economy in chemical fertilizer is possible if more farmers take into account the nutrient value of P and K nutrients in slurry.

Table 22: P and K fertilizer advice for silage (kg/ha)

	P (kg/ha)		K (kg/ha)	
	Slurry	No Slurry	Slurry	No Slurry
Teagasc Advice	9	25	19	136
Nutrient Application (as per table 19)	13		41	

The usage of different fertilizer compounds for silage over all farms is summarised in Table 23. It shows the percentage of the N, P and K applications supplied by the different compounds, the area receiving the compound expressed as a percentage and the number of farms involved. The pattern is similar to that for grazing land; CAN, high N compounds (e.g. 23:2.5:5) and urea supplied over 91% of the N with 18:6:12 supplying the bulk of the remainder. High N compounds, 18:6:12 and 0:7:30 supplied 90% of the P with 0:10:20 and 10:10:20 accounting for the remainder. The K distribution agrees quite well with the P distribution. Straight K accounts for only 0.8% of the K use for silage. There was a 16-18% increase in the use of high N compounds to supply N, P and K for silage since the 2000 survey. This trend was already noted for the period between 1995 and 2000. Thus nutrient are increasingly being applied on a “little and often” basis as opposed to the application of P

and K once per season. This environmentally friendly trend facilitates the more effective integration of slurry applications into fertilization programmes on grassland farms.

Table 23: **Main sources of N, P and K for silage on all farms**

Compound	N	P	K	Area %	No of Farms
	Percentage for Each Source				
CAN	21.3	-	-	18.3	370
UREA	11.8	-	-	5.9	114
Potash 50% K	-	-	0.8	0.4	6
0:7:30	-	15	20.8	4.3	110
0:10:20	-	3.6	2.3	1.2	25
10:10:20	0.5	4.2	2.7	2.2	39
14:7:14	0.1	0.4	0.2	0.1	4
18:6:12	6.5	19.9	12.9	10.3	232
High N Compounds	58.4	55.1	58.2	53.9	819
22:2.5:10	0.5	0.5	0.6	0.6	20
18:2.5:14	0.3	0.3	0.6	0.4	7
Unclassified	0.3	-	-	2.1	30

Hay

The N, P and K fertilizer rates for hay are summarised in Table 24 classified by region. The N rates do not vary as much for hay as they do for grazing and silage. The highest rates are found in the south and mid-east and the lowest in the midlands. Apart from Dublin which represents a small unrepresentative sample, the highest usage of P and K are found in the west and mid-east.

Table 24: N, P and K for hay (kg/ha)

Region	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
South-East	56	4	9	1.2	20	2.6	4.4	73
Dublin	18	11.9	12	7.8	25	15.6	2.4	6
Mid-East	60	6	14	1.4	33	3.3	5	52
Midlands	42	5.4	9	1	23	2.6	4.5	53
Border	75	15.1	11	2.6	24	5.1	2.5	56
South-West	34	3.9	11	1.3	26	3.3	3.2	53
South	61	6.6	8	1.2	22	2.9	2.6	56
West	46	3.3	12	1.3	31	2.8	3.1	57
All	53	2.5	11	0.5	25	1.2	3.6	406

The effect of soil quality on nutrient applications to hay is shown in Table 25. The highest rates of N were applied to soil classes 1 and 2 although errors were too high to make valid comparisons.

Table 25: Effect of soil use class on nutrients for hay

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
1	Wide	59	5.5	11	1.1	25	2.3	3.8	143
2	Moderately Wide	54	4.3	11	1	29	2.5	4.6	86
3	Somewhat Limited	48	5.1	9	1.2	21	2.5	3.4	69
4	Limited	43	3.3	10	1	25	2.2	2.7	108

The estimated amount of N, P and K applied to hay in the different farming systems is given in table 26. The N and K application rates for hay are higher on dairy and tillage farms than on the other farm systems and the N for hay on cattle farms is significantly lower than the others. As already noted, N rates are rather low. P rates do not vary significantly with the type of farm.

Table 26: Estimated N, P and K fertilizer applied to hay (kg/ha)

Farm System	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
Dairy	61	4	11	0.9	26	2	3	153
Cattle	39	2.2	9	0.7	23	1.6	3.3	156
Sheep	52	4	12	1.5	24	3	3.4	46
Tillage	63	11.1	12	2.1	30	4.5	6.5	50
All	53	2.5	11	0.5	25	1.2	3.6	406

N advice by Teagasc for each cut of hay is 65-80 kg/ha if no organic manure is applied and 35-50 if organic manure is recycled. The mean application rate for the Survey farms was 53 kg/ha which is consistent with good use of slurry N on the farms.

The usage of different fertilizer compounds for hay over all farms is summarised in Table 27. High N compounds, 18:6:12, CAN, 10:10:20 and urea supplied over 94% of the N. High N compounds, 18:6:12 and 0:7:30 supplied 93% of the P with 0:10:20 and 10:10:20 supplying the remainder. The K distribution matches the P distribution quite well. Straight K was used on only one farm so it was not tabulated.

Table 27: Main sources of N, P and K for hay on all farms

Compound	N	P	K	Area %	No of Farms
	Percentage for Each Source				
CAN	23.3	-	-	13.2	63
UREA	4.1	-	-	0.8	7
0:7:30	-	6.5	11.5	4.6	9
0:10:20	-	0.3	0.3	0.2	2
10:10:20	4.3	21.5	17.8	9.5	29
15:3:20	0.7	0.7	1.8	1	2
15:10:10	0.9	3	1.2	1.2	2
18:6:12	28.9	48.1	39.8	32.9	111
High N Compounds	33.9	17.4	22.2	29.7	124
22:2.5:10	2	1.2	1.9	1.6	6
18:2.5:14	0.5	0.3	0.8	0.6	2
Unclassified	0.9	-	-	3.2	7

Grassland Overall

The overall N, P and K fertilizer rates for grass are summarised in Table 28 classified by region. The highest N rate is found in the south-east and the lowest in the west. The highest usage of P and K are found in the south-west and south.

Table 28: Regional overall N, P and K rates for grassland (kg/ha)

Region	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
South-East	138	5.3	11	0.6	29	1.5	43.9	191
Dublin	92	25.4	5	1.6	15	5.1	40.3	12
Mid-East	116	7.7	9	0.8	22	1.8	57.6	119
Midlands	111	7	11	0.7	30	1.9	44.1	123
Border	102	5.3	9	0.5	22	1	34.2	221
South-West	96	6	12	0.8	28	1.5	36.4	142
South	183	6	13	0.6	35	1.5	39.9	253
West	71	4.1	9	0.5	23	1.2	28.8	190
All	123	2.5	11	0.2	27	0.6	39.5	1251

The effect of soil quality on overall nutrient applications to grassland is shown in Table 29. The highest rates of N, P and K were applied to soil class 1 and soil class 2 has the next highest N rate. Standard errors for each nutrient are quite small showing that there is a consistent pattern of use across the farms. The P and K levels for three lower three soil classes do not differ significantly.

Table 29: Effect of soil use class on overall nutrients for grassland (kg/ha)

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
1	Wide	154	4.8	12	0.4	30	1.1	44.8	389
2	Moderately Wide	118	5.5	10	0.6	25	1.3	42.3	228
3	Somewhat Limited	98	4.9	10	0.5	24	1.2	37.5	221
4	Limited	105	3.7	11	0.4	27	1	34.1	413

The overall amount of N, P and K applied to grassland in the different farming systems is given in table 30. As with grazing and silage, the highest rates of N, P and K are used on dairy farms followed by tillage, cattle and sheep farms in that order.

Table 30: Overall N, P and K fertilizer applied to different grassland systems (kg/ha)

Farm System	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
Dairy	175	3.6	13	0.4	34	0.9	49.1	522
Cattle	61	2	9	0.3	21	0.8	30	486
Sheep	63	4.2	7	0.5	16	1.2	36.1	143
Tillage	100	6.4	9	0.9	24	2.3	40	97
Overall	123	2.5	11	0.2	27	0.6	39.5	1248

Forage Maize

The nutrients used for forage maize are given in Table 31 broken down by region.

Table 31: N, P and K for maize (kg/ha)

Region	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
South-East	127	10.5	20	4.2	38	8.3	6	20
Mid-East	104	14.2	29	8.4	60	16.5	6	13
Midlands	115	23.4	28	6.3	49	13.4	8	7
Border	170	30.3	18	17.1	44	34.2	7	4
South	92	16.4	40	5.3	128	34	6	10
South-West	120	6.2	29	9.3	68	68	8	2
Overall	117	7.1	27	3	61	9	6	56

The effect of soil quality on nutrient applications to maize is shown in Table 32.

Table 32: Effect of soil use class on nutrients for maize (kg/ha)

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
1	Wide	120	9.1	25	3.3	62	13.2	6	34
2	Moderately Wide	110	17.8	25	8.7	49	17.2	7	12
3	Somewhat Limited	145	12.3	25	7.5	76	20.9	5	6
4	Limited	101	25.3	39	11.8	71	26.2	10	4
	Overall	117	7.1	27	3	61	9	6	56

The amount of N, P and K applied to maize in the different farming systems is given in table 33. The highest levels of N, P and K are applied to maize in farms classified as 'Other Stock' although standard errors are high indicating large variability among farms.

Table 33: N, P and K fertilizer applied to maize (kg/ha)

Farm System	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
Dairy	110	7.1	27	3.4	63	10.6	6	46
Other Stock	173	14.9	52	3.3	112	10.6	4	3
Tillage	144	27	23	7.3	40	12.8	7	7
All	117	7.1	27	3	61	9	6	56

Teagasc advice for forage maize grown on Index 2-3 soils is 100-110 kg/ha for N, 40-50 kg/ha for P and 190-225 kg/ha for K, assuming slurry is not applied. Mean Teagasc N advice based on the national distribution of N index levels and assuming no slurry use was

120 kg/ha. Nitrogen rates in the Survey farms were broadly compatible with this advice. The survey P and K rates were very much lower than the calculated Teagasc advice of 35 kg/ha and 162 kg/ha respectively (Table 27). Normally, high levels of organic manure are applied to this crop; if this is not the case, the P and K rates were well below optimum.

The usage of different fertilizer compounds for maize over all farms is summarised in Table 34. 18:6:12, high N compounds, CAN and urea supplied almost 92% of the N. 18:6:12, 10:10:20, 0:7:30 and high N compounds supplied most of the P. The K distribution mirrored the P distribution although 5% of the K was made up with 50% potash.

Table 34: Main sources of N, P and K for forage maize on all farms

Compound	N	P	K	Area %	No of Farms
	Percentage for Each Source				
CAN	37	-	-	24.1	22
UREA	7.5	-	-	4.8	5
SUPER16%P	-	9.2	-	2.6	5
Potash 50% K	-	-	4.9	3.4	3
0:7:30	-	11.4	21.5	2.7	4
10:10:20	4.2	18.5	16.2	8.8	7
18:6:12	31.8	46.2	40.5	32.1	21
High N Compounds	15.1	6.8	10.1	12	12
Unclassified	0.4	-	-	2	3

FERTILIZER USE FOR TILLAGE CROPS

The nutrient usage for the most commonly grown tillage crops are given in this section. Because most tillage is grown in the south, east, south-east and midlands, the coverage of some of the crops is incomplete in the provincial tables.

Winter Barley

This crop was grown on only 34 farms out of the 1275 farms in the survey. The nutrients used for winter barley are given in Table 35 broken down by region. No barley was grown on survey farms in the south-west, south or west and information for the midlands and Dublin regions have been omitted from the regional table as it was found on only one or two farms in each. Standard errors were high making comparisons difficult.

