LAND DRAINAGE SURVEY

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ABSTRACT

A countrywide land drainage survey is in progress in Ireland since 1964. The system of data collection is described. A preliminary analysis was carried out by a digital computer on the data collected from 6,282 schemes, and some results are presented as examples of the detailed information that can be obtained. The main drainage problems encountered were seepage and springs (36.7 percent), impervious subsoils (34.0 percent) and water table (21.8 percent). Old broken drains were uncovered on 42.7 percent of the area (47,491 acres) surveyed, the figure increasing with increasing drainage depth from 28.1 percent at 21-to 24-in. depth to 56.2 percent at 57-to 81-in. depth. Topsod or topsoil was used as first backfill on 85.0 percent of all tile drains, except those used as mole catchments. Porous fill was used as first backfill on 99.0 percent of mole catchments.

INTRODUCTION

Land drainage, which has been a feature of Irish farming for a long time, received a big impetus in 1949 with the establishment of the Land Rehabilitation Project. This provides State aid for drainage work on farms. It is administered by Land Project Officers who plan and supervise the schemes. On satisfactory completion of the work, the farmer is paid a grant based on the Project Officer's estimate and subject to overriding maxima. At present, grants are paid annually in respect of about 125,000 acres.

In 1961 the Soil Physics Department of An Foras Taluntais initiated a pilot drainage survey with the co-operation of the Land Project in Co. Waterford. After an initial period this pilot survey was extended to five other districts, and in June 1964 the drainage survey proper was commenced on a countrywide basis.

The survey was designed to provide an overall picture of drainage conditions and practices in the country. Accurate identification of the drainage problems was emphasised, and data on the methods used to alleviate these problems were collected. An analysis of the results will provide factual information on the occurrence of drainage problems and can be used as a basis for establishing priorities for research.

PROCEDURE

Punch cards (Appendix I) were used on the pilot survey. Members of the Soil Physics Department spent some time in the field with each Project Officer in the initial stages, and assisted in the completion of cards. In this way a uniform interpretation of the required data was obtained.

As a result of experience gained on the pilot survey, a new card (Appendix II) was designed for the full-scale survey. Some relatively unimportant sections of the punch card were omitted and other more important ones were expanded to provide greater detail. A memorandum of explanatory notes, in which each term used on the survey card is defined, was issued to every officer at the start of the survey.

Each Project Officer completes a survey card for every scheme in progress in his district, and the completed cards are forwarded to the Soil Physics Department. Here the data are extracted and transferred to punched tape for analysis by digital computer.

A preliminary analysis was carried out on 6,282 cards. The total area involved was 47,491 acres. The computer programme was designed to prepare either two-way tables with accumulated acreages or two-way frequency tables. Fifty-two accumulated acreage tables and 26 frequency tables were produced. To exemplify the results obtained, 16 accumulated acreage tables (figures given as percentages) are presented in Tables I to V. Figures from some of the other tables are also used in the discussion.

RESULTS AND DISCUSSION

Table I shows the variability of subsoil permeability, new outfall, type of drain and drainage depth for different subsoil types. Peatland drainage was 5.6 percent of the total, but there were large deviations in different districts from this percentage; Westmeath (28 percent), Mayo (20 percent) and Offaly (19 percent) were most prominent on the high range while no drainage of peat was reported from Carlow, Dublin, Waterford and Wicklow.

Open drains (only) were used on 15.9 percent of the area surveyed, but again there were large variations from this figure. The highest percentages were recorded in Laois (80), Offaly (67) and Dublin (46). Tile drains were used on all schemes in Carlow and Wicklow; Waterford (97 percent) and Kildare (83 percent) were also high on the scale. Mole drainage with tile catchments was most prevalent in Louth (78 percent), Meath (56 percent) and Cavan (53 percent). The highest percentage of stone drains was recorded in Roscommon (70), Donegal (56), Longford (55), Sligo (53) and Mayo (51).

In Limerick 80 percent of the drains were installed at a depth of 21 to 24 in. Percentages for other counties in this range were 78 for Donegal, 76 for Sligo, 75 for Longford and 65 for Leitrim. Louth had the highest percentage (99) of drains in the 27- to 30-in. category, followed by Meath (91), Kildare (75), Westmeath (75) and

TABLE I: Variability (expressed as a percentage) of subsoil permeability, new outfall, type of drain and drainage depth for different subsoil types

		Subsoil type		All subsoils
		Mineral	Peat	
Occurrence on area surveyed		94.4	5.6	
Subsoil permeability	Low	23.4	10.8	22.7
	Medium	68.8	68.0	68.8
	High	7.8	21.2	8.5
New outfall	Good	85.1	70.7	84.3
	Fair	14.2	22.6	14.7
	Bad	0.7	6.7	1.0
Type of drain	Open (only)	15.0	32.0	15.9
	Tile	48.8	28.3	47.7
	Tile + mole	16.1	—	15.2
	Tile + subsoiling	7.1	—	6.7
	Stone	12.2	13.9	12.3
	Sod	—	21.3	1.4
	Misc.	0.8	4.5	0.8
Drainage depth (inches)	21 - 24	21.2	13.1	20.7
	27	24.3	9.9	23.5
	30	21.8	17.8	21.6
	33 - 39	11.3	26.4	12.2
	42 - 54	18.5	27.0	19.0
	57 - 81	2.9	5.8	3.0

Wexford (67). Percentages for the 42- to 54-in. range were 97 for Carlow, 74 for Laois, 65 for Offaly and 58 for Waterford. A much higher percentage of drains deeper than 30 in. was used on peatland than on mineral subsoil.

