A SURVEY OF FERTILIZER USE IN 2000 FOR GRASSLAND AND ARABLE CROPS

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EXECUTIVE SUMMARY

1. The national farm survey data for 2000 was used as the basis for a 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. 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 were analysed using the SAS statistical package and two and three-way tables relating nitrogen, phosphorus and potassium fertilizer use to regions, farm management factors such as farm enterprise, farm size, stocking rate, soil use range etc. were produced. The mean values obtained for different crops were weighted according to the area of the crop on the farm in question. In addition, farms were categorised into different ranges following the Gardiner and Radford (1981) classification, which is a qualitative method by which the range of potential uses of a soil can be expressed.

3. The survey was carried out following the definitions of terms appropriate to the national farm survey (NFS). 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 1 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 Department of Agriculture, Food and Rural Development data on the national annual consumption of fertilizer N, P and K for 2000 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.

5. The agreement between the calculated fertilizer consumption from the survey and the nationally published figures of 407,598 tonnes of N, 49,267 of P and 122,695 of K was remarkably good with error of only 0.1%, -0.8% and 0.4% for the three elements. The good agreement does show that the results of this fertilizer use survey are valid and useful.

6. The Table below summarises the N, P and K usage for grassland and the main tillage crops. The N, P and K rates in this Table are calculated by dividing the total amount of the fertilizer element used for each crop by the total area of the crop grown on the NFS farms.

   Note that the usage of N, P and K for grazing is calculated from the FMS data by omitting the N, P and K for the aftermaths of hay and silage. The N, P and K usage for the silage and hay crops also omits the amounts used for grazing on these areas. This is the reason why the N usage for total grassland is higher than the usage for silage, grazing or hay in the Table.

Summary of N, P and K use for grassland and tillage crops, number of farms which grew the crop and mean area of the crop on these farms

GRASSLAND	N	P	K	No of Farms	Mean Crop Area (ha)
	(kg/ha)				
Grazing	109	9	21	1112	16
Silage	133	15	49	1011	13
Hay	53	11	27	470	4
Total Grassland	136	13	33	1112	39
Forage Maize	99	25	58	41	6
TILLAGE					
Winter Barley	181	26	69	30	21
Spring Barley	115	25	51	145	12
Malting Barley	120	19	49	52	14
Winter Wheat	207	27	72	50	41
Spring Wheat	160	18	42	22	16
Winter Oats	162	28	65	24	14
Spring Oats	118	26	50	24	6
Sugar Beet	160	49	165	59	8
Fodder Beet	162	55	169	28	3
Potatoes	126	107	234	35	9

7. Information from 40,000 soil samples submitted to Teagasc for soil analysis in 2000 together with the results of the soil analysis and the fertilizer advice given by the laboratory allowed the mean Teagasc fertilizer advice or recommendation to be calculated for different crops. The mean advice levels are compared with the NFS mean N, P and K application rates in the report on the assumption that the soils in the NFS farms had the same distribution of soil analysis levels and soil Index levels as the 40,000 laboratory samples.

8. • **Grazing:** The nutrient use in the east, midlands and south of the country was much greater than the usage in the border, south-west and west regions. The mean N usage for grazing was 16% higher than that estimated for 1995 despite a 5% drop in national sales of N. The decrease in mean P and K usage since 1995 was in good agreement with the national drop in P and K sales.

   Stocking rates were calculated for each farm by dividing the NFS livestock units by the area under grazing. For grazing at stocking rates of 2.25 LU/ha and above, the dairy N usage agreed with Teagasc advice, but below this stocking rate, 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 above there was excellent agreement between the P and K dairy usage on the farms and Teagasc advice; below this stocking rate the surveyed usage of P and K is lower than the rates advised by Teagasc for optimal animal production. The N, P and K usage on cattle, mainly sheep and tillage farms was considerably lower than the usage on dairy farms. This major difference was also found in the FUS for 1995 .

9. • **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 Teagasc soil samples was 116 kg/ha assuming slurry use and 146 kg/ha assuming no slurry. Actual FUS usage was 133 kg/ha, showing that farmers either slightly overused N or that many of them did not take account of the N in applied slurry or did not apply all the slurry to the silage crop. The mean N, P and K usage for 2000 declined from the means for 1995, in line with the decrease in national fertilizer sales.

10. • **Hay:** Some hay was grown on 43% of the NFS farms but the average area of hay was much less than that of silage so hay is represented on 12% of the conserved grassland area. The mean N application rate for the NFS 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 NFS 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 drop in N, P and K usage for 2000, compared to usage 1995 mirrors the decline in national fertilizer sales.

11. • **Forage Maize:** Nitrogen rates in the NFS 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.

12. • **Winter Barley:** The mean N application rate of 181 kg/ha for NFS farms was much 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 NFS farms. The mean N usage for winter barley showed an increase of 27% over the estimate for 1995 despite a 5% drop in national sales of N.

13. • **Spring Barley:** The mean N application rate for NFS farms was 115 kg/ha which agrees very well with calculated Teagasc advice of 118 kg/ha. Calculated Teagasc P and K advice also matched the rates used on the NFS farms very closely. The rates for spring barley in 2000 were approximately the same as those estimated for 1995.

14. • **Malting Barley:** The mean N usage was somewhat higher than the calculated Teagasc advice levels for the NFS farms. Estimated Teagasc P and K advice for the NFS farms was in excellent agreement with the application rates for malting barley.

15. • **Winter Wheat:** The surveyed N usage of 207 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 usage matched very well the calculated mean Teagasc P and K rates for winter wheat of 25 and 67 kg/ha respectively. The mean N usage for winter wheat increased by 11% over that estimated for 1995, despite a 5% drop in national sales of N. The mean P was unchanged and K usage dropped by 18% in line with the national drop in K sales.

16. • **Spring Wheat:** The N usage on the NFS farms is much higher than calculated Teagasc advice. Fertilizer use of P and K for spring wheat was below Teagasc advice. The drop in N use since 1995 was in line with national sales but the drop in P and K usage were greater than the national drop in P and K sales.

17. • **Winter Oats:** The N usage on the NFS farms was much higher than Teagasc advice. Fertilizer use of P on tillage farms was higher than advised but K levels for winter oats appeared to be below optimum. The N usage showed a considerable increase since 1995 but the P and K usage were relatively unchanged.

18. • **Spring Oats:** Fertilizer usage of N, P and K nutrients for spring oats was below optimum.

19. • **Sugar Beet:** The N usage on the NFS farms was much higher than Teagasc advises; P and K use appeared to be optimal. The mean N, P and K usage for sugar beet in 2000 were 14%, 35% and 20% respectively below the estimated usage for 1995. Thus, N and P usage for sugar beet decreased considerably more than the drop in sales of these nutrients would suggest.

20. • **Potatoes:** The surveyed N, P and K fertilizer usage was broadly in line with Teagasc advice. The overall rates for P and K usage were relatively unchanged from 1995 means despite the drop in fertilizer sales but N usage increased by 8% compared to a drop of 5% in fertilizer N sales since 1995.

21. • **Types of fertilizers:** The types of fertilizers used for grassland changed significantly since 1995. There was a swing towards using high N compounds to supply P and K for silage. This suggests that many farmers preferred to apply fertilizers on a "little and often" basis as opposed to the application of P and K once per season. This trend facilitated the more effective integration of slurry applications into fertilization programmes on grassland farms.

22. • **REPS:** The level of fertilizer N, P and K applications to grassland and tillage crops on farms which participate in the Rural Environment Protection Scheme (REPS) were considerably below the rates used on non-REPS grassland farms. REPS farms used 49% of the N rate and 64% of the P rate of non-REPS farms. For silage, the comparison was 79% and 75% for N and P and for hay it was 84% and 91% respectively. The favourable ratio applied for N and P all cereal and root crops for which there was reliable data.

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, to determine 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 range 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, soil use class, and participation in of the EU funded Rural Environment Protection Scheme (REPS).

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 1995, the FUS for this year was repeated using exactly the same table categories and statistical methods and the resulting 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 is listed in Appendix 2.

SURVEY METHODS AND VALIDATION

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 (Connolly et al, 2001). Farms are classified into major systems 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 – 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 – dairying, cattle, sheep and tillage.

The national farm distribution used in the NFS 2000 (Connolly *et al*, 2001) is shown in Table 1 using this simplified classification.

Table 1 Percentage Population of Irish farms with different farm size distributed by farm system

System	Farm Size (UAA in ha)						
	< 10	10-20	20-30	30-50	50-100	< 100	Total
Dairying	1.7	4.9	6.4	9.5	6.4	1.2	30.0
Cattle	7.6	18.5	12.0	8.3	3.5	0.6	50.6
Sheep	2.0	4.1	2.9	3.0	1.8	0.7	14.5
Tillage Systems	0.3	0.7	0.8	1.2	1.3	0.7	5.0
All Systems	11.6	28.2	22.1	22.0	12.9	3.2	100

Thus 30% 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 1130 farms. There were 147 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 1.

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 type and quantity of up to 6 fertilizer applications (up to 11 applications for grazing) was also given. The fertilizer type is coded into one of 75 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 range etc. The procedures used were based on those used by Murphy *et al* (1997) in the fertilizer use survey for 1995. However, in the tabulation of average values for 1995, the fertilizer usage was tabulated into un-weighted farm means. In this report, the mean values quoted for different crops are weighted according to the area of the crop on the farm in question. For some crops in the 2000 survey, e.g. for grazed grassland, weighting by area makes little difference although for others the difference can be significant. However, weighting by crop area was more important in the FUS for 1995, because at that time lower income farms, i.e. farms below two European size units (ESU, see glossary in Appendix 1) were included in the sample whereas in national farm surveys from 1996 onwards, farms below 2 ESU were excluded.

Furthermore, the farm categories such as region, soil use class, stocking rate range etc. used in this report are not the same in this report as in Murphy *et al* (1997). To allow comparison of this 2000 FUS data with results from the 1995 FUS, the data were re-analysed using the same procedures and categories as used for the 2000 data and the revised survey for 1995 is presented within this report.

In addition to mean fertilizer application rates, standard errors (s.e.) are also obtained. These give a measure of the variability of the values within 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. If one wished to compare two means to test whether they are significantly different; if the standard error of each of them is similar, then differences between the means greater than 2.8 times the s.e. would be significant at the 5% level. Thus in Table 3, the difference between the N use in the south and south-west is highly significant because the difference between the mean N rates is 84 kg/ha, this is more than 10 times the s.e. of 8.2.

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 2000 is reprinted in Appendix 1.

Land Use Ranges

The categorisation of farms into different ranges follows the classification of Gardiner and Radford (1980). Land use range 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 the NFS reports these are amalgamated into three groups, 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 ranges is regional distributed within 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 procedure use to validate the survey results was to compare the national annual sales of N, P and K published by the Department of Agriculture, Food and Rural Development with the amount calculated from the survey results for N, P and K usage for different crops and 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, 2001) gave the following information on sample numbers and representation for the NFS (Table 2). The upper part 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 participating farm.

In this fertilizer use survey, the grassland and tillage areas represented by each farm in each category were calculated from Table 2, together with information about the national areas under each crop, including grassland, in the survey. 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 gave an estimate of total annual consumption. The results were 407,915; 48,871 and 123161 tonnes for N P and K respectively.

Table 2: Farm sample numbers and representation for NFS 2000

	Number of Farms in the Survey with Different Total Area					
Farm Size (ha)	2 - 10	10 - 20	20 - 30	30 - 50	50 -100	> 100
Dairy	4	20	48	141	95	13
Dairy & Other	1	4	17	42	90	24
Cattle Rearing	10	55	45	69	26	4
Cattle Finishing	8	34	35	58	48	3
Mainly Sheep	2	25	20	39	30	13
Tillage	–	6	7	22	17	31
	Survey Representation of the National Population of Farms					
Farm Size (ha)	2 - 10	10 - 20	20 - 30	30 - 50	50 -100	>100
Dairy	272	195	111	51	38	13
Dairy & Other	974	529	153	107	48	24
Cattle Rearing	365	202	159	67	54	4
Cattle Finishing	712	343	217	99	62	3
Mainly Sheep	1255	203	181	93	72	13
Tillage	–	141	142	68	94	31

The agreement between the calculated consumption from the survey and the nationally published fertilizer sales figures of 407,598; 49,267 and 122,695 tonnes was remarkably good with error of only 0.1%, -0.8% and 0.4% 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 good agreement between fertilizer use and national statistics of fertilizer consumption shows that the results of this fertilizer use survey are valid and useful.

The national sales of N, P and K fertilizer in the year October 1, 1994 to September 30, 1995 were 428,826; 62,410 and 150,543 tonnes. Thus, sales in the year 2000 represented a decrease since 1995 of 5%, 22% and 18% for N, P and K respectively.

Comparison with Teagasc Advice

A statistical analysis of the Johnstown Castle soil analysis results for agricultural samples submitted in the year 2000 was undertaken to find out the percentage of samples which were at N, P and K Index 1, Index 2, Index 3

and Index 4 for each crop. The N Index depends on the crop to be grown, the previous cropping and the fertilization history of the soil. For P and K, the Index depends on the results of soil analysis. There were 40,000 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, 2001). 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 recommendation was calculated from the survey table of percentages of soils in each Index point for N, P and K and assuming that the NFS farms had the same distribution of soil analysis levels as the laboratory samples. This is not certain, as the samples submitted to the laboratory are taken for a variety of reasons and may under or over-estimate national fertility levels. However, they represent the only available estimates and in the following sections of this report, the calculated Teagasc mean advice levels are compared for each crop with the N, P and K use, 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 grazing area and the areas under hay or silage for part of the year are recorded as hay or silage areas. Whilst the estimates of the total amounts of N, P and K used on the total area of grassland are unbiased, there is an over estimation of the amounts of N, P and K per ha used for the grazing land (and consequently an underestimation for the hay and silage areas). The estimates of fertilizer use for hay and silage are unbiased. This survey dealt with this difficulty in the following way.