Table 35: N, P and K for winter barley (kg/ha)

Region	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
South-East	167	17	17	9.3	52	18.5	11	5
Mid-East	161	19	17	4.4	57	12.7	13	12
Border	179	8.9	38	3.6	84	10.5	27	15
All	167	8.8	30	3	71	7.2	19	32

Winter barley was grown on only three of the soil classes (Table 36) and the effect of soil quality on N, P or K applications was not significant.

Table 36: Effect of soil use class on nutrients for winter barley (kg/ha)

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
1	Wide	161	15.8	28	3.3	57	6.7	18	17
2	Moderately Wide	174	11	31	5.4	86	12.8	20	16
3	Somewhat Limited	163	15.4	30	10.7	66	24.3	14	3

Not surprisingly, the amount of N and K applied to spring barley was much greater on mainly tillage farms than it was on dairy farms (Table 37). The crop was not found on cattle or sheep farms in the survey.

Table 37: N, P and K fertilizer applied to winter barley (kg/ha)

Farm System	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
Dairy	175	6.1	23	8.6	45	16.7	18	4
Tillage	166	9.9	31	3.2	75	7.7	19	32
All	167	8.8	30	3	71	7.2	19	36

Teagasc N advice for winter barley is 160 kg/ha for Index 1, 135 kg/ha for Index 2 and 100 kg/ha for Index 3 soils. Most of the crop was grown on mainly tillage farms (Table 30) showing that it is a specialist crop. The mean N application rate of 167 kg/ha for Survey farms was slightly higher than the calculated mean Teagasc advice of 156 kg/ha. The mean N usage for winter barley showed a decrease of 8% over the estimate for 2000 compared to the 5% drop in national sales of N over the same period.

Teagasc P and K advice was calculated by assuming the same distribution of Index 1-4 soils for P and K in Survey farms as found in a national soil analysis survey, as described before. The mean advice levels were 22 kg/ha and 65 kg/ha for P and K respectively. These are somewhat lower than the rates used on the Survey farms.

Spring Barley

The nutrients used for spring barley are given in Table 38 broken down by region. There was a much wider occurrence of this crop than winter barley although the number of occurrences in the survey for the western counties was small. The N rates for south-east, mid-east and Dublin were the highest, and P rates were high in the south-west and border region.

Table 38: N, P and K for spring barley (kg/ha)

Region	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
South-East	126	4.3	24	1.7	41	2.6	15	56
Dublin	124	3.8	19	6.5	59	12.4	24	6
Mid-East	126	5.9	23	2.4	52	4.8	15	29
Midlands	113	9.1	26	3.4	77	7.1	14	20
Border	131	5.9	33	3.9	65	5.6	17	35
South	115	6.9	24	1.5	54	4.2	8	27
South-West	70	12.5	34	2.9	67	5.9	9	6
West	67	11.1	22	8.8	56	16.6	4	5
All	123	2.5	26	1.2	55	2.1	14	184

The effect of soil quality on nutrient applications to spring barley is shown in Table 39.

Table 39: Effect of soil use class on nutrients for spring barley (kg/ha)

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
1	Wide	127	3.7	28	1.8	56	2.8	15	96
2	Moderately Wide	120	4.1	22	1.7	50	4.2	15	55
3	Somewhat Limited	122	7.9	32	2.5	64	5.3	11	21
4	Limited	101	6.1	19	3.5	53	8	9	12
	All	123	2.5	26	1.2	55	2.1	14	184

The amount of N, P and K applied to spring barley in the different farming systems is given in table 40.

Table 40: N, P and K fertilizer applied to spring barley (kg/ha)

Farm System	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
Dairy	113	4.1	23	1.3	49	2.9	11	77
Other Stock	90	4.6	25	2.5	54	4.6	6	27
Tillage	131	3.5	28	2	57	3.4	20	80
All	123	2.5	26	1.2	55	2.1	14	184

Teagasc N advice for spring barley is 100 kg/ha for Index 2 and 75 kg/ha for Index 3 soils. The mean N application rate for Survey farms was 123 kg/ha which corresponds with calculated Teagasc advice of 122 kg/ha. Teagasc P and K advice was calculated by assuming the same distribution of Index 1-4 soils for P and K in Survey farms as found in a national soil analysis survey. The mean results were 25 kg/ha and 57 kg/ha for P and K respectively. This matches very closely with rates used on the Survey farms.

Malting Barley

The nutrients used for malting barley are given in Table 41 broken down by region.

Table 41: N, P and K for malting barley (kg/ha)

Region	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
South-East	116	4.2	21	2.5	50	6.8	19	20
Mid-East	98	10.1	17	8.6	50	16.9	13	5
Midlands	105	9.4	18	2.6	70	6.5	15	11
All	112	3.4	20	1.6	53	4.3	16	36

The effect of soil quality on nutrient applications to malting barley is shown in Table 42.

Table 42: Effect of soil use class on nutrients for malting barley (kg/ha)

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
1	Wide	107	4	20	1.9	50	4.3	15	32
2	Moderately Wide	123	6.3	19	3.8	58	12.2	19	10
3	Limited	125	5.8	23	2	93	7.8	7	2
	All	112	3.4	20	1.6	53	4.3	16	44

The amount of N, P and K applied to malting barley in the different farming systems is given in table 43.

Table 43: N, P and K fertilizer applied to malting barley (kg/ha)

Farm System	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
Dairy	99	6.1	18	3.7	43	7.8	12	15
Other Stock	111	4.6	27	3.4	64	10.6	11	5
Tillage	117	4.4	20	1.9	56	5.8	19	24
All	112	3.4	20	1.6	53	4.3	16	44

Teagasc N advice for malting barley on N Index 1 and 2 mineral soils is 110 and 90 kg/ha respectively. Fertilizer N use was 10% higher in the Survey farms than the calculated advice of 101. Estimated Teagasc P and K advice for the Survey farms is 24 and 55 kg/ha which is reasonably close to the application rates for malting barley in Table 43.

Winter Wheat

The nutrients used for winter wheat are given in Table 44 broken down by region.

Table 44: N, P and K for winter wheat (kg/ha)

Region	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
South-East	231	11.9	19	6.3	43	13.5	36	10
Mid-East	198	8.3	23	3.2	60	9.2	38	19
Border	206	7.5	33	2.3	76	7	42	16
South	170	16.9	26	8.9	68	5.1	13	3
All	203	5.6	23	2.2	55	5.7	40	48

The effect of soil quality on nutrient applications to winter wheat is shown in Table 45.

Table 45: Effect of soil use class on nutrients for winter wheat (kg/ha)

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
1	Wide	209	9.9	27	3.1	53	6.2	41	23
2	Moderately Wide	196	7.3	19	3.9	53	10.9	46	20
3	Somewhat Limited	205	11.5	20	3.9	81	16.6	24	7

The amount of N, P and K applied to winter wheat in the different farming systems is given in table 46.

Table 46: N, P and K nutrients applied to winter wheat (kg/ha)

Farm System	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
Dairy	184	9.8	22	5.1	49	9.9	16	12
Tillage	206	6.4	23	2.6	56	6.7	48	38
All	203	5.6	23	2.2	55	5.7	40	51

Teagasc N advice for winter wheat depends on both the soil N index and the expected yield. Taking the soil analysis survey data for the range of N Index values as applicable, the calculated Teagasc N advice for normal grain yields (9 t/ha of dry matter) would be 174 kg/ha and the advice for very high yields (11 t/ha or greater) would be 209 kg/ha. Crop yields are not available in the survey; however N usage appears to exceed Teagasc advice assuming a normal mixture of low and high yielding crops.

The calculated mean Teagasc P and K advice for winter wheat on the Survey farms was 25 and 69 kg/ha respectively. The surveyed farm P usage matched very well the calculated mean Teagasc P advice for winter wheat of 25 kg/ha but the K usage was lower than advised.

The mean N usage for winter wheat decreased by 2% over that estimated for 2000, despite a 5% drop in national sales of N. The mean P and K usage dropped by 17% and 31% which are much greater decreases than the national drop in P and K sales of 11 and 9% respectively.

Spring Wheat

The nutrients used for spring wheat are given in Table 47 broken down by region. The standard errors are high making comparisons between the different regions difficult to achieve.

Table 47: N, P and K for spring wheat (kg/ha)

Region	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
South-East	157	6.3	21	3.5	45	7.2	19	24
Dublin	158	8.1	7	7.6	14	15.3	21	3
Mid-East	159	14.9	22	3.6	39	6.6	10	13
Midlands	159	25.8	13	6.3	26	12.6	11	4
Border	119	13	53	6.2	130	17.7	26	5
South	152	7.4	12	7.2	23	14.4	9	3
All	152	5.1	24	2.7	53	6.5	17	52

There was a drop of 5% in N use since 2000 in line with the decrease in national sales but an increase in P and K usage of 25 and 21% is difficult to explain as there was a national drop in P and K sales over the period.

The effect of soil quality on nutrient applications to spring wheat is shown in Table 48.

Table 48: Effect of soil use class on nutrients for spring wheat (kg/ha)

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
1	Wide	156	6.6	20	3.5	38	6.8	21	23
2	Moderately Wide	149	9.4	31	4.8	75	12	16	22
3	Somewhat Limited	156	9.3	12	6.9	24	13.8	5	4
4	Limited	112	9.4	24	4.2	49	8.4	7	3

The amount of N, P and K applied to spring wheat in the different farming systems is given in table 49.

Table 49: N, P and K fertilizer applied to spring wheat (kg/ha)

Farm System	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
Dairy	135	8.3	12	3.3	26	6.7	6	14
Tillage	153	6.2	26	3.3	56	8	21	36

The calculated mean Teagasc N recommendations for spring wheat was 109 kg/ha. If one assumed that each farm achieved high yields of grain (9.5 t/ha or greater), the calculated rate would be 145 kg/ha. Thus the N usage on the Survey farms of 152 was higher than Teagasc advises. The calculated advice rates for P and K were 25 and 55 kg/ha. Fertilizer usage of P and K for spring wheat (Table 47) was in close agreement with this advice.

Winter Oats

The nutrients used for winter oats are given in Table 50 broken down by region.

Table 50: N, P and K for winter oats (kg/ha)

Region	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
South-East	141	8.9	22	5.6	23	12.4	26	4
Mid-East	118	18.1	28	5.9	76	15.9	12	5
Border	147	8	34	8.1	68	16.2	13	5
All	138	6.8	26	3.8	48	10	16	15

The effect of soil quality on nutrient applications to winter oats is shown in Table 51.

Table 51: Effect of soil use class on nutrients for winter oats (kg/ha)

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
1	Wide	142	10.6	27	4	37	10.7	18	8
2	Moderately Wide	128	18.4	13	10.8	42	20.5	11	3
3	Somewhat Limited	131	7.3	30	9.5	80	24.8	14	4

The amount of N, P and K applied to winter oats for dairying and tillage is given in table 52. The crop was not found in the other farming systems

Table 52: N, P and K fertilizer applied to winter oats (kg/ha)

Farm System	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
Dairy	106	35.9	15	11.5	30	23	7	3
Tillage	141	5.6	27	4	50	11.3	18	12
All	138	6.8	26	3.8	48	10	16	15

The calculated mean Teagasc N recommendations for winter oats was 105 kg/ha. For shallow/sandy soil, the calculated advice would be 136 kg/ha. Thus the N usage on the Survey farms is much higher than Teagasc advises. The advice for P and K were 27 and 67 kg/ha respectively. Fertilizer use of P was compliant with Teagasc advice on tillage farms but K was somewhat low. For dairy farms, levels appear to be below optimum, presumably because of use of slurry.

Spring Oats

The nutrients used for spring oats are given in Table 53 broken down by region.

Table 53: N, P and K for spring oats (kg/ha)

Region	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
South-East	93	12.7	23	5.3	45	8.4	6	10
Mid-East	122	14.5	19	3.5	38	7.1	9	6
Border	116	11.4	26	2.5	53	4.9	11	15
All	113	7.1	25	1.9	49	3.6	8	31

The effect of soil quality on nutrient applications to spring oats is shown in Table 54.

Table 54: Effect of soil use class on nutrients for spring oats (kg/ha)

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
1	Wide	131	13.6	27	4.4	57	8	9	12
2	Moderately Wide	100	8.8	24	2.3	44	4	11	14
3	Somewhat Limited	118	22.1	26	2.4	53	4.9	5	5
4	Limited	76	13.2	19	6.8	37	13.7	2	4

The amount of N, P and K applied to spring oats in the different farming systems is given in table 55.

Table 55: N, P and K fertilizer applied for spring oats (kg/ha)

Farm System	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
Dairy	94	8.6	16	2.5	36	4.9	6	19
Tillage	127	10.3	30	2.1	58	4.3	12	14
All	113	7.1	25	1.9	49	3.6	8	33

The calculated mean Teagasc N, P and K recommendations for spring oats were 98, 29 and 62 kg/ha respectively. Fertilizer usage of each nutrient for spring oats (Table 53) appears to be slightly above optimum for N. Mean P and K use was somewhat below advised rates.

Cereals Overall

The nutrients used overall for cereals are given in Table 56 broken down by region.

Table 56: N, P and K for cereals (kg/ha)

Region	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
South-East	148	4.5	22	1.6	43	3	29	77
Dublin	163	9.8	8	5.1	24	12.8	64	7
Mid-East	163	6	22	1.9	55	4.9	35	46
Midlands	108	9	21	2.2	65	5	19	30
Border	164	6.3	35	2.1	76	5.1	46	44
South	125	5.6	22	1.5	48	3.8	12	31
South-West	70	12.5	34	2.9	67	5.9	9	6
West	64	10.4	23	7.7	57	14.3	4	6
All	152	2.8	25	0.9	56	2.1	30	247

The effect of soil quality on nutrient applications to cereals is shown in Table 57.

Table 57: Effect of soil use class on nutrients for cereals (kg/ha)

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
1	Wide	151	4.1	26	1.3	52	2.2	30	130
2	Moderately Wide	154	4.6	23	1.9	58	5	38	73
3	Somewhat Limited	153	8.5	27	2.2	69	6.3	20	27
4	Limited	113	9.8	21	2.6	56	6.4	9	17

The amount of N, P and K applied to cereals in the different farming systems is given in table 58.

Table 58: N, P and K fertilizer applied for cereals (kg/ha)

Farm System	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
Dairy	123	4.1	21	1.2	46	2.5	15	99
Other Stock	95	4.6	26	2.1	57	4.1	7	34
Tillage	161	3.7	26	1.4	58	3.3	50	114
All	152	2.8	25	0.9	56	2.1	30	247

Fertilizer Compounds for Cereals

The fertilizer compounds used for supply of N, P and K to cereals are listed in Tables 59-61 and the number of times the fertilizers were used on the tillage farms is given in Table 62.

Table 59: Main sources of N for cereals (%)

	Cereal Crop						
Compound	**W. Wheat**	**S. Wheat**	**W. Barley**	**S. Barley**	**M. Barley**	**W. Oats**	**S. Oats**
CAN	72.4	68.6	62.0	52.4	52.2	76.0	48.5
UREA	7.8	0.9	5.8	0.4	3.0	1.0	2.8
8:5:18	-	2.6	-	-	-	-	-
10:3:18	0.7	-	-	-	-	-	-
10:10:20	5.3	6.8	9.8	7.2	4.0	6.3	9.2
14:7:14	0.1	0.4	-	1.6	6.5	-	-
15:3:20	-	-	-	1.8	6.5	-	-
15:10:10	0.9	1.0	-	0.6	2.4	2.1	2.2
16:5:20	0.1	-	1.9	2.1	4.0	-	-
16:7:13.3:NI	-	7.1	0.5	-	-	-	-
18:6:12	5.0	10.6	7.2	26.3	18.3	0.6	34.0
18:8:6	-	-	-	1.5	-	11.6	-
High N Compounds	6.1	1.2	12.1	5.4	2.2	1.7	1.2
Total	98.4	99.2	99.3	99.3	99.1	99.3	97.9

Table 60: Main sources of P for cereals (%)

	Cereal Crop						
Compound	**W. Wheat**	**S. Wheat**	**W. Barley**	**S. Barley**	**M. Barley**	**W. Oats**	**S. Oats**
0:7:30	10.6	-	6.7	-	-	7.9	-
0:10:20	14.5	0.2	14.2	4.1	0.8	22.0	-
8:5:18	0.3	10.2	-	-	-	-	0.1
10:3:18	1.9	-	-	-	-	-	-
10:10:20	47.0	42.1	55.2	35.9	22.5	33.4	41.7
14:7:14	0.3	1.1	-	3.9	18.2	-	-
15:3:20	-	-	-	1.8	7.2	-	-
15:10:10	5.5	4.2	-	2.0	9.0	7.4	6.7
16:7:13.3:NI	-	19.3	1.3	-	-	-	-
16:5:20	0.2	-	2.6	2.8	7.1	-	-
18:6:12	14.8	21.9	13.5	44.0	34.2	1.1	51.4
18:8:6	-	-	-	3.4	-	27.3	-
High N Compounds	5.1	0.7	6.5	2.2	1.1	0.8	-
Total	100.2	99.7	100.0	100.1	100.1	99.9	99.9

Table 61: Main sources of K for cereals (%)

	Cereal Crop						
Compound	**W. Wheat**	**S. Wheat**	**W. Barley**	**S. Barley**	**M. Barley**	**W. Oats**	**S. Oats**
Potash 50% K	2.1	2.6	3.1	0.8	10.3	4.5	-
0:7:30	18.9	-	11.9	-	-	18.4	-
0:10:20	12.0	0.2	11.8	3.7	0.6	23.8	-
8:5:18	0.4	17.0	-	-	-	-	0.1
10:3:18	4.8	-	-	-	-	-	-
10:10:20	39.0	38.9	46.0	32.2	16.9	36.2	41.9
14:7:14	0.3	1.0	-	3.5	13.6	-	-
15:3:20	-	-	-	5.3	18.1	-	-
15:10:10	2.3	1.9	-	0.9	3.4	4.0	3.4
16:7:13.3:NI	-	17.0	1.0	-	-	-	-
16:5:20	0.4	-	5.5	4.8	10.6	-	-
18:6:12	12.3	20.2	11.3	39.4	25.7	1.2	51.7
18:8:6	-	-	-	1.1	-	11.1	-
High N Compounds	7.7	0.7	9.3	5.1	0.8	0.9	2.1
All	100.2	99.5	99.9	96.8	100.0	100.1	99.2

Table 62: Number of times each fertilizer compound was used for cereals on the survey farms (%)

	Cereal Crop						
Compound	**W. Wheat**	**S. Wheat**	**W. Barley**	**S. Barley**	**M. Barley**	**W. Oats**	**S. Oats**
CAN	53	49	31	149	41	15	22
UREA	5	2	4	3	1	1	1
POTASH 50% K	2	1	2	2	1	1	-
0:7:30	4	-	3	-	-	1	-
0:10:20	7	1	4	4	1	2	-
8:5:18	1	1	-	-	-	-	1
10:3:18	1	-	-	-	-	-	-
10:10:20	16	12	12	50	8	5	10
14:7:14	1	1	-	11	7	-	-
15:3:20	-	-	-	7	5	-	-
15:10:10	3	3	-	5	1	1	1
16:7:13.3:NI	-	1	1	-	-	-	-
16:5:20	1	-	1	4	4	-	-
18:6:12	9	22	8	110	18	1	19
18:8:06	-	-	-	1	-	1	-
High N Compounds	3	3	1	18	2	1	1
All	106	96	67	364	89	29	55

Sugar Beet

The nutrients used for sugar beet are shown in Table 63 classified by region. As in 2000, N rates appear to be highest in the midlands but differences were not significant between any of the regions apart from mid-east where usage was low. Phosphorus rates were highest in the midlands and south-east and lowest in the south and mid-east. Potassium rates were much lower in the mid-east and south than elsewhere.

Table 63: N, P and K for sugar beet (kg/ha)

Region	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
South-East	160	7.5	47	2.9	168	9.3	11	35
Mid-East	107	13.8	21	9.9	76	34.6	10	8
Midlands	183	16.8	51	6.4	221	27.6	6	12
South	180	9.7	35	2.9	126	10.4	9	12
All	159	5.8	43	2.5	157	9.3	10	67

The effect of soil quality on nutrient applications to sugar beet is shown in Table 64. The results are very scattered.

Table 64: Effect of soil use class on nutrients for sugar beet (kg/ha)

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
1	Wide	167	7.5	44	3	162	11.5	9	41
2	Moderately Wide	147	9.6	40	4.6	147	16.3	11	24
4	Limited	180	13.2	51	15.4	244	23.9	7	2

The amount of N, P and K applied to sugar beet in the different farming systems is given in table 65.

Table 65: N, P and K fertilizer applied to sugar beet (kg/ha)

Farm System	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
Dairy	182	11.1	45	3.6	160	10.1	7	21
Other Stock	150	11.5	46	13.7	166	49.4	5	4
Tillage	152	7	42	3.3	156	12.8	11	43
All	159	5.8	43	2.5	157	9.3	10	68

The calculated mean Teagasc N recommendation for sugar beet is 131 kg/ha assuming normal summer rainfall (200 mm from April to June). For sugar beet grown with high summer rainfall (260 mm), the calculated advice would be 140. Thus the N usage on the Survey farms of 159 kg/ha is higher than Teagasc advises. The calculated Teagasc recommendations for P and K were 39 and 180 kg/ha. Phosphorus fertilizer use was optimal at 43 but K levels appears to be somewhat low at 157 kg/ha (Table 65).

Fodder Beet

The nutrients used for fodder beet are given in Table 66 broken down by region.

Table 66: N, P and K for fodder beet (kg/ha)

Region	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
South-East	132	12.7	45	8	150	19.7	2	15
Mid-East	103	32.1	44	21.5	161	35.9	3	4
Midlands	143	20.2	67	5.2	242	28.6	2	7
South	114	19.4	41	9.7	106	26.2	1	8
All	129	8.3	48	4.8	162	13.3	2	34

The effect of soil quality on nutrient applications to fodder beet is shown in Table 67.

Table 67: Effect of soil use class on nutrients for fodder beet (kg/ha)

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
1	Wide	133	8.8	44	6.6	143	17.1	2	19
2	Moderately Wide	108	16.3	47	9.3	166	19.4	2	11
3	Somewhat Limited	155	42.5	65	17.3	185	36.4	2	3
4	Limited	175	37.4	63	11	257	84.1	2	3

The amount of N, P and K applied to fodder beet in the different farming systems is given in table 68.

Table 68: N, P and K fertilizer applied to fodder beet (kg/ha)

Farm System	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
Dairy	117	13.4	51	7.1	164	17	2	17
Other Stock	130	20.9	46	22.1	139	50.9	2	6
Tillage	143	11.8	45	4.7	167	21.9	2	13
All	129	8.3	48	4.8	162	13.3	2	36

Mean Teagasc recommendations for N, P and K were 136, 41 and 185 kg/ha respectively. The N and K rate are low and the P rates are high but as there were a small number of farms in the survey the standard errors are high and valid comparisons on usage cannot be made.

Potatoes

The nutrients used for potatoes are shown in Table 69 classified by region. The overall rates for N, P and K usage have fluctuated widely since 1995 and standard errors are high (Tables 1-11, 2-22, and tables 60 and 107 in Coulter *et al*, 2002,) so it is difficult to interpret the changes in usage that have occurred.