From a crop production and nutrient cycling point of view, fertiliser use on grassland can be divided into a number of discrete crop sub-systems. Four of these sub-systems cover almost all of the grassland, namely: i) grazing only, ii) one cut for hay plus grazing for the remainder of the year iii) one cut for silage plus grazing for the remainder of the year, iv) two cuts of silage plus grazing. Three and four silage cuts have become less used and only account for small areas.

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: as previously stated, the amounts of NPK for silage and hay are recorded correctly. The use of nutrients for grazing the silage and hay aftermaths were 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 was assumed to be approximately 50 percent of the total annual yield. Spring growths plus aftermaths of hay and midsummer silage were assumed to be 66 percent and aftermath of two-cut silage was assumed to be 33 percent.

In calculating the NPK per ha, the NPK recorded for grazing was divided by the grazing area plus 50% of spring grown silage area plus 66% of the hay and/or midsummer silage area.

Using this methodology, the average amounts of fertilizer nutrients applied to grazed grassland were estimated from the fertilizer used on 1051 NFS farms

which contained grassland. The mean overall values were 109, 9 and 21 kg/ha for N, P and K respectively. Table 3 and Figure 1 show the distribution of nutrient use classified by national region. It is clear that the amount of nutrients and particularly N used in the mid-east, midlands and south of the country was very much greater than that used in the border, south-west and west regions.

The mean N usage for grazing was 16% higher than that estimated for 1995 (Table 80) despite a 5% drop in national sales of N. The mean P and K usage dropped by 25% and 16% respectively; these are in good agreement with the national drop in P and K sales of 22% and 18%.

Table 3: Regional distribution of N, P and K application rates for grazing, number of farms with grazing and percentage of farms

REGION[1]	N	s.e.[2]	P	s.e.	K	s.e.	No.	Percentage of Total
	(kg/ha)							
South-East	138	7.7	10	0.8	22	1.9	154	13.8
Dublin	72	23.4	5	2.7	13	8.6	12	1.1
Mid-East	121	11.1	8	0.8	18	1.7	107	9.6
Midlands	105	9.6	10	0.9	22	1.9	108	9.7
Border	69	5.1	7	0.5	15	1.2	187	16.8
South-West	89	7.6	8	0.7	18	1.6	127	11.4
South	172	8.2	12	0.7	28	1.9	230	20.7
West	58	4.8	9	0.8	20	1.7	187	16.8
All	109	3.1	9	0.3	21	0.7	1112	100

[1] Regions are defined in terms of counties in the glossary given in Appendix 1.
[2] The standard error or s.e. gives a measure of the variability or reliability of an estimate. This is discussed more fully in the Survey Methods section of the report.

The estimated amount of N, P and K applied to grazing land in the different farm systems is shown in Table 4. 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 N application rates also depended on the size of the farm; Table 5 shows that on dairy farms, the N rates tended to be larger of farms of 30 ha or greater but there appeared to be no significant difference between the N rates for 30-50 ha farms and for farms larger than this. The P and K rates did not vary with the size of farm.

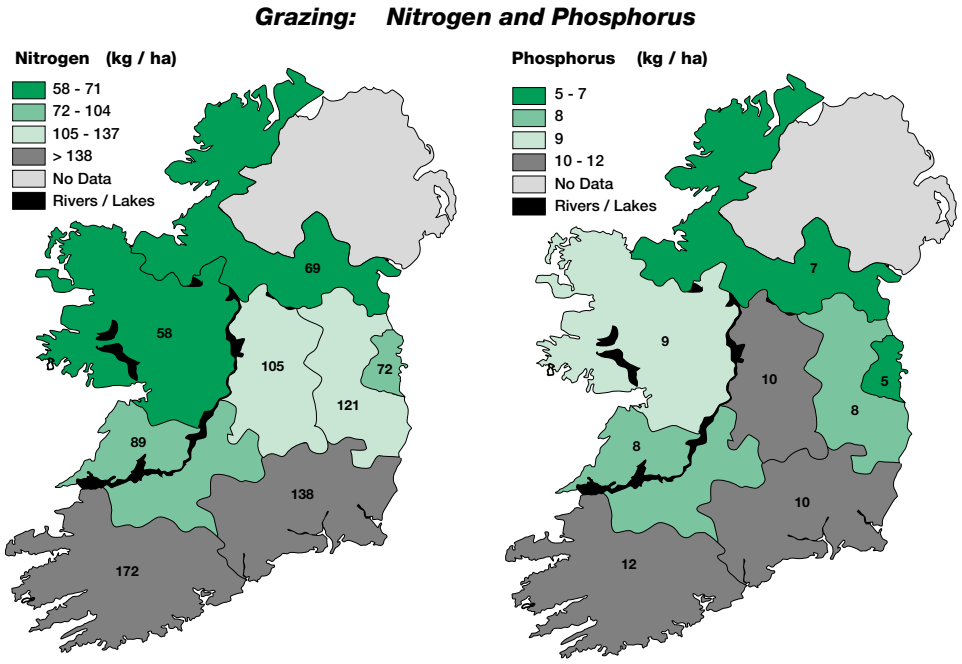

Figure 1: N and P for Grazing

Table 4: Estimated N, P and K fertilizer rates applied to grazed grassland for different farming systems

FARM SYSTEM	N	s.e.	P	s.e.	K	s.e.	No. of Farms	Percentage of total
	(kg/ha)							
Dairy	176	4.9	12	0.5	26	1.1	513	46.1
Cattle	48	2.2	8	0.4	17	1.1	399	35.9
Sheep	48	4.2	6	0.6	13	1.3	129	11.6
Tillage	79	9.1	7	1.1	17	2.7	71	6.4
All	109	3.1	9	0.3	21	0.7	1112	100

Table 5: Relationship between farm size (UAA) and nutrient application rates for grassland on dairy system farms

FARM SIZE (UAA ha)	N	s.e.	P	s.e.	K	s.e.	No of Farms	Percentage of total
	(kg/ha)							
10 - 20	123	23.4	14	3.5	30	7.2	26	2.3
20 - 30	157	13.8	10	0.9	22	2.1	67	6
30 - 50	182	8.5	12	0.7	27	1.7	188	16.9
50 -100	186	7.6	12	0.8	27	1.8	189	17
> 100	173	14.1	12	1.6	26	3.5	38	3.4
Dairy Overall	176	4.9	12	0.5	26	1.1	513	46.1

The effect of soil quality on nutrient applications to grazed grass is shown in Table 6. The highest rates of N and K were applied to the best soils although to achieve high stocking rates, it would be necessary to use larger amounts of N on the poorer soils.

Table 6: Effect of soil use range on nutrient use for grazing (kg/ha)

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	No of Farms	Percentage of total
		(kg/ha)							
1	Wide	156	6.4	10	0.5	23	1.4	358	32.2
2	Moderately Wide	94	6.4	9	0.8	20	1.6	178	16
3	Somewhat Limited	89	5.7	10	0.7	21	1.5	224	20.1
> 3	Limited	81	4.6	8	0.4	19	1.0	352	31.7
	All	109	3.1	9	0.3	21	0.7	1112	100

The fertilizer application rates for different stocking rates are shown in Tables 7-9 for farms in which the main systems are dairying, cattle and sheep respectively. Stocking rates are obtained by dividing the NFS livestock units (LU) by the area under grazing (see Appendix 1). The highest nutrient levels were found in dairy systems with much lower levels for cattle farms and even lower levels for sheep farms.

The N usage increases greatly with stocking rate for all systems. This effect was also found by Murphy *et* al (1997) in the FUS for 1995, and Coulter (2002) showed that the relationship between N usage on dairy farms and stocking

rate was linear for the FUS for 1999. Figure 2 shows the linear relationship between N usage and stocking rate for grazed dairy land for the NFS 2000 data.

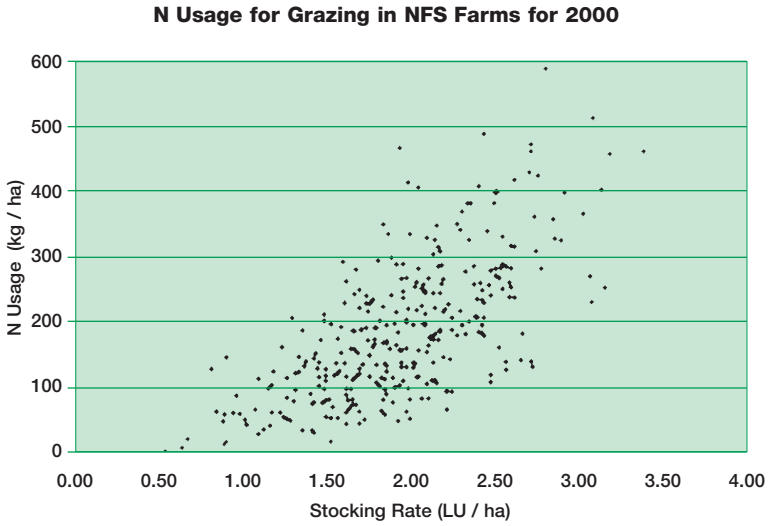

Figure 2 Relationship between Stocking Rate and N Usage on NFS 2000 Dairy Farms

Table 7: Fertilizer application rates (kg/ha) for mainly-dairy system farms by stocking rate

STOCKING RATE (LU/ha)	N	s.e	P	s.e	K	s.e	No of Farms
	(kg/ha)						
< 1.2	58	7.2	6	0.8	12	1.9	41
1.2 - 1.5	101	6.8	9	0.8	19	1.7	55
1.5 - 1.9	137	6.2	10	0.8	24	1.8	128
2.0 - 2.25	182	7.3	12	0.8	27	1.9	153
2.25 - 2.6	248	11.1	15	1.3	33	3.1	89
2.6 - 2.9	297	22.6	14	1.7	33	3.7	31
> 2.9	348	34.6	21	5.3	48	10.9	16

Table 8: Fertilization rates for mainly-cattle system farms by stocking rate

STOCKING RATE (LU/ha)	N	s.e	P	s.e	K	s.e	No of Farms
	(kg/ha)						
< 1.2	26	1.7	6	0.5	11	1	156
1.2 - 1.5	48	3.4	8	0.7	17	1.4	103
1.5 - 1.9	58	3.6	9	1.2	20	2.5	92
2.0 - 2.25	86	9.4	10	1.7	33	10.4	27
2.25 - 2.6	87	13.4	15	3.2	26	6.2	12

Table 9: Fertilization rates for mainly-sheep system farms by stocking rate

STOCKING RATE (LU/ha)	N	s.e	P	s.e	K	s.e	No of Farms
	(kg/ha)						
< 1.2	33	4.7	5	0.8	11	1.8	55
1.2 - 1.5	31	7.9	9	2.4	18	4.8	11
1.5 - 1.9	57	9	8	1.5	16	3.1	28
2.0 - 2.25	62	8.8	6	1.6	11	3.2	22
2.25 - 2.6	43	10.7	7	2.2	14	4.6	8

The estimated N usage is compared with Teagasc N advice for grazed grassland in Table 10. At stocking rates of 2.25 and above, the actual dairy N usage agrees quite well with Teagasc advice but below this stocking rate, actual N usage is higher than the advised rates, the difference increasing with stocking rate up to the rate of 2.25 LU/ha.

The N rates for grazing cattle are well below Teagasc rates, this could be because cattle farmers tend to place a greater reliance on clover than dairy farmers and therefore tend to use less N at a given stocking rate.

The application rates for sheep (Table 9) were low and difficult to compare with Teagasc advice as the quantity of clover in the sward was unknown and Teagasc advice for sheep is very dependent on both the stocking rate and the clover content of the sward.

Table 10: N usage and Teagasc N advice for grazed grassland by stocking rate

STOCKING RATE(LU/ha)	N Usage (kg/ha)	N Advice (kg/ha)
< 1.2	58	45
1.2 - 1.5	101	60
1.8	137	80
2.1	182	100
2.4	248	225
2.8	297	320
3.0	348	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 NFS 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, 2001). Thus, if one assumes that the NFS farms had the same distribution of soil analysis levels as the laboratory samples, and one takes into account the distribution of dairy and cattle farms in the survey, one can calculate the likely P and K advice for the NFS farms. This is discussed in the section on Survey Methods. Table 11 gives the results of the calculation for a range of stocking rates. At stocking rates of 2.1 LU/ha and above there is excellent agreement between the P and K usage on farms with mainly dairying and Teagasc advice; below this stocking rate the surveyed usage of P and K is lower than the rates advised by Teagasc for optimal animal production .

Table 11: 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)	K Usage (kg/ha)	P Advice (kg/ha)	K Advice (kg/ha)
< 1.2	6	12	9	23
1.2 - 1.5	9	19	11	25
1.8	10	24	13	27
2.1	12	27	14	29
2.4	15	33	16	31
2.8	14	33	18	33
3.0	21	48	20	35

Table 12 summarises the usage of different fertilizer compounds for grazing over the NFS farms. It shows the percentage of the N, P and K applications supplied by the different compounds and the number of farms which used the compound. CAN, high N compounds (e.g. 23:2.5:5) and urea supplied almost 92% of the N, high N compounds together with 18:6:12, 10:10:20 and 0:10:20 supplied 92% of the P. The K distribution mirrored the P distribution almost exactly with the same compounds plus 0:7:30 supplying over 95% of the K.