Table 69: N, P and K for potatoes (kg/ha)

Region	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
South-East	107	26.7	93	24.2	258	61.2	5	4
Dublin	163	5.1	161	8.6	332	0.2	19	2
Border	109	11.7	87	11.3	196	25.2	22	9
Mid-East	107	7.6	124	0	247	0.1	23	2
South	46	24.1	39	20.6	111	58.4	1	2
All	115	7.9	102	8.7	225	18.1	15	19

The effect of soil quality on nutrient applications to potatoes is shown in Table 70.

Table 70: Effect of soil use class on nutrients for potatoes (kg/ha)

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
1	Wide	146	8.8	125	8.2	291	22.2	11	7
2	Moderately Wide	97	7.5	85	9.7	186	18.7	18	11
3	Somewhat Limited	160	26.5	160	27.4	321	50.4	15	2
4	All	115	7.9	102	8.7	225	18.1	15	20

The amount of N, P and K applied to potatoes in the different farming systems is given in table 71.

Table 71: N, P and K fertilizer applied to potatoes (kg/ha)

Farm System	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
Dairy	143	39.3	127	38.2	332	83.5	2	4
Tillage	114	8.8	101	9.8	222	19.7	20	15
All	115	7.9	102	8.7	225	18.1	15	19

Mean Teagasc N, P and K fertilizer advice for potatoes was 132, 84 and 220 kg/ha. The surveyed N usage was lower, P was higher and K usage was broadly in line with these figures (Table 71). However, standard errors were high so differences were not significant. The N, P and K usage for potatoes decreased by 9, 5 and 4% respectively since the 2000 survey.

Root Crops Overall

The nutrients used for root crops are given in Table 72 broken down by region.

Table 72: N, P and K for root crops (kg/ha)

Region	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
South-East	155	6.9	49	3.1	168	8.8	10	43
Mid-East	104	8.9	50	12.4	124	25.9	10	16
Midlands	160	15.9	50	5.6	201	22.3	5	19
Border	105	10.9	79	11.2	185	22.3	21	11
South	166	9.8	35	2.5	119	8.8	5	25
All	139	4.7	58	3.5	168	7.5	9	114

The effect of soil quality on nutrient applications to root crops is shown in Table 73.

Table 73: Effect of soil use class on nutrients for root crops (kg/ha)

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
1	Wide	151	6.6	52	4.4	165	10.4	8	65
2	Moderately Wide	124	7.1	58	5.1	160	11	13	41
3	Somewhat Limited	155	16	134	23.7	277	42.4	7	6
4	Limited	163	25.6	53	7.9	230	38.7	4	5

The amount of N, P and K applied to root crops in the different farming systems is given in table 74.

Table 74: N, P and K fertilizer applied to root crops (kg/ha)

Farm System	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
Dairy	157	9.7	46	4.5	153	11.5	5	42
Other Stock	113	18.4	38	9.8	125	28.3	3	12
Tillage	135	5.8	62	4.9	174	10.3	13	63
All	139	4.7	58	3.5	168	7.5	9	117

Fertilizer Compounds for Root Crops

The fertilizer compounds used for supply of N, P and K to root crops are listed in Tables 75-77 and the number of times the fertilizers were used on the tillage farms is given in Table 78.

Table 75: Main sources of N for root crops (%)

	Root Crop			
Compound	**Turnip**	**Potatoes**	**Sugar Beet**	**Fodder Beet**
CAN	12.7	2.8	37.0	29.2
S/A 21% N	-	13.9	-	-
6:10:18	-	-	-	0.9
7:6:17	-	26.7	-	-
8:5:18	25.2	0.9	11.2	30.3
9:4.5:18	-	-	13.9	6.3
9:6:15	-	-	5.4	-
10:3:18	-	-	2.8	4.1
10:5:25	-	-	2.9	3.8
10:10:20	-	50.4	-	4.5
13:4:14	-	-	22.1	10.3
14:7:14	-	-	-	0.8
15:10:10	41.3	-	-	-
18:6:12	-	-	0.8	5.2
22:2.5:10	20.8	-	-	-
High N Compounds	-	-	0.2	2
Total	100.0	94.7	96.3	97.4

Table 76: Main sources of P for root crops (%)

	Root Crop			
Compound	**Turnip**	**Potatoes**	**Sugar Beet**	**Fodder Beet**
0:10:20	12.7	15.0	-	-
6:10:18	-	-	-	4.1
7:6:17	-	26.3	-	-
8:5:18	25.2	0.7	26	51.5
9:4.5:18	-	-	25.8	8.6
9:6:15	-	-	13.5	
10:3:18	-	-	3.1	3.4
10:5:25	-	-	5.3	5.1
10:10:20	0.0	58.0	-	12.3
13:4:14	-	-	25.3	8.6
14:7:14	-	-	-	1.1
15:3:20	-	-	-	-
15:10:10	41.3	-	-	-
16:7:13.3:NI	-	-	-	-
16:5:20	-	-	-	-
18:6:12	-	-	1.0	4.7
22:2.5:10	20.8	-	-	-
High N Compounds	-	-	-	0.5
All	100.0	100.0	100.0	99.9

Table 77: Main sources of K for root crops (%)

	Root Crop			
Compound	**Turnip**	**Potatoes**	**Sugar Beet**	**Fodder Beet**
POTASH 50% K	-	0.7	-	-
0:10:20	-	13.4	-	-
6:10:18	-	-	-	2.2
7:6:17	-	33.2	-	-
8:5:18	60.5	1.1	25.5	54.4
9:4.5:18	-	-	28.1	10.1
9:6:15	-	-	9.2	-
10:3:18	-	-	5.1	5.9
10:5:25	-	-	7.2	7.5
10:10:20	-	51.6	-	7.2
13:4:14	-	-	24.1	8.9
14:7:14	-	-		0.7
15:3:20	-	-	-	-
15:10:10	29.4	-	-	-
18:6:12	-	-	0.5	2.7
22:2.5:10	10.1	-	-	-
High N Compounds	-	-	0.2	0.3
All	100.0	100.0	99.9	99.9

Table 78: Number of times each fertilizer compound was used for root crops on the survey farms (%)

	Root Crop				
Compound	**Turnip**	**Potatoes**	**Sugar Beet**	**Fodder Beet**	**Total**
CAN	1	2	57	16	76
POTASH 50% K	-	1	-	-	1
S/A 21% N	-	2	-	-	2
0:10:20	-	1	-	-	1
6:10:18	-	-	-	2.0	2
7:6:17	-	14	-	-	14
8:5:18	1	1	12	16	30
9:4.5:18	-	-	13	3	16
9:6:15	-	-	9	-	9
10:3:18	-	-	5	2	7
10:5:25	-	-	3	1	4
10:10:20	-	12	-	2	14
13:4:14	-	-	19	3	22
14:7:14	-	-	-	1	1
15:10:10	1	-	-	-	1
18:6:12	-	-	2	4	6
22:2.5:10	1	-	-	-	1
High N Compounds	-	-	1	1	2
All	4	33	121	51	209

CHANGES IN FERTILIZER USE FROM 1995-2003

The N, P and K usage for grassland and crops is detailed in Appendix 1 for the year 2002 and in Appendix 2 for the year 2001. A summary of nutrient usage for grassland for the years 1995-2003 are given in Table 79.

Table 79: Mean fertilizer nutrient use for grassland from 1995-2003

Year	N	P	K	Mean Farm Area (ha)	No of Farms
	(kg/ha)				
1995	123	16	39	32.9	1207
1999	145	13	34	36.9	1097
2000	136	13	33	39.1	1112
2001	133	11	30	40.7	1207
2002	126	11	28	39.4	1224
2003	123	11	27	39.5	1251

Because grassland is the major crop grown in Ireland, one would expect a strong relationship between usage of N, P and K and national sales of the elements as chemical nutrients (Appendix 4). The changes in N usage from 1995 to 2003 (Figure 4) appear to be similar to those for national N sales although the correlation coefficient of 0.45 is not statistically significant. The relationship between P and K usage and national sales of the elements (Figures 5 and 6) are very much stronger, with correlation coefficients of 0.99 and 0.95 respectively.

Figure 4: Relationship between N usage and national sales of N

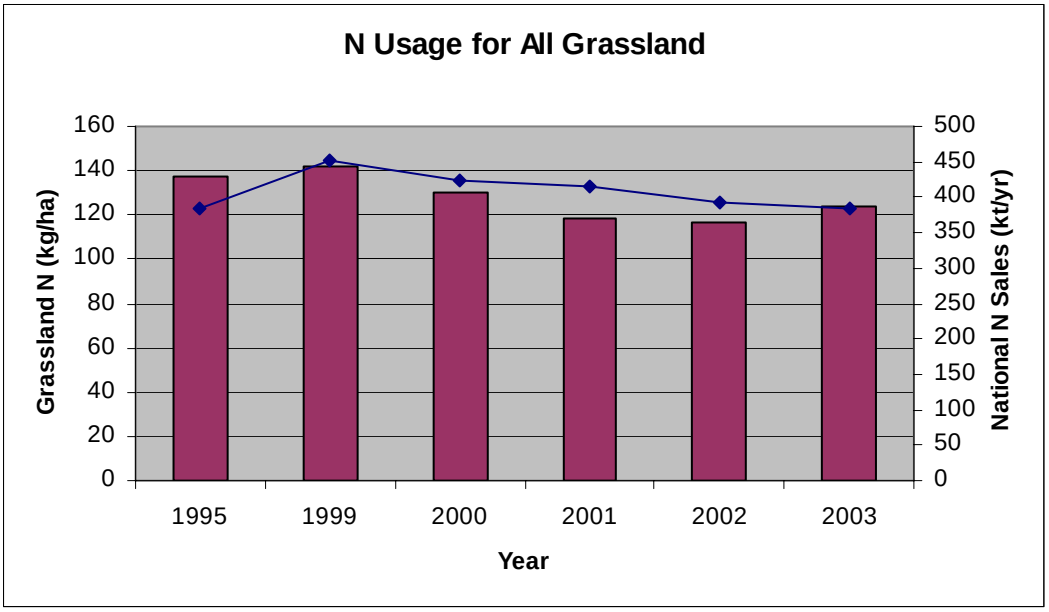


Figure 5: Relationship between P usage and national sales of P

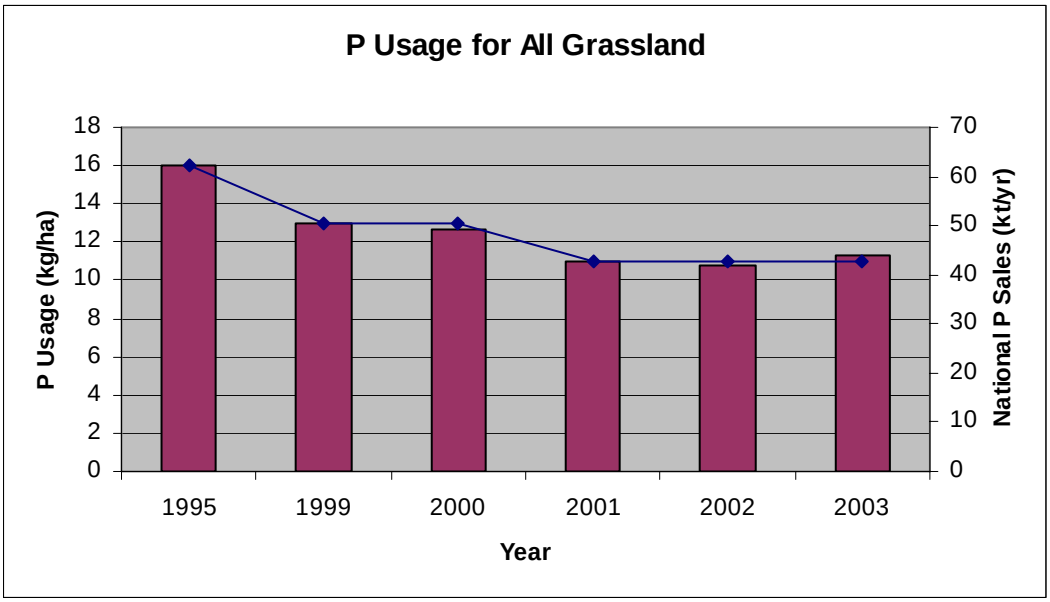
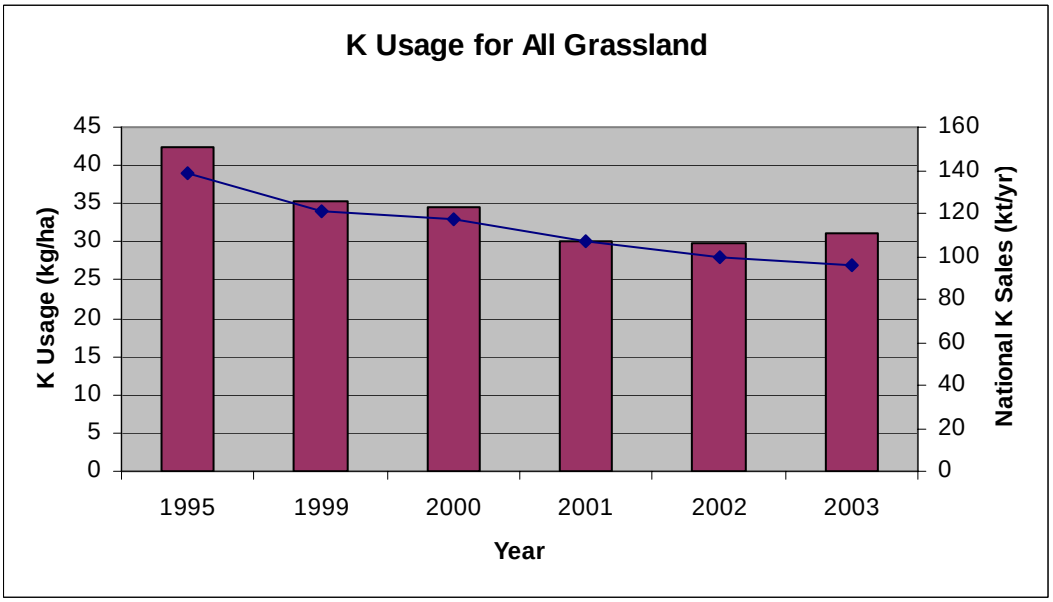


Figure 6: Relationship between K usage and national sales of K



A summary of nutrient usage for cereals and root crops for the years 1995-2003 is shown in Tables 80 – 81. The N usage for cereals shows an increase of about 11% over the period but was quite variable. P use was constant but K use showed a decrease of approximately 19%. For root crops, the usage of all three nutrients decreased markedly; the changes were 14%, 24% and 16% for N, P and K respectively.

Table 80: Mean fertilizer use for cereals from 1995-2003

Year	N	P	K	Mean Farm Area (ha)	No of Farms
	(kg/ha)				
1995	137	26	69	18	262
1999	127	25	56	23	210
2000	160	25	60	28	214
2001	147	24	53	27	240
2002	157	25	56	28	255
2003	152	25	56	30	247

Table 81: Mean Fertilizer Use for Root Crops from 1995-2003

Year	N	P	K	Mean Farm Area (ha)	No of Farms
	(kg/ha)				
1995	161	76	199	5	211
1999	154	62	190	7	126
2000	146	70	187	8	112
2001	151	74	208	9	120
2002	142	57	169	9	123
2003	139	58	168	9	117

FERTILIZER USE ON FARMS IN THE REPS SCHEME

There were 1243 livestock farms in the survey, out of a total of 1,275 farms. Of the grassland farms, 337 were participants in the national Rural Environmental Protection Scheme or REPS and 906 were not. The objectives of the REPS scheme are *inter alia* to establish procedures and production methods which help environmental protection by good farming practice and improved management of farm nutrients (Anon, 2000). Thus, REPS members must abide by regulations which limit the amount of chemical fertilizers and organic nutrients that can be applied to their crops. There are whole farm stocking rate limits, organic nutrient limits or other restrictions. The REPS scheme is voluntary, and individual farmers may choose to avail of it or operate outside of it.

It is important to note that the method of calculation of stocking rates and fertilizer use within REPS and other EU and Government schemes differs from the procedures used for NFS stocking rates and fertilizer usage calculations within this report (see Appendix 3).

REPS – Grazing and Tillage Summary

The range of crops was not as variable on the REPS farms as on farms overall; all the REPS farms had grassland (Table 82) but a relatively small number grew tillage crops (Table 83). For example, winter crops were grown on only few of the REPS farms. The area under the different crops tended to be smaller in REPS farms; indeed the average size of the REPS farms was also smaller at 41.5 ha compared to the overall average of 56.3 ha.

Table 82: Number of grassland farms and mean area of grassland crops on REPS and NON-REPS farms

Crop	REPS Farms	Mean Crop Area REPS (ha)	NON-REPS Farms	Mean Crop Area NON-REPS (ha)
Grazing	337	28.3	903	34.5
Silage	312	9.3	304	13.8
Hay	102	3	840	13.1

Table 83: Number of farms with different tillage crops and mean crop area on REPS and NON-REPS farms

Crop	REPS Farms	Mean Crop Area REPS (ha)	NON-REPS Farms	Mean Crop Area NON-REPS (ha)
Cereal Crops				
Winter Barley	4	9	32	20
Spring Barley	37	12	147	15
Malting Barley	6	11	38	16
Winter Wheat	1	11	50	41
Spring Wheat	2	10	50	17
Winter Oats	1	11	14	16
Spring Oats	3	3	32	9
Root Crops				
Sugar Beet	8	7	60	10
Fodder Beet	5	2	31	2
Potatoes	2	8	18	16

The level of fertilizer N, P and K applications to grassland and tillage crops on REPS farms is shown in Table 84. Winter wheat and winter oats were omitted as the crops were grown on only one farm each. For grassland and most crops, the N, P and K rates for REPS are considerably below the average rates used for the Non-REPS farms.

Table 84: N, P and K rates applied to various crops on REPS and NON-REPS farms

Crop	N	P	K	N	P	K
Grassland	**REPS (kg/ha)**			**NON-REPS (kg/ha)**		
Grazing	64	5	12	117	9	20
Silage	98	11	33	126	14	43
Hay	46	10	24	54	11	26
Cereal Crops						
Winter Barley	109	28	56	171	30	72
Spring Barley	106	20	58	126	27	54
Malting Barley	105	24	62	113	20	52
Winter Wheat	-	-	-	203	23	55
Spring Wheat	165	12	25	151	25	54
Winter Oats	-	-	-	138	27	51
Spring Oats	98	17	70	113	25	49
Root Crops						
Sugar Beet	153	37	138	160	43	159
Fodder Beet	111	51	173	133	47	160
Potatoes	115	99	280	115	102	222

To facilitate comparison, Table 85 expresses the rates of N, P and K applications on REPS farms as percentage of the usage on non-REPS farms.

Table 85: Usage of N, P and K usage on REPS farms as a percentage of usage on non-REPS farms

Crop	N	P	K
Grassland		**RATIO %**	
Grazing	55	56	60
Silage	78	79	77
Hay	85	91	92
Cereal Crops			
Winter Barley	64	93	78
Spring Barley	84	74	107
Malting Barley	93	120	119
Winter Wheat	-	-	-
Spring Wheat	109	48	46
Winter Oats	-	-	-
Spring Oats	87	68	143
Root Crops			
Sugar Beet	96	86	87
Fodder Beet	83	109	108
Potatoes	100	97	126

Grazing

The nutrients usage for grazing on REPS farms is presented in Table 86. The N, P and K applications in the Table are very much lower than those for all Survey farms (non-REPS and REPS, presented earlier in Table 7). On average, the application rate of N for REPS was only 62% of that applied over all farms, and the corresponding figures for P and K were 63% and 67% respectively. Comparison with non-REPS usage is shown in Table 84.

Table 86: Regional distribution of N, P and K fertilizers for grazing on REPS farms

Region	N	s.e	P	s.e	K	s.e	No of REPS Farms
	(kg/ha)						
South-East	89	9.5	7	0.9	17	2.5	36
Mid-East	51	6.6	3	0.7	7	1.7	17
Midlands	65	9.9	5	0.8	13	1.7	45
Border	45	5.4	4	0.6	8	1.3	62
South-West	64	8.5	8	1.2	15	1.9	38
South	85	7.4	6	0.8	14	1.5	56
West	52	5.4	5	0.5	13	1.2	82
All	64	2.9	5	0.3	12	0.6	336

The effect of soil quality on nutrient applications to grazed grass on REPS farms is shown in Table 87. The rates for N, P and K were not significantly different for the various soil types.

Table 87: Effect of soil use range on nutrients for grazing on REPS farms

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	No of REPS Farms
		(kg/ha)						
1	Wide	68	6.1	6	0.7	13	1.4	82
2	Moderately Wide	61	6	5	0.6	12	1.3	62
3	Somewhat Limited	63	7.1	5	0.6	11	1.5	57
> 3	Limited	61	4.8	6	0.5	12	1.0	136
	All	64	2.9	5	0.3	12	0.6	337

The effect of farm system on nutrient applications to grazed grass on REPS farms is shown in Table 88. The rates for N, P and K for dairying were far higher than for all other systems and the N rates for cattle systems were significantly lower than average.

Table 88: N, P and K fertilizer applied to grazing ground of REPS farms by farm system

Farm System	N	s.e.	P	s.e.	K	s.e.	No of Farms
	(kg/ha)						
Dairy	108	5.6	8	0.6	18	1.2	92
Cattle	39	2.6	4	0.4	10	0.9	157
Sheep	52	6.2	4	0.6	9	1.2	69
Tillage	55	9.9	4	0.9	10	2.3	19
All	64	2.9	5	0.3	12	0.6	337

Silage

The nutrients applied to silage ground on REPS farms in different regions is shown in Table 89. As found for silage overall, the highest rates of N were applied in the south and south-east but rates for REPS farms are much lower than for Non-REPS farms (Table 84).

Table 89: N, P and K for silage on REPS farms by region

Region	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
South-East	112	6.9	11	1.1	34	3.8	9.8	36
Mid-East	93	7.7	10	2	28	4.8	11.0	13
Midlands	100	7.4	10	1	37	3.5	11.1	41
Border	76	5.5	8	0.7	23	2.3	8.5	58
South-West	105	7.3	16	2.4	43	4.6	11.6	35
South	118	6.7	10	1.1	31	3.5	8.8	51
West	89	5.4	11	1.1	35	3.6	7.6	77
All	98	2.6	11	0.5	33	1.4	9.3	311

The effect of soil quality on nutrient applications to silage is shown in Table 90. There is no significant variation between fertilizer usage on different soil classes.

Table 90: Effect of soil use range on nutrients for silage on REPS farms

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
1	Wide	103	6	10	0.9	33	2.7	10.6	78
2	Moderately Wide	103	4.8	10	1	30	3.1	8.1	60
3	Somewhat Limited	106	8.1	10	1.2	38	4.5	8.4	53
4	Limited	89	3.3	12	0.9	33	2.2	9.3	121
	All	98	2.6	11	0.5	33	1.4	9.3	312

The amount of N, P and K applied to REPS silage land in the different farm systems is shown in Table 91.

Table 91: N, P and K fertilizer applied to silage ground of REPS farms by farm system

Farm System	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
Dairy	116	5.1	12	1.1	39	2.8	12.7	92
Cattle	84	3.1	10	0.7	29	1.9	8.5	149
Sheep	92	5.3	11	1.2	32	3.7	5.8	53
Tillage	87	14.5	8	1.7	24	4.7	8.1	18
All	98	2.6	11	0.5	33	1.4	9.3	312

Hay

The amount of N, P and K applied to hay under REPS in the different regions is presented in Table 92.