Table 12: Main sources of N, P and K for grazing (%) and number of NFS farms receiving the different compounds

COMPOUND	N	P	K	No of Farms
	Percentage from Each Compound			
C.A.N	40.6	–	–	708
S/A 21% N	0.5	–	–	5
UREA	17.3	–	–	55
SUPER 8%P	–	0.6	–	4
SUPER 16%P	–	1	–	3
POTASH 50%	–	–	2.9	1
0:7:30	–	3.6	7.0	10
0:10:20	–	9.8	8.8	10
10:10:20	1.1	13.8	12.4	52
14:7:14	0.1	0.5	0.5	1
18:6:12	6.5	27.2	24.5	127
High N Compounds	33.6	41.6	41.6	68
TOTAL	99.7	98.1	97.7	1044

Silage

The nutrients used for silage, classified by region, are presented in Table 13 and Figures 3 and 4. In general, the highest rates of N are found in the south-east, midlands, mid-east and south regions but highest P rates are found in the midlands and south-west.

The mean N, P and K usage for 2000 are 5%, 25% and 23% respectively below the estimated usage for 1995 (Table 87). This is in broad agreement with the drop in sales of N, P and K of 5%, 22% and 19% respectively.

Table 13: N, P and K for silage by region

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
South-East	136	5.5	14	0.9	42	2.8	138	16
Dublin	126	9.4	15	4.7	47	12.9	8	15
Mid-East	141	5.3	16	1.2	54	4	93	18
Midlands	137	5.5	18	1.2	56	3.7	98	16
Border	116	4.2	12	0.6	37	1.9	172	10
South-West	123	4.4	17	1.1	54	3.5	116	13
South	151	3.7	15	0.8	54	2.8	219	15
West	102	4.8	15	0.9	45	2.6	167	8
All	133	1.8	15	0.3	49	1.2	1011	13

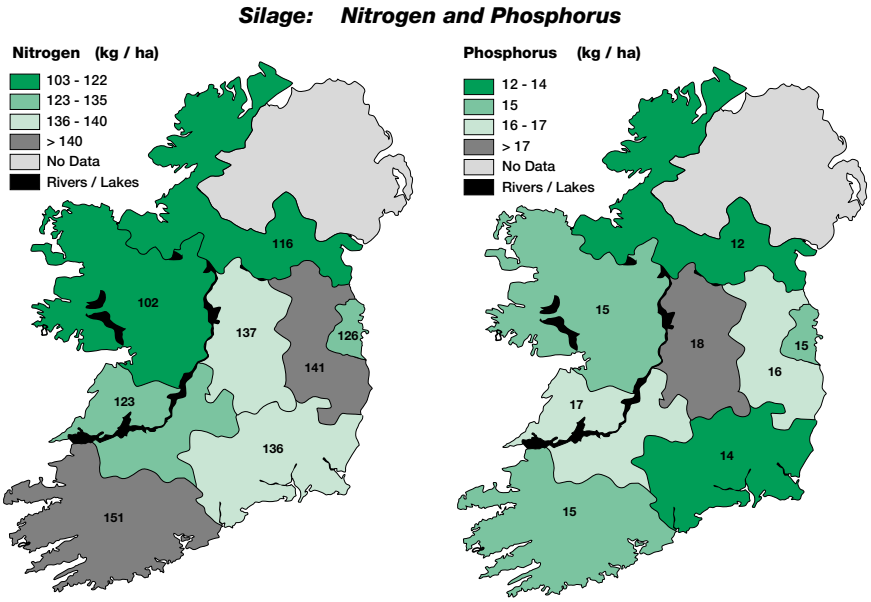

Figure 3: N and P usage for silage (kg/ha)

The effect of soil use-range on nutrient applications to silage is shown in Table 14. As with grazing, the highest rates of N and K were applied to the best soils, this effect is most pronounced for N. There is no clear pattern for P.

Table 14: Effect of soil use range on nutrients use for silage

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
		(kg/ha)							
1	Wide	148	3.3	15	0.6	52	2.2	331	17
2	Moderately Wide	132	4.1	14	0.9	46	2.8	158	13
3	Somewhat Limited	121	4.2	15	0.7	49	2.3	207	12
> 3	Limited	118	2.7	16	0.6	46	1.9	315	11
	All	133	1.8	15	0.3	49	1.2	1011	13

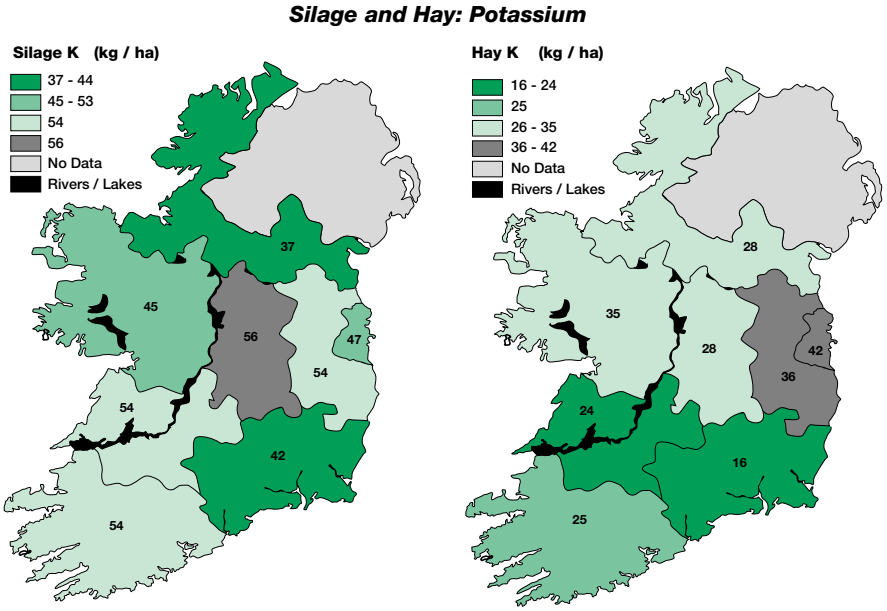

Figure 4: K fertilizer usage for silage and hay (kg/ha)

The estimated amount of N, P and K applied to silage land in the different farm systems is shown in Table 15.

Table 15: Estimated N, P and K fertilizer applied to silage ground for different farming systems

FARM SYSTEM	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
Dairy	151	2.5	16	0.5	53	1.7	504	17.5
Cattle	95	2.3	14	0.5	41	1.6	353	9.0
Sheep	94	3.9	14	1.3	39	3.2	101	6.8
Tillage	116	8.4	13	1.5	44	5.0	53	13.1
All	133	1.8	15	0.3	49	1.2	1011	13.2

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, although the differences are not as great as the differences for different farm enterprises under grazing (see Table 4).

The nutrient rates also depend on the size of the farm. Table 16 shows that the N and K rates for silage tend to be higher on dairy farms of 30 ha or larger. 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 errors for N, P and K rates on the 10-20 ha farms are high, suggesting that the fertilizer use varies widely between the farms.

Table 16: 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.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
10 - 20	139	21.6	17	2.4	48	6.6	22	5.7
20 - 30	136	5.8	13	1.1	50	4.5	65	8.6
30 - 50	147	4.5	15	0.7	54	2.7	187	13.4
50 -100	152	3.8	16	0.8	53	2.8	187	22.9
> 100	164	7.6	17	2.1	57	7.0	38	35.2
All	151	2.5	16	0.5	53	1.7	504	17.5

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 present survey cannot distinguish between cuts, times of application or spread slurry so it is difficult to determine if the average of 133 kg/ha (Table 15) is in line with Teagasc advice. However, 281 of 993 silage farms (28%) applied more than 150 kg/ha N. If it is assumed that these high N application rates were for two silage cuts, then 28% of farms would follow the advice for two cuts. Assuming most of the grazing was on old pasture, Teagasc N advice for a composite of 72% of one cut and 28% of two cuts of silage would be 116 kg/ha assuming slurry and 146 kg/ha assuming no slurry. Actual usage was 133 kg/ha (Table 15) showing that farmers either slightly overused N, did not appreciate the N in slurry or that not all the slurry was 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, 2001). The total nutrients required are also tabulated; a summary of the advice is shown in Table 17 for soils cropped with 1 or 2 cuts of silage.

Table 17: 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 for silage in the four Index categories were 16%, 36%, 25% and 22% for P and 15%, 47%, 23% and 15% for K respectively. Using information from Table 17, the percentage of NFS 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 18). Comparison between the calculated advice in the Table and the mean nutrient applications for the NFS farms shows that the N and P usage on the NFS farms was about midway between the slurry and no-slurry advice suggesting that in only about half of the NFS farms were the P and K nutrients in slurry taken into account.

Table 18: P and K fertilizer advice for silage (kg/ha)

	P (kg/ha)		K (kg/ha)	
	Slurry	No Slurry	Slurry	No Slurry
Teagasc Advice	7	25	19	136
Nutrient Application (as per table 15)	15		49	

Table 19 gives the main fertilizer compounds used for silage. Compounds which were used on only one of the NFS farms were omitted. The pattern is similar to that for grazing land; high N compounds, CAN, urea and 18:6:12 supplied over 99% of the N. High N compounds together with 0:7:30, 18:6:12, 0:10:20 and 10:10:20 supplied 98.4% of the P and the same compounds supplied 98% of the K. Straight K accounted for only 1.6% of the K use for silage.

Table 19: Main sources of N, P and K for silage on all farms

COMPOUND	N	P	K	No of Farms
	Percentage from Each Compound			
High N Compounds	49	45.4	48.2	661
C.A.N	25.7	–	–	344
S/A 21% N	0.2	–	–	2
UREA	17.6	–	–	153
SUPER 16%P	–	0.8	–	5
POTASH 50%	–	0	1.6	11
0:7:30	–	23.6	31.3	165
0:10:20	–	5.5	3.4	38
10:10:20	0.4	3.5	2.2	36
14:7:14	–	0.2	0.1	2
18:6:12	7	20.4	12.6	219
TOTAL	99.9	99.4	99.4	1636

Hay

The N, P and K fertilizer rates for hay are classified by region in Table 20 and Figures 4 and 5. The N rates are not as variable 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. With the exception of Dublin which represents a small

variable sample, the highest usage of P and K were found in the west, mid-east and border regions.

The mean N, P and K usage for hay in 2000 are 5%, 27% and 23% respectively below the estimated usage for 1995 (Table 91). This is in broad agreement with the drop in sales of N, P and K of 5%, 22% and 19% respectively.

The Table shows that hay was made on 470 of the NFS farms compared to 1011 farms which made silage (Table 13). This represents 43% of the farms which made either or both. However, the mean hay area on the NFS farms was 3.7 ha compared to 13.2 ha for silage, thus the area of hay grown represented only 12% of the total conserved grass area. The summer of 2000 had many more dry periods than average; in particular it had a long dry spell at the end of July making it very suitable for haymaking (Schulte, personal comm.). In 1999, 36% of grassland farms made hay representing less than 10% of the conserved grass area (Coulter, *unpublished work*).

Table 20: N, P and K for hay by region

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
South-East	48	4.7	7	1	16	2.2	74	4.2
Dublin	57	15	21	5.9	42	11.7	7	3.7
Mid-East	65	4.4	12	1.4	36	4.4	48	6.3
Midlands	35	3.6	11	1.7	28	4.2	58	4.8
Border	56	3.3	12	1.1	28	2.5	70	3.2
South-West	49	3.2	9	1.1	24	3.3	72	3.6
South	70	4.6	9	0.9	25	2.2	71	2.3
West	56	4.2	15	1.8	35	4.1	70	2.7
All	53	1.6	11	0.5	27	1.3	470	3.7

The effect of soil quality on nutrient applications to hay is shown in Table 21. Unlike grazing and silage, highest rates of N and K were applied to soil class 2 which has a narrower use range than the best grassland soils (Gardiner and Radford, 1980). The highest rates of P were applied to hay on Soil Class 3

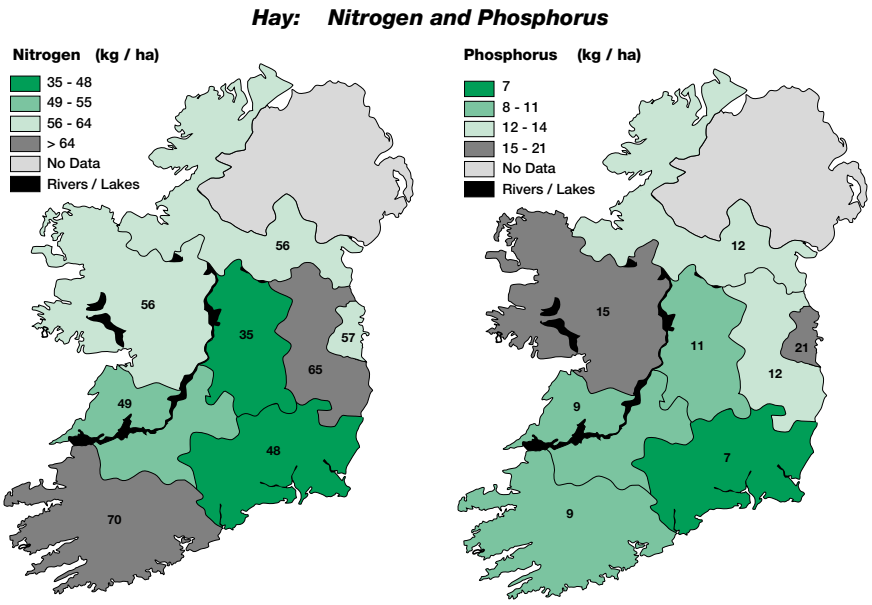

Figure 5: N and P fertilizer usage for hay

Table 21: Effect of soil use range on nutrients for hay

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
		(kg/ha)							
1	Wide	51	2.9	11	0.9	27	2.1	159	3.9
2	Moderately Wide	58	3.8	9	1.3	31	3.8	82	4.6
3	Somewhat Limited	53	3.3	14	1.2	29	2.6	94	3.4
> 3	Limited	50	2.7	9	0.7	23	2	135	3.3
	All	53	1.6	11	0.5	27	1.3	470	3.7

The estimated amount of N, P and K applied to hay in the different farming systems is shown in Table 22.