Table 92: N, P and K for hay on REPS farms by region

Region	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
South-East	70	10.5	10	2.6	25	6.2	3.0	12
Mid-East	31	4.6	8	1.4	17	2.8	4.3	21
Midlands	36	8.3	7	1.6	13	3.7	2.1	18
Border	51	9	18	5	38	9.5	5.7	5
South-West	46	5.7	8	2.2	23	4.7	2.5	16
South	100	14.6	10	1.2	28	3.7	2.0	7
West	48	4	13	1.8	33	4	2.7	22
All	46	3	10	0.8	24	1.8	3.0	101

The effect of soil quality on nutrient applications for hay on REPS farms is shown in Table 93. Unlike grazing and silage, highest rates of N, P and K were applied to soil class 3, which has a narrower use range than the best grassland soils (Gardiner and Radford, 1980).

Table 93: Effect of soil use range on nutrients for hay on REPS farms

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
1	Wide	47	5.3	10	1.5	22	3.3	3.8	33
2	Moderately Wide	46	5.5	13	1.9	29	4.1	3.1	22
3	Somewhat Limited	29	6.6	6	1.7	19	5	2.3	15
4	Limited	53	6.1	10	1.4	23	2.9	2.5	32
	All	46	3	10	0.8	24	1.8	3	102

The average N, P and K usage for hay on REPS farms under different systems is shown in Table 94.

Table 94: N, P and K fertilizer applied to hay on REPS farms by system

Farm System	N	s.e.	P	s.e.	K	s.e.	Mean Area (ha)	No of Farms
Dairy	48	7.8	8	1.4	22	3.9	3.0	23
Cattle	42	4.1	9	1.1	22	2.4	2.9	50
Sheep	57	5	14	2.5	30	4.8	2.6	20
Tillage	45	10.9	11	2.7	24	6	4.7	9
All	46	3	10	0.8	24	1.8	3.0	102

Conclusions on REPS fertilizer usage

The level of fertilizer N, P and K applications to grassland and tillage crops on farms which participated in REPS were considerably below the rates used on non-REPS farms (Table 84). For grazing, REPS farms used 55% of the N rate and 56% of the P rate of non-REPS farms, for silage the comparison was 78% and 79% for N and P and for hay it was 85% and 91% respectively. The favourable ratio applied for P and K for all cereal and root crops for which there was reliable data with the exception of potatoes. In an analysis of the impact of REPS for 1999, McEvoy and Ryan (2000) also found that inorganic N and P use on REPS farms was considerably below the rates used on non-REPS farms.

Comparisons between fertilizer usage for REPS and non-REPS farms at different whole-farm stocking rates was outside the scope of this fertilizer use survey owing to differences between the procedures for calculating stocking rates in this survey (Appendix 3) and in area aid schemes such as REPS.

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APPENDIX 1: N, P AND K FERTILIZER USAGE FOR 2002

Table 1-1: N, P and K usage for grazing 2002

Region	N	s.e	P	s.e	K	s.e	Area	Farms
South-East	132	6.8	9	0.6	19	1.3	35.8	176
Dublin	27	17.6	1	1	3	3.3	27.5	10
Mid-East	100	7.8	7	0.7	16	1.4	45.6	121
Midlands	91	7.7	9	0.8	21	1.9	35.2	119
Border	81	5.6	7	0.6	15	1.1	28.3	224
South-West	86	6.7	8	0.5	19	1.5	33.5	144
South	167	7.3	11	0.6	24	1.3	33.7	223
West	55	3.8	6	0.4	15	1.1	24.2	196
All	106	2.7	8	0.2	19	0.5	32.7	1213
Soil Class	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Wide	140	5.4	9	0.4	20	1	37.1	376
Moderately Wide	99	6.4	8	0.6	17	1.2	33.7	211
Somewhat Limited	83	4.7	9	0.5	20	1.3	31.1	237
Limited	85	4.2	7	0.4	17	0.8	29.1	388
Farm System	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Dairy	163	4.1	11	0.4	24	0.8	39.4	513
Cattle	42	1.7	5	0.3	13	0.6	25.8	471
Sheep	48	3.9	6	0.6	13	1.3	31.4	135
Tillage	81	7.9	6	1	14	2.1	32.6	90
Pigs & Poultry	179	85.8	5	2.3	11	5	46.5	4
All	106	2.7	8	0.2	19	0.5	32.7	1213

Table 1-1 (Continued): N, P and K usage for grazing 2002

Dairy System by Stocking Rate	N	s.e	P	s.e	K	s.e	Area	Farms
< 1.2	66	10.7	6	0.8	14	2	30.9	42
1.2 – 1.5	111	7.3	8	0.7	19	1.7	43.5	57
1.5 - 1.9	136	5.5	11	0.6	24	1.3	41.4	154
2.0 - 2.25	194	7.1	12	0.7	27	1.8	42.3	133
2.25 - 2.6	214	10.9	13	1.1	26	2.3	36.6	94
2.6 - 2.9	263	19.5	14	2	30	5.1	33.2	23
> 2.9	264	50.7	18	4.5	42	9.4	25.5	10
Cattle System by Stocking Rate	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
< 1.2	67	3.1	12	0.6	32	1.8	6.6	185
1.2 – 1.5	88	3.9	13	1.1	36	2.6	9.7	106
1.5 - 1.9	94	4.3	12	1	33	2.4	10.2	81
2.0 - 2.25	95	10.3	16	2.3	40	5.2	8	32
2.25 - 2.6	104	8.5	20	4.6	66	18.1	8.2	9

Table 1-2: Fertilizer use for silage 2002

Region	N	s.e	P	s.e	K	s.e	Area	Farms
South-East	128	4.3	14	1	40	2.9	15.2	153
Dublin	67	18.9	10	4.3	25	10.1	8.4	7
Mid-East	122	4.1	11	0.8	36	2.5	16.8	114
Midlands	121	5.6	15	0.9	50	3	14	105
Border	104	3.5	12	0.6	33	1.4	10.3	211
South-West	110	3.9	15	0.9	43	2.3	12.7	130
South	146	4.3	14	0.8	50	2.6	13.5	213
West	90	3.5	13	0.7	36	1.8	7.6	179
All	120	1.7	13	0.3	41	0.9	12.4	1112
Soil Class	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Wide	134	3.3	13	0.6	44	1.9	15	347
Moderately Wide	118	3.5	12	0.6	36	1.9	12.9	189
Somewhat Limited	106	3.2	13	0.7	37	1.6	11.1	217
Limited	112	2.7	14	0.6	44	1.7	10.6	359
Farm System	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Dairy	139	2.2	14	0.4	47	1.4	16.9	507
Cattle	84	2.1	13	0.5	35	1.3	8.3	418
Sheep	87	3.5	11	0.9	30	2.2	8	107
Tillage	110	7	11	1.4	30	3.5	11.3	76
Pigs & Poultry	180	42.8	5	4.4	15	9.5	15.6	4
All	120	1.7	13	0.3	41	0.9	12.4	1112

Table 1-3: N, P and K usage for hay 2002

Region	N	s.e	P	s.e	K	s.e	Area	Farms
South-East	64	4.5	10	1.1	24	2.4	3.9	72
Dublin	41	22	14	8.2	27	16.5	6.2	4
Mid-East	63	5.1	15	2.4	35	5	6.2	45
Midlands	46	5.2	12	1.4	33	3.9	3.8	49
Border	49	10.3	9	2	18	3.9	2.6	40
South-West	37	3.8	12	2	28	4.4	3.5	42
South	74	7.3	9	1.1	26	3.3	2.7	48
West	38	4.4	8	1.3	21	3	2.4	47
All	55	2.2	11	0.6	28	1.4	3.7	347
Soil Class								
Wide	58	3.7	12	1	30	2.3	3.5	139
Moderately Wide	63	4.1	12	1	28	2.4	4.4	73
Somewhat Limited	45	5.5	10	2.2	22	4.5	3.9	60
Limited	46	4.5	9	1	26	2.8	2.9	74
Farm System								
Dairy	59	3.6	11	1.2	28	2.7	3.1	132
Cattle	41	3.1	9	1	23	2.3	3.3	122
Sheep	46	4.8	9	1.7	22	3.7	3.8	41
Tillage	73	6.6	15	1.4	35	3.1	5.8	51
All	55	2.2	11	0.6	28	1.4	3.7	346

Table 1-4: Fertilizer compounds used for grassland all systems in 2002

Compound	N	P	K	Area %
	Percentage for Each Source			
0:10:20	0	6.3	4.9	1.8
0:7:30	0	7.3	12.2	2.8
10:10:20	0.8	9.5	7.4	3.5
14:7:14	0.1	0.5	0.4	0.3
18:2.5:14	0.2	0.3	0.6	0.2
18:6:12	6.4	24.4	19.1	13.9
20:3:6	0.1	0.2	0.2	0.1
22:2.5:10	1.3	1.7	2.7	1.1
25:2.2:4.50	0.3	0.3	0.2	0.2
25:5:5	0.8	1.7	0.7	0.5
7:6:17	0	0	0	0.1
CAN	33.7	0	0	25.3
High N Compounds	40.8	46.6	50	39.7
Potash 50% K	0	0	0.8	0.1
S/A21%N	0.1	0	0	0.1
SUPER16%P	0	0.4	0	0.2
UREA	15.1	0	0	8.7
All	99.7	99.2	99.2	98.6

Table 1-5: N, P and K usage for forage maize 2002

Region	N	s.e	P	s.e	K	s.e	Area	Farms
South-East	113	14.6	28	4.4	49	12.7	6	21
Mid-East	99	13.6	24	5.8	43	13.7	8	16
Midlands	125	15.5	32	4.6	68	8.6	10	7
Border	81	24.2	16	9.2	58	48.3	5	7
South	142	30.9	48	10.2	113	25	6	10
South-West	113	7.5	12	4.6	28	19	7	6
All	113	7.6	28	2.8	58	8	7	67
Farm System	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Dairy	117	8.8	29	3.3	58	8.5	7	52
Other Stock	87	24.3	23	8	53	24.2	5	6
Tillage	97	19.4	23	7.9	60	31.6	7	9
Soil Use Range	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Wide	124	11.5	33	3.8	63	10.3	7	36
Moderately Wide	93	13	21	7.3	51	19.5	6	14
Somewhat Limited	87	16.1	16	5.5	45	23.8	6	13
Limited	136	17.5	35	5.4	64	18	12	4
All	113	7.6	28	2.8	58	8	7	67

Table 1-6: N, P and K usage for winter wheat 2002

Region	N	s.e	P	s.e	K	s.e	Area	Farms
South-East	179	12.4	13	4.9	27	10.3	39	13
Dublin	181	6.2	6	8.1	12	16.1	51	5
Mid-East	195	6.6	23	3.1	61	7.3	30	24
Border	229	6	33	2.1	76	6.8	45	19
South	176	8.4	34	2.3	92	12.6	12	2
All	201	4.8	22	2.1	53	5.1	38	64
Farm System	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Dairy	195	8.5	27	4	83	9.6	15	13
Tillage	202	5.6	22	2.4	51	5.8	45	49
Soil Use Range	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Wide	194	8	23	3.4	50	7.9	42	28
Moderately Wide	217	6.3	23	3.2	61	8.4	41	23
Somewhat Limited	178	5.4	19	5.2	39	10.3	22	13
All	201	4.8	22	2.1	53	5.1	38	64