Table 22: Estimated N, P and K fertilizer applied to hay under different farming systems

FARM SYSTEM	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area(ha)
	(kg/ha)							
Dairy	55	2.5	10	0.8	25	2.1	208	3.1
Cattle	47	2.3	12	0.7	28	1.7	170	3.7
Sheep	57	4.9	11	1.5	25	3.1	51	3.6
Tillage	60	5.8	10	1.7	34	5.2	41	7.1
All	53	1.6	11	0.5	27	1.3	470	3.7

The N and K application rates for hay are higher on mainly tillage farms than on the other farm systems, and the N for hay on cattle farms is significantly lower than on the other systems. As already noted, N rates are rather low for hay. P rates do not vary very much with the type of farm. A higher rate of N might be expected on tillage farms, as tillage tends to deplete the N supply of the soil.

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 NFS farms was 53 kg/ha which is consistent with good use of slurry N on the farms.

The percentage of soil samples for hay in the four Index categories were 22%, 37%, 24% and 16% for P and 20%, 50%, 18% and 12% for K respectively. Appropriate Teagasc P and K advice was calculated for the farms from Teagasc K advice for hay assuming the above distribution of Index 1-4 soil analysis categories applied in the survey. Comparison between the calculated advice in the Table and the mean nutrient applications for the NFS farms (Table 23) suggests that where organic manure was applied to hay, its P and K nutrients were taken fully into account. Where slurry was not used it is likely that fertilizer rates were low.

Table 23: Calculated P and K fertilizer advice for hay on the NFS farms and actual application rates.

	P (kg/ha)		K (kg/ha)	
	Slurry	No Slurry	Slurry	No Slurry
Teagasc Advice	8	25	11	132
Nutrient Application	15		49	

Table 24 gives the main fertilizer compounds used for hay. High N compounds, together with 18:6:12, CAN and urea supply almost 96% of the N; high N compounds together with 18:6:12, 10:10:20, 0:7:30 and 0:10:20 supply 99% of the P and 97% of the K. Straight K accounts for only 2.7% of the K use for hay.

Table 24: Main sources of N, P and K for hay on all farms

COMPOUND	N	P	K	No of Farms
	Percentage from Each Compound			
High N Compounds	47.8	23.8	28.4	152
CAN	18.2	–	–	67
UREA	7	–	–	14
SUPER 8% P	–	0.8	–	1
POTASH 50% K	–	–	2.7	2
0:7:30	–	10.4	17.6	19
0:10:20	–	7.1	5.6	10
10:10:20	4.1	20.1	15.8	40
18:6:12	22.8	37.5	29.5	116
TOTAL	99.9	99.7	99.6	422

Forage Maize

Forage maize is included under grassland as it is used exclusively as a livestock feed. The nutrients used for forage maize are shown in Table 25 classified by region. A total of only 41 farms in the NFS grew forage maize. Since the sample size is small, standard errors are large and it is difficult to make valid comparisons between the regions. Comparison with Table 94 show that the crop was much more widely grown in 2000 than in 1995 when it was found on only 10 NFS farms in two regions compared to 41 farms in 5 regions in 2000.

The estimated fertilizer usage for 1995 (Table 94) shows a slight drop in N and P use in line with the drop in national sales, but there appeared to be an increase of 18% in K usage over the period. However this difference is not statistically significant due to high standard errors.

Table 25: N, P and K for maize by region

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area(ha)
	(kg/ha)							
South-East	98	10.3	22	3.2	51	7.2	18	5
Mid-East	86	21.1	20	5.1	57	12.2	9	9
Midlands	163	12.8	39	10.5	64	33.2	4	6
Border	53	20.5	34	15.7	75	26.1	3	9
South	125	19.3	27	19.1	55	38.2	6	4
All	99	8.5	25	3.4	58	7.1	41	6

The effect of soil quality on nutrient applications to maize is shown in Table 26. Again, sample sizes are too small in classes 3 and greater to make valid comparisons.

Table 26: Effect of soil use range on nutrients for maize

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
		(kg/ha)							
1	Wide	109	10.5	23	5.3	60	11.4	23	5
2	Moderately Wide	70	16.8	27	5.5	54	10	11	8
3	Somewhat Limited	130	17	23	7.5	47	14.9	4	5
> 3	Limited	146	21.1	34	13.8	77	36.4	3	5
	All	99	8.5	25	3.4	58	7.1	41	6

The amounts of N, P and K applied to maize under two farming systems are shown in Table 27. The application rates for N on dairy farms were 62% greater than on tillage farms. Differences were not significant for the other nutrients.

Table 27: N, P and K fertilizer applied to maize for dairy and tillage farm systems

FARM SYSTEM	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
Dairy	107	9.2	26	3.8	58	8	32	5
Tillage	66	17	21	7.8	48	15.3	8	8
All	99	8.5	25	3.4	58	7.1	40	6

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 NFS 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.

Table 28 gives the main sources of fertilizer nutrients for forage maize. CAN, urea, 18:6:12 and high N compounds supply most of the N, 10:10:20, 18:6:12, 8% super phosphate and 0:7:30 supply most of the P while 0:7:30, 10:10:20 and 18:6:12 supply the majority of the K.

Table 28: Main sources of N, P and K for forage maize on all farms

COMPOUND	N	P	K	No of Farms
	Percentage from Each Source			
High N Compounds	13.6	5.6	6.5	6
CAN	31.6	–	–	11
UREA	21.5	–	–	6
SUPER 16% P	–	16.1	–	7
POTASH 42 & 50% K	–	–	6.9	2
0:7:30	–	15.5	29	5
10:10:20	6.8	26.6	23.2	7
14:7:14	2.4	4.6	4	2
16:5:20	3.0	3.7	6.5	1
18:6:12	19.8	25.9	22.5	12
TOTAL	98.7	98	98.6	59

FERTILIZER USE FOR TILLAGE CROPS

The nutrient usage for the most commonly grown tillage crops is analysed in this section. Tillage was grown in most parts of the country in 1970, since then the occurrence of tillage has reduced to the area south-east of a line drawn between County Louth and County Cork (Coulter *et al,* 1998) This is reflected by the present survey, in which data is incomplete in most of the regional tables.

Winter Barley

This crop was grown on only 32 farms out of the 1130 farms in the survey. The nutrients used for winter barley are shown in Table 29 classified by region. No barley was grown on NFS farms in the south-west or west and information for the midlands and Dublin regions have been omitted from the regional Table as the crop was grown on only one farm in each. It was found in only 3 NFS farms in the south and 4 in the south-east, thus preventing comparisons with these regions due to high standard errors. The N and K rates for the border and mid-east regions were almost the same, although the P rates for the border region were 50% higher than that for the mid-east.

Table 29: N, P and K use for winter barley by region

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
South-East	172	16.4	17	12.8	38	25.1	4	25
Mid-East	185	6.4	22	3.4	80	12.6	10	26
Border	185	9.3	34	3.4	77	7.8	13	17
South	177	18.3	18	1.1	36	2.1	3	16
All	181	4.7	26	2.6	69	6.6	32	21

The mean N usage for winter barley showed an increase of 27% over the estimate for 1995 (Table 96) despite a 5% drop in national sales of N. The mean P and K usage dropped by 10% and 18% compared to the national drop in P and K sales of 22% and 18%.

Winter barley was grown on only two of the soil classes (Table 30) and the effect of soil quality on N, P or K applications was not significant.

Table 30: Effect of soil use range on nutrient usage for winter barley

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
		(kg/ha)							
1	Wide	179	6.4	23	3.5	67	10.3	16	26
2	Moderately Wide	185	7.4	31	4.1	73	8.3	14	17
	All	181	4.7	26	2.6	69	6.6	30	21

Fertilizer usage in two of the farm systems is shown in Table 31. Because of small number of dairy farms in the Table the s.e. for dairy farms is high, thus one cannot confirm that the usage of N and K applied to winter barley was greater on mainly tillage farms than they was on dairy farms. Winter barley was not grown on cattle or sheep farms in the survey.

Table 31: N, P and K fertilizer applied to winter barley for dairy and tillage farm systems

FARM SYSTEM	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
Dairy	165	12.7	26	7.5	52	15.1	5	10
Tillage	182	5.1	26	2.8	70	7.2	27	23
All	181	4.7	26	2.6	69	6.6	32	21

Teagasc N advice for winter barley is 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 181 kg/ha for NFS farms was significantly higher than the calculated mean Teagasc recommendation of 156 kg/ha.

Teagasc P and K advice was calculated by assuming the same distribution of Index 1-4 soils for P and K in NFS farms as found in a national soil analysis survey, as described before. The mean results were 25 kg/ha and 66 kg/ha for P and K respectively. This matches almost exactly the rates used on the NFS farms.

Spring Barley

The nutrients used for spring barley are shown in Table 32 and Figure 6, both classified by region. There is relatively wide distribution of this crop although the number of occurrences in the survey for the west and south-western

counties is small (Table 32). The N, P and K rates for Dublin were the highest and N and P in the border region were high but strangely, the south-west had the lowest N but the highest P and K. However, only three NFS farms in this region grew spring barley and the standard errors of the estimates were high, particularly in the west.

The rates for spring barley in 2000 are approximately the same as those estimated for 1995 (Table 97).

Table 32: N, P and K for spring barley by region

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
South-East	119	4.5	23	1.7	47	2.4	45	13
Dublin	133	9.4	36	3	71	6	7	15
Mid-East	109	5.9	25	2.3	52	4.7	20	14
Midlands	111	5.8	23	2.2	54	3.7	17	7
Border	126	5	27	2	53	3.9	26	12
South	100	5.2	20	1.6	41	3.2	24	10
South-West	54	12.4	38	3.7	76	7.4	3	7
West	78	36.4	26	7.4	51	14.8	3	4
All	115	2.5	25	0.9	51	1.6	145	12

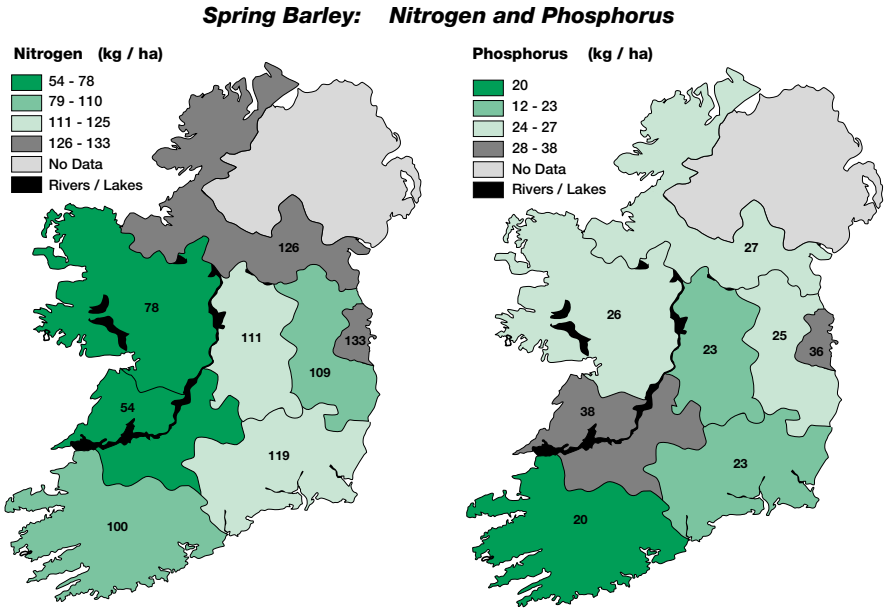

Figure 6: Regional N and P rates for spring barley

The effect of soil quality on nutrient applications to spring barley is shown in Table 33.

Table 33: Effect of soil use range on nutrient use for spring barley

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
		(kg/ha)							
1	Wide	112	3	25	1.1	49	2	82	11
2	Moderately Wide	121	4.5	22	1.9	48	2.8	41	13
3	Somewhat Limited	119	9.2	30	2.5	59	5.2	15	14
> 3	Limited	92	15.1	36	4.2	73	7.7	7	4
	All	115	2.5	25	0.9	51	1.6	145	12

The amount of N, P and K applied to spring barley in the different farming systems is presented in Table 34.

Table 34: N, P and K fertilizer applied to spring barley for different farming systems

FARM SYSTEM	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
Dairy	109	3.4	25	1.2	49	2.3	72	9
Other Livestock	78	8.6	25	2.9	53	5.1	21	4
Tillage	123	3.5	25	1.5	52	2.5	52	18
All	115	2.5	25	0.9	51	1.6	145	12

Teagasc N advice for spring barley is 120 kg/ha for Index 2 and 100 kg/ha for Index 3 soils. The mean N application rate for NFS farms was 115 kg/ha which corresponds to with calculated Teagasc advice of 118 kg/ha. Teagasc P and K advice was calculated by assuming the same distribution of Index 1-4 soils for P and K in NFS 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 the rates used on the NFS farms.

Malting Barley

The nutrients used for malting barley are shown in Table 35 classified by region. The mean N usage for malting barley was 9% higher than that estimated for 1995 (Table 98) despite a 5% drop in national sales of N. The mean P and K usage dropped by 14% and 18% respectively; these are in reasonable agreement with the national drop in P and K sales of 22% and 18%.

Table 35: N, P and K for malting barley by region

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
South-East	125	7	20	2	49	3.3	28	14
Mid-East	119	9.3	15	5.2	43	7.8	8	19
Midlands	106	4.9	20	2.8	61	5.2	7	17
South	116	8.1	19	4	47	5.7	8	9
All	120	4.3	19	1.5	49	2.5	52	14

The effect of soil quality on nutrient applications to malting barley is shown in Table 36. Most of the malting barley was grown on the better soils

Table 36: Effect of soil use range on nutrient use for malting barley

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
		(kg/ha)							
1	Wide	115	4.3	23	1.5	46	2.6	36	15
2	Moderately Wide	135	10.7	8	2.4	53	6.2	14	14
	All	120	4.3	19	1.5	49	2.5	52	14

The amount of N, P and K applied to malting barley in the different farming systems is presented in Table 37.

Table 37: N, P and K fertilizer applied to malting barley for different farming systems

FARM SYSTEM	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
Dairy	115	5.2	23	1.6	51	2.8	25	12
Other Livestock	86	8.5	18	3.1	46	9.2	5	12
Tillage	128	6.9	16	2.7	47	4.5	22	18
All	120	4.3	19	1.5	49	2.5	52	14

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 somewhat higher in the NFS farms than the calculated advice of 100. Estimated Teagasc P and K advice for the NFS farms is 24 and 53 kg/ha which matches the application rates for malting barley in Table 36.

Winter Wheat

The nutrients used for winter wheat are shown in Table 38, classified by region. The N and P rates for the border area are much higher than for any other region. This effect was not found in the FUS for 1995 (Table 99) where N rates were also highest in the Border region.

Table 38: N, P and K for winter wheat by region

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
South-East	185	12.1	17	6.8	39	14.9	9	40
Dublin	201	7.8	22	8.5	80	2.6	5	58
Mid-East	209	7.2	28	2.2	81	8.6	21	41
Border	223	7.6	35	2.0	76	6.4	12	45
South	179	14.5	24	4.7	47	9.4	3	11
All	207	4.5	27	2.0	72	5.1	51	41

The mean N usage for winter wheat increased by 11% over that estimated for 1995 (Table 98) despite a 5% drop in national sales of N. The mean P was unchanged and K usage dropped by 18% in line with the national drop in K sales.

The effect of soil quality on nutrient applications to winter wheat is shown in Table 39.

Table 39: Effect of soil use range on nutrients for winter wheat

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
		(kg/ha)							
1	Wide	202	6.1	24	2.7	64	8.4	27	40
2	Moderately Wide	216	7.9	30	3.4	81	6.1	17	51
3	Somewhat Limited	187	7.2	36	3.2	73	6.4	7	20
	All	207	4.5	27	2	72	5.1	51	41

The amount of N, P and K applied to winter wheat in the different farming systems is shown in Table 40.

Table 40: N, P and K fertilizer applied to winter wheat for dairy and tillage farm systems

FARM SYSTEM	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
Dairy	166	13.1	28	3.1	62	8	12	13
Tillage	210	4.7	27	2.3	72	6	38	51
All	207	4.5	27	2	72	5.1	50	41

Teagasc N advice for winter wheat depends on both the soil N index and the expected yield. Taking the soil analysis survey data for N, P and K Index as applicable, the calculated Teagasc N advice for normal grain yields (9 t/ha of dry matter) would be 172 kg/ha and the advice for very high yields (11 t/ha or greater) would be 207 kg/ha.

The provision for extra N for high yielding crops was introduced into Teagasc advice in 2001. Before that time, the maximum N recommendation was 185 kg/ha for medium and heavy textured soils and 210 kg/ha for those shallow or sandy soils which can sustain a high level of output. Because soils were not all light textured and all crops cannot have been top-yielding, N usage appears to exceed Teagasc advice.

The calculated mean Teagasc P and K advice for winter wheat on the NFS farms was 25 and 67 kg/ha respectively. The usage presented in Table 39 matches this advice very well.

Spring Wheat

The nutrients used for spring wheat are shown in Table 41, classified by region. The number of farms is too small and standard errors are too high to measure differences in fertilizer use data between the different regions.

Table 41: N, P and K for spring wheat by region

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
South-East	150	16.5	17	3.8	39	5.4	7	17
Dublin	153	7.5	13	12.4	51	14.2	3	26
Mid-East	171	2.4	21	8.2	42	16.4	4	23
Border	115	24	22	9.3	45	18.6	3	8
South	172	9.4	20	3.1	39	6.2	5	14
All	160	7.2	18	2.6	42	4.3	22	16

The mean N, P and K usage for spring wheat were 5%, 28% and 28% lower than the estimates for 1995 (Table 100). The drop in N use was in line with national sales but drop in P and K usage was greater than the national drop in P and K sales of 22% and 18% respectively.

The effect of soil quality on nutrient applications to spring wheat (Table 42) shows that spring wheat is grown only on better soils. The N and P usage appears to be greater on soils of class 1.

Table 42: Effect of soil use range on nutrients for spring wheat

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
		(kg/ha)							
1	Wide	168	8.3	22	2.9	44	5.7	13	20
2	Moderately Wide	143	13.3	10	4.7	41	6.7	10	12
	All	160	7.2	18	2.6	42	4.3	23	16

The amount of N, P and K applied to spring wheat in the different farming systems is shown in Table 43.

Table 43: N, P and K fertilizer applied to spring wheat for dairy and tillage farm systems

FARM SYSTEM	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
Dairy	147	12.8	24	4.6	47	9.2	8	8
Tillage	162	8.8	17	3.2	41	5	16	20
All	160	7.2	18	2.6	42	4.3	24	16

The calculated mean Teagasc N recommendations for spring wheat was 112 kg/ha. If one assumed that each farm achieved high yields of grain (9.5 t/ha or greater), the calculated rate was 148 kg/ha. Thus the N usage on the NFS farms was much higher than Teagasc advises. The calculated advice rates for P and K were 26 and 57 kg/ha. Fertilizer use of these elements for spring wheat (Table 43) appears to be below these optima.

Winter Oats

The nutrients used for winter oats are shown in Table 44 classified by region. The N usage shows a considerable increase since 1995 (Table 101) but the P and K usage are relatively unchanged.

Table 44: N, P and K for winter oats by region

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
South-East	149	10.9	38	6.4	83	8.1	4	14
Dublin	129	14.3	34	5.7	89	14.5	3	13
Mid-East	174	31.4	23	5.7	66	26.5	4	17
Border	172	8.6	29	2.6	61	6.5	9	16
South	156	14.5	10	7.4	20	14.8	4	8
All	162	7.4	28	2.5	65	6.6	24	14

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

Table 45: Effect of soil use range on nutrients for winter oats

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
		(kg/ha)							
1	Wide	158	10.4	26	3.4	62	10.1	15	14
2	Moderately Wide	169	13.5	34	4	74	7.8	6	18
3	Somewhat Limited	163	8.1	25	1.8	51	3.7	3	7
	All	162	7.4	28	2.5	65	6.6	24	14

The amount of N, P and K applied to winter oats for dairying and tillage systems is shown in Table 46. The crop was not found in the other livestock farming systems.

Table 46: N, P and K fertilizer applied to winter oats for dairy and tillage farm systems

FARM SYSTEM	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
Dairy	147	15.1	18	5.8	49	19.2	5	6
Tillage	164	8.6	29	2.8	67	7.5	18	17
All	162	7.4	28	2.5	65	6.6	24	14

The calculated mean Teagasc N recommendations for winter oats was 108 kg/ha. For shallow/sandy soil, the calculated advice would be 138 kg/ha. Thus the N usage on the NFS farms is much higher than Teagasc advises. The advice for P and K was 21 and 67 kg/ha respectively. Fertilizer use of P on tillage farms was higher than Teagasc advice but K levels for winter oats on dairy farms (Table 46) and on somewhat limited use range soils (Table 45) appear to be slightly below optimum.

Spring Oats

The nutrients used for spring oats are presented in Table 47 classified by region. The use of P and K in the mid-east appears to be much lower than in the other regions although farm numbers are small and standard errors large making comparisons with other regions difficult.

Table 47: N, P and K for spring oats by region

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
South-East	94	11.1	35	1.6	71	3.3	5	3
Mid-East	122	15.2	16	3.1	33	7.3	4	9
Border	122	10.9	28	2.5	57	5.1	12	6
All	118	7.7	26	2	50	4.1	24	6

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

Table 48: Effect of soil use range on nutrients for spring oats

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
		(kg/ha)							
1	Wide	130	13	26	4.6	49	9.8	8	8
2	Moderately Wide	108	10.1	24	1.3	48	2.6	12	5
3	Somewhat Limited	95	26.8	35	4.5	74	5.6	4	2
	All	118	7.7	26	2	50	4.1	24	6

The amount of N, P and K applied to spring oats in the different farming systems is shown in Table 49.

Table 49: N, P and K fertilizer applied for spring oats for different farming systems

FARM SYSTEM	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
Dairy	103	10.4	26	2.4	51	4.8	10	5
Other Livestock	39	12.5	27	3.8	41	12.5	6	2
Tillage	137	7.5	25	4	51	8	8	10
All	118	7.7	26	2	50	4.1	24	6

The calculated mean Teagasc N, P and K recommendations for spring oats were 100, 32 and 58 kg/ha respectively. Fertilizer usage of each nutrient for spring oats (Table 49) appears to be slightly above optimum for N. Nitrogen use on the other-livestock farms in the survey was very low. P and K use was uniform across farm systems and somewhat below advised rates.

Fertilizer Compounds for Cereals

The fertilizer compounds used for supply of N, P and K to cereals are listed in Tables 50-52 and the total number of times the fertilizers were used on the tillage farms in 2000 is shown in Table 53

Table 50: Main sources of N for cereals

	Percent Usage for Cereal Crops						
COMPOUND	W.Wh.	S.Wh.	W.Bar.	S.Bar.	M.Bar.	W.Oats	S.Oats
High N Compounds	0.6	3.4	0.5	4.5	9.6	2.1	–
CAN	76.7	72.1	72.5	51.3	53.7	71.4	58.7
UREA	10.4	2.6	13.6	1.8	–	9.6	–
10:10:20	6.9	5.4	4.7	9.6	2.3	8.2	10.5
14:7:14	0.1	–	–	1.9	7.7	–	–
15:3:20	–	–	–	–	2.4	–	–
15:10:10	0.3	–	–	1	2.4	–	–
16:5:20	0.4	–	–	0.1	2.4	–	–
18:6:12	4.2	16.3	8.7	29	19.6	8.7	30.5
All	99.6	99.8	100	99.2	100.1	100	99.7

Table 51: Main sources of P for cereals

	Percent Usage for Cereal Crops						
COMPOUND	W.Wh.	S.Wh.	W.Bar.	S.Bar.	M.Bar.	W.Oats	S.Oats
High N Compounds	0.1	1.9	–	1.1	0.4	0.6	–
0:7:30	18.2	–	26.6	–	–	11.8	–
0:10:20	15.4	–	20	0.8	0.7	24.1	1.5
10:10:20	52.7	48.6	32.9	44.8	14.6	46.8	48.1
14:7:14	0.5	–	–	4.5	24.6	–	–
15:3:20	–	–	–	–	3	–	–
15:10:10	1.4	–	–	3	10.1	–	–
16:5:20	0.9	–	–	0.2	4.8	–	–
18:6:12	10.7	48.6	20.5	45.1	41.7	16.6	46.7
All	99.9	99.1	100	99.5	99.9	99.9	96.3

Table 52: Main sources of K for cereals

COMPOUND	Percent Usage for Cereal Crops						
	W.Wh.	S.Wh.	W.Bar.	S.Bar.	M.Bar.	W.Oats	S.Oats
High N Compounds	1	4.8	1	5.4	17.1	2.3	–
POTASH 50% K	7.7	12.1	1.9	–	1.5	–	–
0:7:30	29.5	–	42.5	–	–	21.9	–
0:10:20	11.7	–	14.9	0.8	0.6	20.9	1.5
10:10:20	39.8	41.2	24.5	43.7	11.2	40.5	49
14:7:14	0.3	–	–	4.4	18.8	–	–
15:3:20	–	–	–	–	7.7	–	–
15:10:10	0.5	–	–	1.4	3.9	–	–
16:5:20	1.3	–	–	0.3	7.3	–	–
18:6:12	8.1	41.1	15.3	44	31.9	14.4	47.6
All	99.9	99.2	100.1	100	100	100	98.1

Table 53: Number of times each fertilizer compound was used for cereals on NFS farms

COMPOUND	Frequency of Use for Cereal Crops							
	W.Wh.	S.Wh.	W.Bar.	S.Bar.	M.Bar.	W.Oats	S.Oats	Total
High N Compounds	3	5	1	15	9	2	0	35
CAN	50	22	32	108	52	21	15	300
UREA	6	2	4	4	0	3	0	19
POTASH50%K	2	0	1	0	2	0	0	5
0:7:30	10	1	6	0	0	3	0	20
0:10:20	12	0	6	2	1	5	1	27
10:10:20	18	0	8	46	7	7	0	86
14:7:14	1	6	0	6	8	0	8	29
15:3:20	0	0	0	0	4	0	0	4
15:10:10	1	0	0	4	2	0	0	7
16:5:20	1	0	0	1	4	0	0	6
18:6:12	12	11	10	81	22	7	12	155
All	116	47	68	267	111	48	36	693

Sugar Beet

The nutrients used for sugar beet are shown in Table 54 classified by region. Nitrogen application rates appear to be highest in the midlands but differences were not significant between any of the regions. Phosphorus rates were highest in the midlands and lowest in the south and K rates were much lower in the south than elsewhere (Figure 7). The N and P rates for the border region are not given in Table 54 as they apply to one farm only in Co Louth.