Table 1-7: N, P and K usage for spring wheat 2002

Region	N	s.e	P	s.e	K	s.e	Area	Farms
South-East	169	13	28	3.8	55	7.7	12	18
Dublin	167	17.7	51	19.9	101	39.8	15	2
Mid-East	182	10.5	24	4.3	48	7.6	11	16
Midlands	189	13.4	13	8	87	19.4	16	4
Border	159	23.5	28	7.5	56	14.9	17	3
South	109	24.9	17	5.8	34	11.6	12	5
All	168	7.1	25	2.5	57	5	12	48
Farm System	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Dairy	125	14.1	23	3.8	47	7.6	7	14
Tillage	177	7.7	26	3.1	59	6.1	15	34
Soil Use Range	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Wide	179	11.4	25	3.7	60	7.4	14	25
Moderately Wide	154	8.1	26	3.9	55	7.6	11	19
Somewhat Limited	162	24.4	23	9.4	46	18.7	15	3
Limited	129	24.2	22	0	44	0	5	2
All	168	7.1	25	2.5	57	5	12	49

Table 1-8: N, P and K usage for spring barley 2002

Region	N	s.e	P	s.e	K	s.e	Area	Farms
South-East	115	3.6	25	1.5	46	2.5	12	62
Dublin	122	5	30	5.2	60	10.4	20	6
Mid-East	119	4.7	25	1.5	54	2.5	17	25
Midlands	119	7	28	3.3	67	5.6	11	21
Border	138	6.4	28	1.7	55	3.4	13	34
South	98	6.7	24	2.4	49	4.6	8	26
South-West	78	13.2	24	3.1	50	3.7	11	4
West	56	11.6	28	3.2	55	6.4	5	9
All	118	2.4	26	0.8	53	1.5	12	187
Farm System	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Dairy	113	3.6	26	1.4	54	2.6	9	82
Other Stock	82	7.2	26	1.9	56	3.6	6	30
Tillage	126	3.4	26	1.2	52	2.2	17	73
Soil Use Range	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Wide	118	3.1	27	1.2	55	2.2	13	96
Moderately Wide	117	4.5	24	1.1	47	1.8	12	60
Somewhat Limited	130	7.4	30	2.8	64	4.9	12	19
Limited	80	9	20	4.5	45	9.5	8	12
All	118	2.4	26	0.8	53	1.5	12	187

Table 1-9: Compounds used for cereals in 2002

Compound	N	P	K	Area %
	Percentage for Each Source			
0:10:20	0	21.1	18.6	7.2
0:7:30	0	5.8	10.9	2.9
10:10:20	5.5	34.7	30.5	13.5
14:7:14	1.7	5.3	4.7	1.4
15:10:10	0.7	2.9	1.3	1.1
15:3:20	0.9	1.1	3.2	0.8
16:5:20	0.4	0.9	1.6	0.7
18:6:12	12.3	26	22.9	12.8
25:5:5	0.2	0.3	0.1	0.3
CAN	71.6	0	0	46
High N Compounds	2.6	1.8	2.3	1.9
Potash 42% K	0	0	4	1.1
UREA	3.4	0	0	2.3
Assorted	0.6	0	0	7.3
Total	99.9	99.9	100.1	99.3

Table 1-10: Fertilizer usage for sugar beet 2002

Region	N	s.e	P	s.e	K	s.e	Area	Farms
South-East	153	8.9	36	3.9	135	13.6	10	37
Mid-East	154	16.3	45	7.8	190	30	10	9
Midlands	105	25.7	34	8.7	133	32.7	8	11
South	183	10.1	40	2.6	145	8.2	10	12
All	153	7	39	2.7	145	9.7	9	69
Farm System	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Dairy	179	11.7	44	3.7	164	9.4	8	21
Other Stock	177	22.1	41	6	219	8.6	4	3
Tillage	144	8.8	37	3.6	137	13.4	11	45
Soil Use Range	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Wide	159	9.8	40	3.4	144	11.1	9	44
Moderately Wide	147	9.4	39	4.4	158	17.8	10	23
All	153	7	39	2.7	145	9.7	9	67

Table 1-11: Fertilizer usage for potatoes 2002

Region	N	s.e	P	s.e	K	s.e	Area	Farms
South-East	103	9.4	90	8.3	295	25.9	5	3
Dublin	129	8.5	129	8.5	259	17.1	14	3
Border	119	5	77	5.8	201	14.6	17	10
Mid-East	156	6	146	1.9	291	3.8	26	3
All	128	4.8	102	7.4	237	11.8	14	22
Farm System	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Dairy	129	16.7	114	18.9	302	29.7	1	4
Tillage	129	5.8	101	9.2	236	14.5	20	15
Soil Use Range	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Wide	139	10.1	105	13.5	253	23.6	15	7
Moderately Wide	120	5.4	94	10	220	15	15	12
Somewhat Limited	135	7.4	135	9	271	10.4	11	3
All	128	4.8	102	7.4	237	11.8	14	22

Table 1-12: Compounds used for root crops in 2002

Compound	N	P	K	Area %
	Percentage for Each Source			
0:7:30	0	1.4	2	1.3
10:10:20	15.4	38.4	25.9	27.6
10:3:18	8.7	6.5	13.1	5.9
13:4:14	17.1	13.2	15.5	7.1
7:6:17	6.2	13.3	12.7	2.6
8:5:18	7.7	12.1	14.7	6.5
9:4.5:18	3.4	4.2	5.7	2.2
9:6:15	4.6	7.7	6.5	5.7
CAN	28.1	0	0	29.6
High N Compounds	1.3	0.4	0.2	0.9
Potash 50% K	0	0	1.1	2
Various	3	0	0	7.5
All	97.4	99.5	99.6	100

APPENDIX 2: N, P AND K FERTILIZER USAGE FOR 2001

Table 2-13: N, P and K usage for grazing 2001

Region	N	s.e	P	s.e	K	s.e	Area	Farms
South-East	142	6.6	9	0.6	21	1.5	35.4	178
Dublin	40	25.3	1	0.5	2	1.5	30.9	10
Mid-East	104	9.1	7	0.8	16	1.6	42	113
Midlands	101	8.1	8	0.7	20	1.8	38.1	114
Border	87	5.8	6	0.5	13	0.9	27.7	235
South-West	95	7.4	7	0.5	15	1.3	32.9	131
South	169	6.8	11	0.6	25	1.4	33.9	227
West	52	4.2	7	0.5	15	1.2	25.1	189
All	112	2.8	8	0.2	18	0.5	32.6	1197
Soil Class	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Wide	147	5.2	9	0.4	21	1	36.2	379
Moderately Wide	110	6.8	8	0.6	19	1.2	32.6	211
Somewhat Limited	86	4.9	7	0.5	16	1.1	30.7	233
Limited	86	4.5	7	0.4	15	0.9	30	373
Farm System	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Dairy	164	3.9	10	0.4	24	0.8	37.8	569
Cattle	41	1.9	5	0.3	12	0.7	26.3	412
Sheep	43	3.7	4	0.4	9	1	30.4	139
Tillage	100	8.9	7	0.7	16	1.8	30.3	71
Pigs & Poultry	134	48.9	4	2.5	9	4.9	39.8	5
All	112	2.8	8	0.2	18	0.5	32.6	1196

Table 2-13 (Continued): N, P and K usage for grazing 2001

Dairy System by Stocking Rate	N	s.e	P	s.e	K	s.e	Area	Farms
< 1.2	59	8.5	7	0.9	14	2	30.2	41
1.2 – 1.5	108	7.6	8	0.9	19	2	42.8	59
1.5 - 1.9	140	5.6	8	0.6	19	1.4	41.4	150
2.0 - 2.25	174	6	11	0.7	26	1.6	39.4	154
2.25 - 2.6	212	9	12	0.9	28	2.2	35	109
2.6 - 2.9	289	15.3	15	1.8	32	3.6	31.7	40
> 2.9	294	39	21	3	43	6.6	25.3	16
Cattle System by Stocking Rate	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
< 1.2	24	2.2	3	0.3	7	0.7	25.2	176
1.2 – 1.5	43	3.6	7	0.8	15	1.7	26.8	105
1.5 - 1.9	55	4.1	7	0.9	15	1.8	30.9	75
2.0 - 2.25	74	7	8	1.3	18	3	23	39
2.25 - 2.6	56	13.8	9	2.2	19	4.7	19.5	11

Table 2-14: Fertilizer use for silage 2001

Region	N	s.e	P	s.e	K	s.e	Area	Farms
South-East	132	4.1	13	0.8	42	2.6	16.3	163
Dublin	109	25.3	7	3.8	23	11.7	9.1	7
Mid-East	127	5.4	14	0.9	48	3	17.9	106
Midlands	125	5.6	16	1.1	54	3.7	16.4	108
Border	122	3.7	12	0.5	35	1.5	11.4	222
South-West	116	3.8	15	0.9	45	2.8	13.4	120
South	149	4.2	13	0.7	48	2.5	15.1	222
West	96	3.5	14	0.8	38	2.2	9.1	167
All	127	1.7	14	0.3	44	1	13.8	1115
Soil Class	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Wide	137	3.2	13	0.5	47	1.9	16.8	357
Moderately Wide	133	4	13	0.7	41	2.2	14.1	193
Somewhat Limited	118	3.4	14	0.6	42	2	12.2	220
Limited	114	2.8	14	0.5	43	1.7	11.6	345
Farm System	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Dairy	143	2.3	15	0.4	49	1.4	18.1	565
Cattle	91	2.4	12	0.5	34	1.3	9.1	372
Sheep	90	4.1	14	1.1	33	2.2	8.5	108
Tillage	117	5.8	12	1.3	38	4	12	65
Pigs & Poultry	149	30.5	5	5.1	16	13.1	17	4
All	127	1.7	14	0.3	44	1	13.8	1115

Table 2-15: N, P and K usage for hay 2001

Region	N	s.e	P	s.e	K	s.e	Area	Farms
South-East	61	5.6	11	1.6	24	3.3	4.6	69
Dublin	20	11.5	9	4.3	21	8.9	6.6	7
Mid-East	62	6.1	12	1.5	31	3.4	5.9	55
Midlands	42	4.9	11	1.6	26	3.4	4.5	60
Border	50	5.5	12	1.6	25	3.2	2.5	55
South-West	29	4.4	9	1.6	20	3.2	3.8	53
South	79	5.6	8	1.2	20	2.9	3.4	55
West	42	4.9	12	1.9	29	4.1	3.2	53
All	52	2.2	11	0.6	25	1.3	4.1	407
Soil Class								
Wide	55	3.4	9	0.9	22	2	4.3	146
Moderately Wide	68	5.3	14	1.5	34	3.2	4.8	90
Somewhat Limited	30	3.4	10	1.4	22	2.9	4	76
Limited	47	4.3	10	1	23	2.2	3.2	94
Farm System								
Dairy	67	3.8	11	1	24	2.1	3.5	163
Cattle	37	2.9	9	1	22	2.1	3.7	147
Sheep	40	5.5	12	1.9	27	3.8	4.7	48
Tillage	61	5.7	13	1.4	32	3.1	6.3	48
All	52	2.2	11	0.6	25	1.3	4.1	407

Table 2-16: Compounds used for grassland over all systems in 2001

Compound	N	P	K	Area %
	Percentage for Each Source			
0:10:20	0	6.4	4.9	2.3
0:7:30	0	9.7	15.7	4.9
10:10:20	0.9	11.1	8.4	14.8
14:7:14	0	0.1	0.1	0.1
16:5:20	0.1	0.3	0.4	0.3
18:2.5:14	0.1	0.1	0.3	0.3
18:4:12	0.1	0.1	0.2	0.2
18:6:12	5.4	21.5	16.3	21.2
19:0:4	0.1	0	0.1	0.2
20:2.5:5.0	0	0.1	0.1	0.1
20:3:6	0.1	0.2	0.1	0.1
22:2.5:10	1	1.4	2.1	1.8
25:2.2:4.50	0.4	0.5	0.4	0.3
25:5:5	0.2	0.6	0.2	0.3
27:6:6	0.1	0.2	0.1	0
6:4.30:3.80	0	0.2	0.1	0.4
7:6:17	0	0.1	0.1	0.5
CAN	35.7	0	0	10.6
High N Compounds	38.6	46.5	47.8	38.2
Potash 42% K	0	0	0.2	0.1
Potash 50% K	0	0	1.9	0.4
S/A21%N	0	0	0	0.1
SUPER16%P	0	0.3	0	0.1
UREA	16.9	0	0	1.5
All	99.7	99.4	99.5	98.8