Table 54: N, P and K for sugar beet by region

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
South-East	159	8	50	4.4	170	8.1	32	8
Mid-East	160	8.2	55	9.9	173	21.6	7	8
Midlands	176	19.2	70	6.7	180	15.6	7	5
South	159	8.6	40	1.6	143	5.8	12	12
All	160	5	49	2.8	165	5.7	58	8

The mean N, P and K usage for sugar beet 2000 were 14%, 35% and 20% respectively below the estimated usage for 1995 (Table 106). Thus N and P usage for sugar beet has dropped considerably more than the drop in sales of these nutrients would suggest.

The effect of soil quality on nutrient applications to sugar beet is shown in Table 55. Most sugar beet was grown on better soils.

Table 55: Effect of soil use range on nutrients for sugar beet

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
		(kg/ha)							
1	Wide	162	5.5	46	2.4	157	5.7	39	9
2	Moderately Wide	154	11.2	56	8	186	13.8	17	8
	All	160	5	49	2.8	165	5.7	59	8

The amount of N, P and K applied to sugar beet in the different farming systems is shown in Table 56.

Table 56: N, P and K fertilizer applied to sugar beet for different farming systems

FARM SYSTEM	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
Dairy	173	10.6	51	4.8	149	10.6	24	6
Other Livestock	152	15.1	57	2.6	203	10	3	4
Tillage	155	5.2	48	3.7	171	6.7	32	10
All	160	5	49	2.8	165	5.7	59	8

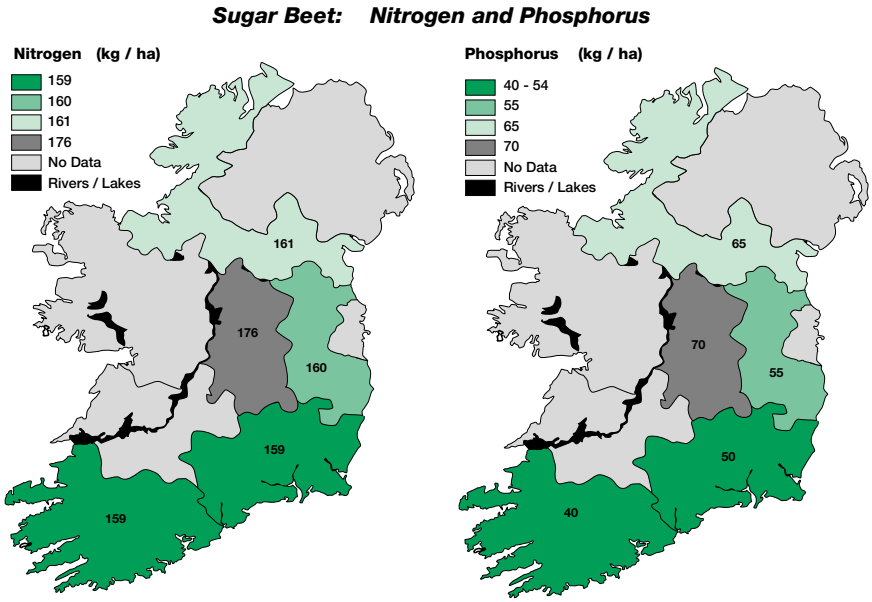

Figure 7: Regional N and P usage for sugar beet

The calculated mean Teagasc N recommendation for sugar beet was 139 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 149. Thus the N usage on the NFS farms is much higher than Teagasc advises. The calculated Teagasc recommendations for P and K were 39 and 170 kg/ha. Phosphorus fertilizer use was higher than optimum but K levels appears to be optimal (Table 66).

Fodder Beet

The nutrients used for fodder beet are shown in Table 57 classified by region. The overall rates for P and K usage have decreased from 1995 means in line with the drop in fertilizer sales but N usage has increased slightly, but not significantly.

Table 57: N, P and K for fodder beet

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
South-East	195	17.7	61	6.1	171	10.5	10	2
Mid-East	172	9.2	51	20.7	146	35.8	5	8
Midlands	167	30.3	60	4.9	199	17.8	3	2
South	117	12.3	51	5.7	183	20.5	9	1
All	162	8.7	55	5.8	169	11.8	28	3

The effect of soil quality on nutrient applications to fodder beet is shown in Table 58.

Table 58: Effect of soil use range on nutrients for fodder beet

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
		(kg/ha)							
1	Wide	158	9.2	53	7.2	163	14	21	3
2	Moderately Wide	181	34.6	68	8.8	185	22.9	5	2
	All	162	8.7	55	5.8	169	11.8	26	3

The amount of N, P and K applied to fodder beet in the different farming systems is shown in Table 59.

Table 59: N, P and K fertilizer applied to fodder beet for different farming systems

FARM SYSTEM	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
Dairy	143	11.4	54	3.3	182	10.8	18	2
Other Livestock	151	27.1	60	2.7	215	9.8	3	2
Tillage	182	14.6	56	17	150	29.1	7	6
All	162	8.7	55	5.8	169	11.8	28	3

Mean Teagasc recommendations for N, P and K were 142, 40 and 197 kg/ha respectively. The N and P rates appear to be high and the K rate low but there were a small number of farms in the survey so the standard errors are high and valid conclusions on usage cannot be drawn.

Potatoes

The nutrients used for potatoes are shown in Table 60 classified by region. The overall rates for P and K usage are relatively unchanged from 1995 means (Table 107) despite the drop in fertilizer sales but N usage has increased by 8% compared to a drop of 5% in fertilizer N sales since 1995.

Table 60: N, P and K for potatoes by region

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
South-East	117	11.6	108	12.3	262	28.3	4	1
Dublin	135	11	135	11	270	21.9	3	25
Border	104	4	102	3.5	211	9.9	13	11
Mid-East	165	20.4	102	13.7	253	5.9	4	22
South	74	6.1	63	5.2	179	14.8	5	4
West	97	24.7	67	13.7	225	72.5	5	< .5
All	126	6.1	107	4.1	234	7.1	35	9

The effect of soil quality on nutrient applications to potatoes is shown in Table 61. As a crop, potatoes were grown across a wide rang of soil-use classes.

Table 61: Effect of soil use range on nutrients for potatoes

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
		(kg/ha)							
1	Wide	158	17	79	4.2	240	13.4	11	7
2	Moderately Wide	116	5.7	116	5.6	233	11.6	13	17
3	Somewhat Limited	117	7.7	116	8.1	235	14.5	6	5
> 3	Limited	48	20.7	42	18.1	143	77.6	5	< .5
	All	126	6.1	107	4.1	234	7.1	35	9

The amount of N, P and K applied to potatoes in the different farming systems is shown in Table 62.

Table 62: N, P and K fertilizer applied to potatoes for different farming systems

FARM SYSTEM	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
Dairy	113	7.7	108	7.9	243	17.1	12	1
Other Stock	138	25.8	112	22.3	328	70.3	6	< .5
Tillage	126	8.9	107	6	234	9.7	17	18
All	126	6.1	107	4.1	234	7.1	35	9

Mean Teagasc N, P and K fertilizer advice for potatoes was 134, 86 and 219 kg/ha. The surveyed nutrient usage was broadly in line with these figures (Table 62).

Other Tillage Crops

The survey included a number of other crops but the number of farms involved and the amounts grown were insufficient to justify breaking down the N, P and K usage into different categories. Table 63 shows the fertilizer usage found on NFS farms for these crops.

Table 63: N, P and K fertilizer applied to other tillage crops

CROP	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
Turnips	96	19.9	49	9	108	14.8	8	1
Oats & Vetches	67	9.2	21	2.9	44	5.6	25	4
Kale & Rape	77	12.9	26	4.2	52	8.3	10	2
Others	5	1.8	3	1	7	2.3	123	19

Fertilizer Compounds for Root Crops

The fertilizer compounds used for supply of N, P and K to root crops are listed in Tables 64-66 and the number of times the fertilizers were used on the tillage farms is shown in Table 67.

Table 64: Main sources of N for root crops

COMPOUND	Percent N Usage for Root Crop			
	Sugar Beet	Fodder Beet	Potatoes	Turnip
CAN	32.1	37.7	–	3.9
6:10:18	0.4	1.2	–	10.1
8:5:18	11.9	24.1	–	5.1
9:4:5	3.3	–	–	–
9:6:15	2.3	2.3	–	–
13:4:14	29	23.8	–	–
10:7.5:17.5	12.2	2.7	–	–
10:0:25 (Import)	2.3	–	–	–
S/A 21% N	–	–	13.8	–
7:6:17	–	–	4.4	–
10:10:20	–	5.5	73.9	21.1
18:6:12	2.4	1.6	–	17.7
High N Compounds	3	1	7.9	42.2
All	99.9	100	100	100.1

Table 65: Main sources of P for root crops

COMPOUND	Percent P Usage for Root Crop			
	Sugar Beet	Fodder Beet	Potatoes	Turnip
CAN	–	–	–	–
6:10:18	2.1	5.9	–	32.8
8:5:18	24.2	44.2	–	6.2
0:7:30	–	–	6.6	–
9:4.5:18	5.4	–	–	–
9:6:15	5	4.6	–	–
13:4:14	29	21.5	–	–
10:5:25	1.6	–	–	–
7:6:17	–	–	4.4	–
10:7.5:17.5	29.8	6	–	–
0:10:20	–	–	1.1	–
10:10:20	–	16.1	86.4	41
18:6:12	2.6	1.6	–	11.5
High N Compounds	0.2	0.3	1.5	8.5
All	99.9	100	100	100

Table 66: Main sources of K for root crops

COMPOUND	Percent K Usage for Root Crop			
	Sugar Beet	Fodder Beet	Potatoes	Turnip
06:10:18	1.2	3.5	–	26.8
08:5:18	26	52	–	10
09:4:5	6.4	0	–	–
09:6:15	3.8	3.7	–	–
13:4:14	30.4	24.5	–	–
10:5:25	2.4	0	–	–
10:7.5:17.5	20.8	4.6	–	–
10:0:25 (Import)	5.7	–	–	–
POTASH 50% K	–	–	1	–
0:7:30	–	–	12.9	–
07:6:17	–	–	5.8	–
10:10:20	–	10.5	79.2	37.2
18:6:12	1.5	1	–	10.4
High N Compounds	1.9	0.2	–	15.5
All	100.1	100	98.9	99.9

Table 67: Number of times each fertilizer compound was used for root crops on NFS farms

COMPOUND	Frequency of Compounds for Root Crops				
	Turnip	Potatoes	Sugar Beet	Fodder Beet	Total
CAN	1	3	42	17	63
6:10:18	2	2	1	2	7
8:5:18	1	1	9	15	26
9:4:5	0	0	2	0	2
9:6:15	0	0	5	2	7
13:4:14	0	0	27	6	33
10:7.5:17.5	0	0	13	1	14
10:0:25:(Import)	0	0	5	0	5
S/A 21% N	0	16	0	0	16
POTASH 50% K	0	15	0	0	15
10:10:20	1	210	0	1	212
18:6:12	2	0	1	1	4
High N Compounds	1	0	4	1	6
All	8	249	110	46	413

FERTILIZER USE ON FARMS IN THE REPS SCHEME

There were 1,112 farms in the NFS 2000 survey that had grazing, silage and or hay, together with livestock, out of a total of 1130 farms overall. Of the grassland farms, 351 were participants in the national Rural Environmental Protection Scheme or REPS and 761 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. REPS is a voluntary scheme, 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 1).

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 68) but a relatively small number grew tillage crops (Tables 68-69). Winter wheat was not grown on any 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 43.3 ha compared to the overall survey average of 51.2 ha.

Table 68: 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	350	—	761	—
Silage	314	10.4	697	14.5
Hay	159	3.9	311	3.6

Table 69: 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	3	9	29	22
Spring Barley	36	11	109	12
Malting Barley	13	13	39	15
Winter Wheat	–	–	51	41
Spring Wheat	1	3	23	17
Winter Oats	1	14	23	14
Spring Oats	2	2	22	6
Root Crops				
Sugar Beet	13	6	46	9
Fodder Beet	4	4	24	3
Potatoes	3	< 0.5	32	10

The level of fertilizer N, P and K applications to grassland and tillage crops on REPS farms is shown in Table 70. For almost every crop, the levels are considerably below the average rates used for the Non-REPS farms.

Table 70: 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	7	15	130	11	23
Silage	111	12	40	140	16	52
Hay	47	10	28	56	11	27
Cereal Crops						
Winter Barley	129	24	81	183	26	68
Spring Barley	99	22	51	121	26	51
Malting Barley	110	11	49	122	21	49
Winter Wheat	–	–	–	207	27	72
Spring Wheat	133	9	19	160	18	42
Winter Oats	116	26	111	164	28	63
Spring Oats	38	29	70	120	26	50
Root Crops						
Sugar Beet	155	52	176	161	49	163
Fodder Beet	142	65	208	164	54	166
Potatoes	114	64	164	126	108	234

To facilitate comparison, Table 71 expresses the rates of N, P and K applications on REPS farms as percentage of the usage on non-REPS farms.

Table 71: Usage of N, P and K usage on REPS farms as a percentage of usage on non-REPS farm

CROP	N	P	K
Grassland		**RATIO %**	
Grazing	49	64	65
Silage	79	75	77
Hay	84	91	104
Cereal Crops			
Winter Barley	70	92	119
Spring Barley	82	85	100
Malting Barley	90	52	100
Winter Wheat	–	–	–
Spring Wheat	83	50	45
Winter Oats	71	93	176
Spring Oats	32	112	140
Root Crops			
Sugar Beet	96	106	108
Fodder Beet	87	120	125
Potatoes	90	59	70

Grazing

The nutrient usage for grazing on REPS farms is presented in Table 72. The N, P and K applications in the Table are very much lower than those for all NFS farms (non-REPS and REPS, presented earlier in Table 3). On average, the application rate of N for REPS was only 59% of that applied over all farms, and the corresponding figures for P and K were 78% and 71% respectively. Comparison with non-REPS usage is shown in Table 71.

Table 72: 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	79	8.6	6	0.7	14	1.8	40
Mid-East	46	8.8	3	0.9	6	1.9	25
Midlands	76	10.7	7	1.3	17	2.6	43
Border	48	4.8	5	0.6	11	1.3	66
South-West	79	9.6	7	1.3	16	2.6	40
South	85	7	7	0.8	21	5.4	53
West	50	4.6	8	1.4	17	2.8	82
All	64	2.8	7	0.4	15	1.2	351

The effect of soil quality on nutrient applications to grazed grass on REPS farms is shown in Table 73. The highest rates of N were applied to the best soils but the rates for P and K were not significantly different for the various soil types.

Table 73 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	81	7.6	5	0.6	15	3.8	78
2	Moderately Wide	67	6.4	8	1.7	19	3.4	66
3	Somewhat Limited	59	4.9	6	0.8	12	1.3	71
> 3	Limited	56	4.1	7	0.6	15	1.3	136
	All	64	2.8	7	0.4	15	1.2	351

Silage

The nutrients applied to silage ground on REPS farms in different regions is shown in Table 74. As expected, the application rates for N, P and K are much higher than for grazing (Table 72). However, the rates for REPS farms are much lower than shown for all NFS farms in Table 13.

Table 74 N, P and K for silage on REPS farms by region

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area(ha)
	(kg/ha)							
South-East	109	7.5	12	1.8	43	5.8	35	10.3
Dublin	112	13.9	10	4.7	41	18.8	2	19.6
Mid-East	93	8.2	10	1.6	30	5.7	19	12.3
Midlands	122	7.2	15	1.4	47	5.1	38	13.6
Border	97	5.6	11	0.8	35	3.1	63	8.8
South-West	118	5.7	14	1.6	46	5	37	12.5
South	125	6.3	10	1.1	40	4.4	52	11.6
West	99	5.4	12	1.3	36	3.8	68	7.4
All	111	2.5	12	0.5	40	1.7	314	10.4

The effect of soil quality on nutrient applications to silage is shown in Table 75. There is no significant variation between fertilizer usage on different soil classes.

Table 75 Effect of soil use range on nutrients for silage on REPS farms

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
		(kg/ha)							
1	Wide	116	5	11	1	41	3.6	73	13.6
2	Moderately Wide	109	5.2	11	1.5	38	4.1	55	9.4
3	Somewhat Limited	107	6.1	13	1	40	3.3	63	10.3
> 3	Limited	109	4	13	0.8	40	2.9	123	9.1
	All	111	2.5	12	0.5	40	1.7	314	10.4

The amount of N, P and K applied to REPS silage land in the different farm systems is shown in Table 76.

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Table 76 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.	No of Farms	Mean Crop Area(ha)
	(kg/ha)							
Dairy	129	4.3	12	0.8	44	3.3	105	13.8
Cattle	96	3.1	12	0.8	37	2.3	135	9.7
Sheep	99	5.3	12	1.5	36	3.4	55	6.6
Tillage	91	11.2	11	3	40	8.6	19	7.8
All	111	2.5	12	0.5	40	1.7	314	10.4

Hay

The amount of N, P and K applied to hay in the different farming systems under REPS is presented in Table 77.

Table 77 N, P and K for hay on REPS farms by region

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
South-East	38	7.7	7	2	15	4.3	22	4.3
Mid-East	59	10.2	16	3.6	48	13.2	13	6.3
Midlands	34	6	9	1.4	27	4.7	25	5.8
Border	40	5.9	7	1.7	18	3.5	24	2.9
South-West	46	5.6	9	2.1	31	7.4	24	3.5
South	65	7.7	8	1.7	25	4.9	16	1.9
West	62	5.8	13	2.5	31	5.7	34	3.2
All	47	2.7	10	0.9	28	2.5	159	3.9

The effect of soil quality on nutrient applications for hay on REPS farms is shown in Table 78. Unlike grazing and silage, highest rates of N and K were applied to soil class 2 which has a narrower use range than the best grassland soils (Gardiner and Radford, 1980). The P rates did not differ significantly between the different soil types.

Table 78 Effect of soil use range on nutrients for hay on REPS farms

Class	Soil Use	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
		(kg/ha)							
1	Wide	42	5	11	1.3	29	3.6	44	4.1
2	Moderately Wide	56	7.1	9	2.8	33	8.8	31	4.1
3	Somewhat Limited	41	6.1	13	2	23	3.9	30	3.3
> 3	Limited	48	4	9	1.1	27	3.6	54	3.9
	All	47	2.7	10	0.9	28	2.5	159	3.9

The average N, P and K usage for hay on REPS farms under different systems is shown in Table 79.

Table 79 N, P and K fertilizer applied to hay on REPS farms by system

FARM SYSTEM	N	s.e.	P	s.e.	K	s.e.	No of Farms Area	Mean Crop (ha)
	(kg/ha)							
Dairy	50	4.7	8	1.8	27	4.8	55	2.9
Cattle	39	4	11	1.1	28	2.9	64	4.3
Sheep	61	6.6	9	1.9	21	3.7	25	5
Tillage	43	8.2	12	4	47	14.3	15	4.3
All	47	2.7	10	0.9	28	2.5	159	3.9

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. REPS farms used 49% of the N rate and 64% of the P rate of non-REPS farms, for silage the comparison was 79% and 75% for P and K and for hay it was 84% and 91% respectively. The favourable ratio applied for P and K for all cereal and root crops for which there was reliable data. 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 not within the scope of this fertilizer use survey.

COMPARABLE FERTILIZER USAGE IN 1995

Tables 80-111 present fertilizer usage data calculated from the 1995 NFS. The statistical procedures, table categories and table designs follow the same form as for the survey of 2000 data to facilitate comparison between fertilizer usage in the two years.

Grazing

The estimated fertilizer usage for grassland in 1995 is listed in Tables 80-85 and the main sources of fertilizer elements is shown in Table 86.

Table 80: Regional distribution of N, P and K application rates for grazing in 1995, number and percentage of farms with grazing

REGION	N	s.e.	P	s.e.	K	s.e.	No.	Percentage of Total
	(kg/ha)							
South-East	127	6.8	11	0.8	24	1.7	190	15.7
Dublin	83	26.2	5	2.2	11	4.4	10	0.8
Mid-East	105	8.3	11	0.9	23	1.9	139	11.5
Midlands	74	10.1	10	0.8	22	1.8	126	10.4
Border	66	4.6	11	0.8	22	1.6	210	17.4
South-West	76	7.7	11	1.4	25	3.1	115	9.5
South	147	8.5	14	0.8	31	1.8	209	17.3
West	54	4.4	12	1	26	2.4	208	17.2
All	94	2.8	12	0.3	25	0.8	1207	100

Table 81: Estimated N, P and K fertilizer rates applied in 1995 to grazed grassland for different farming systems

FARM SYSTEM	N	s.e.	P	s.e.	K	s.e.	No. of Farms	Percentage of total
	(kg/ha)							
Dairy	157	5.3	14	0.5	31	1.2	462	38.3
Cattle	48	2.4	10	0.5	20	1	435	36
Sheep	54	4.3	11	1.1	24	2.5	211	17.5
Tillage	88	9.6	9	1.2	21	2.9	89	7.4
All	94	2.8	12	0.3	25	0.8	1207	100

Table 82: Relationship between farm size (UAA) and nutrient application rates in 1995 for grassland on dairy system farms

FARM SIZE (UAA ha)	N	s.e.	P	s.e.	K	s.e.	No of Farms	Percentage of total
	(kg/ha)							
2 - 10	91	22	13	3.5	26	7.1	15	1.2
10 - 20	112	12.2	10	1.1	25	3.3	53	4.4
20 - 30	161	12.6	15	1.1	33	2.5	92	7.6
30 - 50	156	7.9	15	1	32	2.4	148	12.3
50 -100	181	12.4	16	1.1	35	2.4	116	9.6
> 100	168	16.9	11	1.1	24	2.9	38	3.1
Dairy Overall	157	5.3	14	0.5	31	1.2	462	38.3

Table 83: Fertilizer application rates (kg/ha) for mainly-dairy system farms in 1995 by stocking rate

STOCKING RATE (LU/ha)	N	s.e	P	s.e	K	s.e	No of Farms
	(kg/ha)						
< 1.2	55	7.1	8	1	15	2	46
1.2 - 1.5	85	7.8	12	1.1	25	2.5	57
1.5 - 1.9	129	7	13	0.9	29	2.2	135
2.0 - 2.25	172	7.3	16	1.3	34	2.8	104
2.25 - 2.6	221	10.7	18	1.4	39	3.2	75
2.6 - 2.9	323	36.4	21	1.9	45	4.9	28
> 2.9	248	35.7	14	3.1	36	7.4	17

Table 84: Fertilization rates for mainly-cattle system farms by stocking rate in 1995

STOCKING RATE(LU/ha)	N	s.e	P	s.e	K	s.e	No of Farms
	(kg/ha)						
< 1.2	24	2.4	7	0.7	14	1.4	195
1.2 - 1.5	46	4	10	1	20	2	80
1.5 - 1.9	58	5	12	1	25	2	90
2.0 - 2.25	86	8.5	16	1.5	32	3	41
2.25 - 2.6	116	12.9	17	2.4	37	5.6	25

Table 85: Fertilization rates for mainly-sheep system farms by stocking rate in 1995

STOCKING RATE(LU/ha)	N	s.e	P	s.e	K	s.e	No of Farms
	(kg/ha)						
< 1.2	43	7.7	12	2.1	27	5.5	80
1.2 - 1.5	23	3.9	6	1.2	12	2.4	34
1.5 - 1.9	49	7.2	12	1.8	24	3.8	39
2.0 - 2.25	78	10.2	11	1.4	22	2.9	30
2.25 - 2.6	97	19.4	10	2.7	20	5.5	16

Table 86: Main sources of N, P and K for grazing (%) in 1995 and number of NFS farms receiving the different compounds

COMPOUND	N	P	K	No of Farms
	Percentage from Each Compound			
C.A.N	44.0	–	–	707
UREA	14.1	–	–	51
SUPER 8%P	–	0.2	–	4
SUPER 16%P	–	1.0	–	1
POTASH 50%	–		0.9	1
0:7:30	–	5.2	10.5	12
0:10:20	–	12.2	11.4	18
10:10:20	1.8	15.7	14.7	89
14:7:14	0.1	0.5	0.4	1
10:10.9:18.3-NI	0.7	6.8	5.3	6
18:6:12	10.5	31.4	29.3	142
High N Compounds	28.4	25.2	26.1	66
TOTAL	99.7	98.1	97.7	1044

Silage

Table 87: N, P and K usage in 1995 on NFS farms for silage by region

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
South-East	146	4.2	20	1	59	2.7	14	152
Dublin	114	25.3	13	5	33	12.3	6.5	5
Mid-East	167	7.8	22	1.4	72	4.3	19.4	95
Midlands	126	5.9	22	1.2	68	4.1	11.6	96
Border	121	5.7	17	1.1	49	2.6	8.2	171
South-West	126	6.4	19	1.4	68	5.1	10.9	88
South	158	4	20	0.9	66	3.3	9.9	189
West	112	4.9	23	1	65	2.9	6.9	176
All	140	2.1	20	0.4	64	1.3	10.9	972

Table 88: Estimated N, P and K fertilizer applied to silage ground in 1995 for different farming systems

FARM SYSTEM	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
Dairy	161	3	21	0.6	70	2	445	14.7
Cattle	95	2.8	20	0.7	52	1.7	327	7.1
Sheep	96	3.8	19	1	53	3	142	6.9
Tillage	162	9	20	1.7	68	7	51	11.3
All	140	2.1	20	0.4	64	1.3	972	10.9

Table 89: Relationship between farm size and nutrient application rates for silage in 1995 on mainly dairy farms

FARM SIZE	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
2 - 10	95	19.9	20	6	47	12.7	11	2.4
10 - 20	117	7.6	17	1.5	54	4.9	45	5.4
20 - 30	151	6.5	21	1.2	69	4	90	7.9
30 - 50	148	4.6	20	1.1	66	3.3	145	11.9
50 -100	165	4.4	23	1	77	4	116	20.7
> 100	185	13.3	22	2.8	68	6.8	38	37.2
All	140	2.1	20	0.4	64	1.3	972	10.9

Table 90: Main sources of N, P and K for silage in 1995 on all farms

COMPOUND	N	P	K	No of Farms
	Percentage from Each Compound			
High N Compounds	44.5	32.6	37.4	509
C.A.N	30	–	–	339
UREA	15.3	–	–	121
S/A 21% N	0.2	–	–	4
SUPER 16%P	–	0.1	–	1
POTASH 50%	–	0	0.2	3
0:7:30	–	27.6	37.8	197
0:10:20	–	7.3	4.7	41
10:10:20	1.1	7.3	4.7	82
14:7:14	0.1	0.3	0.2	3
18:6:12	8	18.5	11.8	286
10:10.9:18.3-:NI	0.8	6.2	3.3	33
TOTAL	100	99.9	100.1	1619