Table 2-17: N, P and K usage for forage maize 2001

Region	N	s.e	P	s.e	K	s.e	Area	Farms
South-East	139	9.6	32	3.4	70	7	6	29
Mid-East	109	12.7	22	4.3	53	9.7	8	15
Midlands	93	20.9	33	4.5	69	13.8	9	8
Border	117	12.4	9	8.2	12	15.8	7	4
South	96	17.8	32	8.3	77	15.1	6	10
South-West	115	22.1	37	4	84	26.4	5	6
All	116	6.3	28	2.2	64	5	7	72
Farm System	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Dairy	114	7.1	29	2.4	65	5.7	7	56
Other Stock	168	18.6	36	5.3	87	19.4	5	5
Tillage	110	15.5	21	6.5	50	12	7	11
Soil Use Range	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Wide	120	10.2	32	3.3	77	7.4	7	36
Moderately Wide	115	9.6	21	3.7	50	7.8	6	19
Somewhat Limited	118	15.5	22	5.5	35	11.1	6	10
Limited	98	17.7	34	4.9	70	15.6	8	7
All	116	6.3	28	2.2	64	5	7	72

Table 2-18: N, P and K usage for winter wheat 2001

Region	N	s.e	P	s.e	K	s.e	Area	Farms
South-East	163	3.7	48	13	28	10.7	54	6
Dublin	214	8.9	9	11.6	80	19.8	71	3
Mid-East	203	7.4	26	2.9	71	9.5	33	17
Border	204	6.1	22	3.3	57	7.6	46	13
South	187	0.6	22	2.4	43	4.9	9	2
All	197	4.3	26	3.2	59	5.4	42	41
Farm System	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Dairy	186	5.7	29	2.5	57	5	17	6
Tillage	198	4.8	26	3.6	59	6.1	47	35
Soil Use Range	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Wide	183	5.9	34	5.2	44	5.8	40	21
Moderately Wide	209	5	18	3.2	67	6.9	44	19
All	197	4.3	26	3.2	59	5.4	42	40

Table 2-19: N, P and K usage for spring wheat 2001

Region	N	s.e	P	s.e	K	s.e	Area	Farms
South-East	124	10.9	18	2.8	38	4.9	14	17
Dublin	156	7	26	4	53	7.9	27	5
Mid-East	167	11.7	17	3.6	37	7.6	18	11
Midlands	174	49.6	8	3.5	48	20.9	16	3
Border	177	12.9	42	2	83	3.9	7	4
South	140	15.6	19	3.6	39	7.1	9	8
All	149	6.3	20	1.7	43	3.3	15	49
Farm System	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Dairy	142	10.4	17	2.9	36	5.9	8	15
Tillage	151	8.4	19	2	43	4	19	31
Soil Use Range	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Wide	142	11.2	16	2	35	4.5	15	25
Moderately Wide	164	3.8	23	2.7	51	4.5	16	17
Somewhat Limited	140	11.8	30	4.6	63	8	12	6
All	149	6.3	20	1.7	43	3.3	15	49

Table 2-20: N, P and K usage for spring barley 2001

Region	N	s.e	P	s.e	K	s.e	Area	Farms
South-East	115	4.3	30	2.6	51	2.3	14	57
Dublin	129	7.1	28	3.4	55	6.8	23	7
Mid-East	126	6.8	25	2.6	53	5.5	15	27
Midlands	115	8.4	20	2.4	62	5.1	11	22
Border	123	5.1	27	1.5	56	3.3	14	34
South	114	8.5	23	2.2	48	3.8	7	28
South-West	63	15.2	27	4.5	55	8.9	9	3
West	91	23.4	27	5.8	53	11.6	3	3
All	119	2.6	27	1.1	54	1.6	13	181
Farm System	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Dairy	113	4.5	28	2	52	2.5	10	83
Other Stock	89	6.5	30	2	66	4.2	7	32
Tillage	128	3.1	25	1.6	52	2.4	20	64
Soil Use Range	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Wide	121	3.9	27	1.7	55	2.4	12	95
Moderately Wide	118	4.1	23	1.2	49	2.4	14	55
Somewhat Limited	117	7.6	35	3.7	60	3.9	17	18
Limited	101	7.7	24	2.5	54	6.6	8	13
All	119	2.6	27	1.1	54	1.6	13	181

Table 2-21: Compounds used for cereals in 2001

Compound	N	P	K	Area %
	Percentage for Each Source			
0:10:20	0	12.7	10.5	8.7
0:7:30	0	5	8.8	5.2
10:10:20	5.2	35	28.9	16.4
14:7:14	1.5	5	4.2	2.8
15:10:10	0.1	0.6	0.2	0.2
15:3:20	0.8	1	2.8	1.4
16:5:20	2.2	4.5	7.5	3.9
18:6:12	15.4	34.3	28.4	20.5
CAN	68.2	0	0	33.1
Compounds	3.3	1.5	4.3	3.6
UREA	3	0	0	1.5
All	99.7	99.6	95.6	97.3

Table 2-22: Fertilizer usage for sugar beet 2001

Region	N	s.e	P	s.e	K	s.e	Area	Farms
South-East	162	5.3	49	3.6	189	11.9	9	34
Mid-East	144	16.9	56	4.9	211	21.2	11	6
Midlands	165	10.1	53	3	235	8	8	11
South	190	14.4	44	3.4	153	7.5	10	14
All	168	4.9	50	2.3	191	7.5	9	65
Farm System	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Dairy	180	8	45	3.1	175	10.4	7	22
Other Stock	164	25	35	11.5	164	23	5	3
Tillage	164	6.4	53	3.1	199	10.1	11	40
Soil Use Range	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Wide	182	6.1	50	3.1	186	10.7	9	42
Moderately Wide	143	6.6	51	3.9	198	10	10	19
All	168	4.9	50	2.3	191	7.5	9	61

Table 2-23: Fertilizer usage for potatoes 2001

Region	N	s.e	P	s.e	K	s.e	Area	Farms
South-East	116	7.8	104	6.1	299	19.9	2	4
Dublin	168	21.5	145	19.5	310	38.6	27	4
Border	116	3.2	114	3.2	236	7.2	13	11
Mid-East	128	5.1	113	11.1	226	22.2	27	4
South	93	3.7	80	3.1	225	8.9	1	3
All	134	6.2	122	5.2	256	11.2	14	26
Farm System	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Dairy	123	9.8	117	5.5	283	13	3	8
Tillage	137	8	124	6.9	258	14.6	19	17
Soil Use Range	**N**	**s.e**	**P**	**s.e**	**K**	**s.e**	**Area**	**Farms**
Wide	140	8.1	107	7.4	230	15.9	10	9
Moderately Wide	136	9.4	130	7.4	270	16.3	18	14
Somewhat Limited	103	5.4	105	3.5	221	11.1	9	4
All	134	6.2	122	5.2	256	11.2	14	27

Table 2-24: Compounds used for root crops in 2001

Compound	N	P	K	Area %
	Percentage for Each Source			
10:10:20	24.3	49.6	35.3	22.1
10:3:18	6.1	3.7	8	5.8
10:5:25	3	3	5.4	4.3
13:4:14	14.1	8.8	11	14.8
18:6:12	0.6	0.4	0.3	0.9
7:6:17	2.4	4.2	4.2	9.4
8:5:18	11.8	15	19.2	21.9
9:4.5:18	4.1	4.2	6	6
9:6:15	3.6	4.9	4.4	2.5
CAN	24.8	0	0	0.5
Potash 50% K	0	0	1.1	3.6
All	94.8	93.8	94.9	91.8

APPENDIX 3: GLOSSARY OF TERMS

Crop Area The total adjusted area under crops, plus adjusted commonage area.

European Size Unit (ESU) An alternative measurement of farm size to that measured by surface area. A farm business with a size of one ESU has a standard gross margin of €1200.

Forage and Crop Area The total adjusted area under grass (including rough grazing), plus adjusted commonage area.

Frequencies of Farms (%) Frequency distribution tables are given for farm systems, management variables, soil groups etc. These tables show the estimated per cent of farms in the population having various levels of the variables.

Grassland The sum of areas under silage, hay and pasture, of which:

Silage - Basic area of ground cut at least once for silage (no adjustments are made for land cut more than once or for grazing).

Hay - Basic area of ground cut at least once for hay (no adjustments are made for land cut more than once or for grazing).

Grazing Livestock Unit (LU) A dairy cow is taken as the basic grazing livestock unit. All other grazing stock are given equivalents as follows:

Cattle	Dairy cows	1.0
	Suckling cows	0.9
	Heifers-in-calf	0.7
	Calves under 6 months	0.2
	Calves 6-12 months	0.4
	Cattle 1-2 years	0.7
	Cattle over 2 years	1.0
	Stock bulls	1.0

Sheep	Heavy Breeds	Cross-Breeds	Hill Sheep
Ewes and rams	0.25	0.20	0.14
Lambs to weaning	0.00	0.00	0.00
Lambs after weaning	0.12	0.12	0.10
Hoggets and wethers	0.16	0.16	0.14

Per Cent of Population These figures are estimates of the percentage of the population (of farms) that fall into individual categories. For example in Table 5 of the main text, 1.3% of the population (of farms) are estimated to be Dairying System farms of less than 10 UAA (Ha).

Region Areas defined by the CSO containing the following counties:

Region	Counties
Border	Louth, Leitrim, Sligo, Cavan, Donegal, Monaghan
Dublin	Dublin
Mid-East	Kildare, Meath, Wicklow
Midlands	Laois, Longford, Offaly, Westmeath
South	Cork**,** Kerry
South-East	Carlow, Kilkenny, Wexford, Tipperary SR, Waterford
South-West	Clare, Limerick, Tipperary NR
West	Galway, Mayo, Roscommon

Remainder of Farm Land covered by woods, areas not in agricultural use for economic, social or other reasons but which could be so used. It also includes ground covered by paths, roads, buildings or land which cannot be farmed, e.g., quarries, barren land, swamps, areas under water, etc.

Rough Grazing Grazed, unreclaimable bogland, grazed mountain of known area and grazed lowland partially covered by scrub, bushes or rock. It does not include land with impeded drainage unless subject to flooding.

Soil Use Class Farms are classified according to Gardiner and Radford (1982) into four major groups depending on the range of uses to which it may be put. Soil use class 1 can grow the widest range of crops without limitation and soil use class 4 contains farms with limited to extremely limited use range.

Total Area The map area of land owned, plus land rented, minus land let. It is equal to UAA plus `remainder of farm'.

Utilised Agricultural Area (UAA) The area under crops and pasture plus the area (unadjusted) of rough grazing. It is the total area owned, plus area rented, minus area let, minus area under remainder of farm.

APPENDIX 4: NATIONAL FERTILIZER SALES 1995-2003

YEAR	N	P	K
1995	428826	62410	150543
1999	442916	50509	125729
2000	407598	49267	122695
2001	368667	42697	106884
2002	363513	41869	105597
2003	388080	43832	111136

APPENDIX 5: UNITS OF MEASUREMENT

Metric	Imperial
1 kg	2 units
1 kg/ha	0.81 units/acre
1 kg/ha	0.91 lb/acre
1 tonne/ha	0.4 tons/acre
1 m^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 K_2O	Multiply by 1.205
Oxide to Element	
P_2O_5 to P	Multiply by 0.436
K_2O to K	Multiply by 0.830