Hay

Table 91: N, P and K for hay in 1995 by region

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
South-East	68	3	14	0.9	31	2.1	4.1	120
Dublin	45	7.7	23	4.1	45	8.2	7.3	8
Mid-East	72	7.4	16	1.3	39	3.7	5.9	77
Midlands	46	4.8	14	1.1	35	3.1	4.4	86
Border	55	3.3	15	0.8	35	1.9	3.3	120
South-West	33	4.2	13	1.3	32	3.4	3.6	81
South	64	3.8	13	1.1	30	2.8	2.8	100
West	44	3	18	1.2	39	2.8	3.2	113
All	56	1.7	15	0.4	35	1	3.8	705

Table 92: Estimated N, P and K fertilizer applied to hay in 1995 under different farming systems

FARM SYSTEM	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area(ha)
	(kg/ha)							
Dairy	64	3.3	13	0.6	32	1.7	281	3.2
Cattle	46	2.1	16	0.7	35	1.5	265	3.7
Sheep	50	3.3	16	1.2	37	2.9	103	4.7
Tillage	73	5.5	15	1.4	40	4.5	53	6.1
All	56	1.7	15	0.4	35	1	702	3.8

Table 93: Main sources of N, P and K for hay in 1995 on all farms

COMPOUND	N	P	K	No of Farms
	Percentage from Each Compound			
High N Compounds	34.2	13.3	17.5	158
CAN	19.3	–	–	108
UREA	3	–	–	20
SUPER 8% P	–	0.3	–	1
POTASH 50% K	–		1.3	3
0:7:30	–	7.4	13.5	41
0:10:20	–	4.6	3.9	19
10:10:20	7.3	27.5	23.5	93
18:6:12	34.6	43.3	36.9	232
10:10.9:18.3-:NI	0.7	2.8	2	11
TOTAL	99.1	99.2	98.6	686

Forage Maize

Table 94: N, P and K for forage maize in 1995 by region

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area(ha)
	(kg/ha)							
South-East	99	12.5	39	12.6	51	18.4	7	5
Mid-East	106	6.8	19	9.8	44	19.1	3	5
All	101	8.7	33	9.5	49	13.5	10	5

Table 95: Main sources of N, P and K for forage maize on NFS farms in 1995

COMPOUND	N	P	K
	Percentage from Each Source		
High N Compounds	8.4	2.7	7.3
CAN	9.6	–	–
UREA	33.2	–	–
SUPER 16% P	–	17.6	–
15:10:10	10.2	20.8	14.1
10:10:20	7.8	23.8	32.2
10:10.9:18.3-N.I.	1.7	5.5	6.3
18:6:12	29.1	29.6	40.1
TOTAL	100	100	100

Cereals

The estimated fertilizer usage for cereals in 1995 is listed in Tables 96-102.

Table 96: N, P and K use for winter barley in 1995 by region

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
South-East	167	15.6	33	4	77	8.6	10	11
Mid-East	130	5.1	25	3.4	98	7.9	20	17
Midlands	129	23.7	26	6.6	77	18.3	4	9
Border	143	12.4	36	2.4	71	4.2	12	13
South	173	19.7	32	7.8	67	11.2	2	14
All	143	6	29	2	85	4.6	49	14

Table 97: N, P and K use for spring barley in 1995 by region

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
South-East	126	4.4	24	1.2	47	2.4	10	46
Mid-East	113	8.1	27	3	64	4	9	18
Midlands	110	4.3	27	1.4	58	3.5	9	25
Border	111	5.6	30	1.8	60	3.6	14	31
South-West	92	10.4	25	1.4	51	2.7	8	4
South	106	5.6	27	1.6	53	3.1	7	28
West	72	10.7	27	2.4	54	5	4	9
All	114	2.4	27	0.7	55	1.4	9	161

Table 98: N, P and K use for malting barley in 1995 by region

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
South-East	105	5	28	1.9	56	3.9	28	11
Dublin	76	7.7	28	15.5	73	3.2	2	19
Mid-East	125	5.5	14	3.8	66	6.7	11	20
Midlands	117	9	26	2.7	72	4.4	11	12
Border	111	3.5	26	5.4	53	10.7	2	9
South	106	5.4	22	2.1	52	5.3	17	12
South-West	107	2.5	16	7.9	47	1.4	3	20
All	110	2.9	22	1.4	60	2.4	74	13

Table 99: N, P and K use for winter wheat in 1995 by region

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
South-East	192	13.3	27	5.5	75	12.1	9	22
Dublin	181	44.7	28	1.7	111	24.8	2	26
Mid-East	180	6.4	26	3.1	87	6.8	22	28
Midlands	164	27.5	19	0.8	74	7.7	2	6
Border	201	12.3	29	3	95	5.2	8	30
All	187	5.1	27	2	88	4.5	44	26

Table 100: N, P and K use for spring wheat in 1995 by region

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
South-East	166	11.3	27	4.3	59	6.4	11	10
Mid-East	182	13.9	18	6	60	13.1	6	9
Border	200	44.8	30	2.7	61	5.5	4	7
South	129	7.4	19	2.1	43	1.4	3	11
All	168	9	25	2.6	58	4.3	26	9

Table 101: N, P and K for winter oats in 1995 by region

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
Mid-East	108	11.9	24	5.5	62	16.9	7	10
Border	138	7	35	1.2	70	2.3	2	15
South-East	143	13.8	38	4	77	8.1	5	10
South	135	14.5	37	0	74	0	2	9
All	127	6.7	29	3.2	67	8.1	16	10

Table 102: N, P and K for spring oats in 1995 by region

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
South-East	95	11.5	32	3.6	54	6.8	8	3
Mid-East	101	11.8	34	2.8	68	5.7	5	4
Border	100	11.5	30	2	61	4	12	3
South	61	9.4	35	2.1	70	4.3	6	2
West	44	10.5	33	3.1	69	5.6	8	2
All	87	6	32	1.2	63	2.5	39	3

Fertilizer Compounds for Cereals in 1995

The fertilizer compounds used for supply of N, P and K to cereals are listed in Tables 103-105.

Table 103: Main sources of N for cereals in 1995

COMPOUND	Percent Usage for Cereal Crops						
	W.Wh.	S.Wh.	W.Bar.	S.Bar.	M.Bar.	W.Oats	S.Oats
CAN	77.8	62.1	75.4	50.6	46.2	75.1	41.6
UREA	13.9	1.2	7.7	0.1	1.4	10.4	–
10:10:20	3.7	6.6	3.7	8.9	7.2	4.6	17.1
14:7:14	–	0.6	2.2	5.2	5.4	2.2	3.6
16:5:20	–	–	–	–	4.5	–	–
18:6:12	2.0	20.3	6.2	30.2	23.5	7.8	37.7
High N Compounds	1.9	9.2	3.4	3.1	10.6	–	–
All	99.3	100	98.6	98.1	98.8	100.1	100

Table 104: Main sources of P for cereals in 1995

COMPOUND	Percent Usage for Cereal Crops						
	W.Wh.	S.Wh.	W.Bar.	S.Bar.	M.Bar.	W.Oats	S.Oats
0:7:30	30.2	1.7	21.3	1.2	1.7	12.3	0.3
0:10:20	33.4		37.8	1.9	1.3	52.1	12.6
10:10:20	26.4	45.1	18.3	38.3	35.5	19.7	46.4
15:10:10	–	–	–	–	–	–	6.5
14:7:14		2.2	5.4	11.1	13.3	4.7	–
15:3:20	–	–	0.4	0.5	4.4	–	–
16:5:20	0.2	–	–	0.9	1.2	–	–
18:6:12	4.6	46.3	10.2	43.1	38.6	11.2	34.1
10:10.9:18.3 – NI	4.8	–	5.5	0.2	1.5	–	–
High N Compounds	0.4	4.7	1.2	1.1	1.7	–	–
All	100	100	100.1	98.3	99.2	100	99.9

Table 105: Main sources of K for cereals in 1995

COMPOUND	Percent Usage for Cereal Crops						
	W.Wh.	S.Wh.	W.Bar.	S.Bar.	M.Bar.	W.Oats	S.Oats
Potash 50% K	16.8		12.6	0.3	3.9	23.1	
0:7:30	39.1	3.1	31.1	2.5	2.8	45.6	0.7
0:10:20	20.2		25.8	1.8	1.0	17.3	13.0
10:10:20	16.0	38.2	12.5	36.8	26.6	4.1	47.8
15:10:10	–	–	–	–	–	–	3.3
14:7:14	–	1.9	3.7	10.7	10.0	9.8	–
15:3:20	–	–	1.0	1.5	11.1	–	–
16:5:20	0.3	–	–	1.7	1.8	–	–
18:6:12	2.8	39.3	6.9	41.4	28.9	–	35.0
10:10.9:18.3 – NI	2.4	–	3.1	–	0.9	–	–
High N Compounds	2.4	17.5	3.2	2.3	12.4	–	–
All	100	100	99.9	99	99.4	99.9	99.8

Root Crops

The estimated fertilizer usage for root crops in 1995 is listed in Tables 106-109.

Table 106: N, P and K use for sugar beet in 1995 by region

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
South-East	194	8.6	79	7.6	213	7.9	34	9
Mid-East	187	10.1	65	8.2	218	14.9	13	8
Midlands	166	9.8	85	15.9	229	11.1	8	5
Border	188	8.6	67	11.1	172	9.8	13	9
South-West	130	13.5	77	2.2	192	5.6	2	12
All	187	5.2	75	4.8	206	5.6	70	8

Table 107: N, P and K use for potatoes in 1995 by region

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
South-East	124	6.4	111	8.4	266	15	8	2
Mid-East	124	26.1	106	22.4	300	63.4	3	1
Midlands	102	30.4	78	15.6	178	36.3	14	< 0.5
Border	114	4.1	113	3.8	230	7.3	31	4
South	99	19.1	95	18.4	285	51.7	9	1
South-West	123	24.6	123	24.6	245	49.2	4	1
West	142	10.7	136	11	307	19.4	21	< 0.5
All	117	3.7	112	2.9	238	6.4	90	2

Table 108: N, P and K usage for fodder beet in 1995

Region	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
South-East	161	12.1	78	6.8	213	7.6	27	2
Mid-East	144	35	46	14.6	159	46.4	7	4
Midlands	212	31.8	60	9.8	186	16.9	6	2
South	147	12.8	71	10.3	182	17.1	19	2
All	158	8.7	67	4.8	192	9.3	59	2

Table 109: N, P and K fertilizer applied to other tillage crops in 1995

CROP	N	s.e.	P	s.e.	K	s.e.	No of Farms	Mean Crop Area (ha)
	(kg/ha)							
Turnips	74	14.4	56	7.1	157	12.4	22	2
Oats & Vetches	57	8.5	12	2.7	26	5.3	23	2
Kale & Rape	69	17.2	12	2.3	27	5.4	12	3
Others	19	5.9	10	2.3	20	4.7	80	13

Fertilizer Compounds for Root Crops in 1995

The fertilizer compounds used for supply of N, P and K to root crops are listed in Tables 110-112.

Table 110: Main sources of N for root crops in 1995

COMPOUND	Percent N Usage for Root Crop			
	Potatoes	Sugar Beet	Fodder Beet	Turnip
CAN	30.2	34.4		1.6
6:10:18	–	0.8	11.5	–
08:5:18	0.7	27.9	60.2	–
7:6:17	–	–	–	13.9
9:4.5:18	17.0	7.2	–	–
9:6:15 & 9:7:23	4.1	0.8	5.0	–
13:4:14	22.8	7.9	–	–
10:10:20	–	0.4	–	80.8
18:6:12	0.7	4.6	15.0	1.5
9:4.5:18.6	5.9	1.7	–	–
10:10.9:18.3 - NI	16.0	12.8	8.3	1.1
High N Compounds	1.9	0.6	–	0.3
All	99.3	99.1	100	99.2

Table 111: Main sources of P for root crops in 1995

COMPOUND	Percent P Usage for Root Crop			
	Potatoes	Sugar Beet	Fodder Beet	Turnip
6:10:18	–		3.2	25.2
8:5:18	–	1.1	41	49.5
0:7:30	–	0.4	0.8	1.7
7:6:17	12.4	0.1	–	–
9:4.5:18	–	21.4	8.5	–
9:6:15 & 9:7:23	–	6.8	1.3	5.1
13:4:14	–	17.6	5.7	–
10:10:20	83.9	–	1	–
18:6:12	0.5	0.6	3.6	6.6
9:4.5:18.6	–	7.4	2	–
10:10.9:18.3 – NI	1.3	43.7	32.8	11.9
High N Compounds	0.1	0.3	0.1	–
All	98.2	99.4	100	100

Table 112: Main sources of K for root crops in 199

COMPOUND	Percent K Usage for Root Crop			
	Potatoes	Sugar Beet	Fodder Beet	Turnip
6:10:18	–	–	2.0	16.2
8:5:18	–	1.4	51.5	63.5
0:7:30	0.0	0.6	1.1	2.6
5:5:10	0.7	–	–	–
7:6:17	16.6	0.1	–	–
9:4.5:18/18.6	–	41.8	14.7	–
9:6:15 & 9:7:23	–	6.1	1.1	6.0
13:04:14	–	22.3	6.9	–
0:10:20	1.0	–	–	–
10:10:20	79.3	–	0.7	–
18:6:12	0.5	0.4	2.5	4.7
10:10.9:18.3 - NI	1.0	26.5	19.2	7.1
High N Compounds	0.1	0.6	0.1	–
All	99.2	99.8	99.8	100.1

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APPENDIX 1: 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.
- **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 mths. 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 1, 1.7% of the population (of farms) are estimated to be Dairying farms with 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 Range 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 range 1 can grow the widest range of crops without limitation and soil use range 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 2: 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