Table II shows the variability of type of drain, drainage depth and first backfill for different subsoil permeabilities. Topsod or topsoil was used as first backfill on 51.9 percent of all drains, and various porous materials accounted for a further 29.1 percent. However, extensive use was made of topsod or topsoil in many counties—100 percent for Carlow, 93 for Waterford, 79 for Limerick, 78 for Wexford, 75 for Kildare, 74 for Wicklow, 72 for Mayo and Westmeath and 70 for Kilkenny. Most use was made of combined porous fills in Leitrim (84 percent), Louth (81 percent), Monaghan (77 percent), Longford (75 percent), Meath (66 percent), Cavan (58 percent), Roscommon (51 percent), Sligo (49 percent) and Clare (49 percent). Subsoil was used as first backfill on a very limited scale, the overall figure being 0.4 percent. The highest percentage recorded was 4.2 for Wicklow, followed by 2.3 for Louth, 1.9 for Roscommon, 1.7 for Westmeath, 1.5 for Longford and 1.1 for Galway.

In Table III the occurrence of broken drains is analysed for subsoil type, drainage problem and drainage depth. Deviations from the average percentage of 42.7 were found in Waterford (85), Wicklow (84), Carlow (73), Meath (67), Cork (63) and, at

TABLE II: Variability (expressed as a percentage) of type of drain, drainage depth and first backfill for different subsoil permeabilities

		Subsoil permeability			All subsoils
		Low	Medium	High	
Occurrence on area surveyed		22.7	68.8	8.5	
Type of drain	Open (only)	4.6	18.3	26.7	15.9
	Tile	34.2	49.7	63.4	47.7
	Tile+mole	34.3	10.9	—	15.2
	Tile+subsoiling	10.3	6.3	0.7	6.7
	Stone	13.4	12.4	4.9	12.3
	Sod	1.0	1.2	1.9	1.4
	Misc.	2.2	1.2	2.4	0.8
Drainage depth (inches)	21 - 24	28.9	19.9	5.2	20.7
	27	32.3	21.5	16.4	23.5
	30	24.0	21.4	16.3	21.6
	33 - 39	8.8	11.9	23.8	12.2
	42 - 54	5.7	21.8	31.6	19.0
	57 - 81	0.3	3.5	6.7	3.0
First backfill	None	4.9	18.5	26.7	16.1
	Subsoil	0.5	0.3	0.8	0.4
	Topsod & topsoil	38.7	55.0	62.3	51.9
	Organic	2.2	2.5	2.9	2.5
	Clinker	1.3	0.8	—	0.8
	Loose stones	9.8	6.4	2.9	6.9
	Broken stones	17.2	6.5	2.4	8.6
	Chips	3.1	1.8	—	2.0
	Screened gravel	14.7	5.4	1.2	7.1
	Naturally occurring gravel	7.6	2.8	0.8	3.7

the other end of the scale, in Kerry (13), Mayo (11), Westmeath (8), Sligo (7), Longford (5), Monaghan (4), Leitrim (3) and Louth (2). A noticeable feature is that the incidence of broken drains increases with increasing drainage depth.

Table IV shows the variability of subsoil permeability, type of drain and drainage depth for different drainage problems. A countrywide breakdown of drainage problems gives 36.7 percent seepage and springs, 34.0 percent impervious subsoil, 21.8 percent water table, and 7.5 percent others. However, in some districts the occurrence of problems differed considerably from these average percentages. Seepage problems were very evident in Carlow (100 percent), Wicklow (80 percent), Tipperary (76 percent), Waterford (60 percent) and Cork (56 percent). Impervious subsoils were most frequently encountered in Louth (83 percent), Leitrim (81 percent), Longford (80 percent), Cavan (74 percent), Monaghan (66 percent) and Limerick (55 percent). Water table problems occurred most often in Laois (70 percent), Westmeath (65 percent) and Galway (56 percent).

Table V shows the variability of drainage depth, first backfill and second backfill

for different types of drain. Topsod or topsoil was used as a first backfill on 85 percent of all tile drains except those used as mole catchments. On mole catchments some type of porous fill was used as first backfill on 99 percent of all tiles laid. On subsoiling catchments, however, less than 15 percent of the tiles received porous fill as first backfill.

Seepage and springs, and impervious subsoils are the most important drainage problems in Ireland, though high water tables occur with sufficient frequency to merit investigation. The overall average occurrence of broken drains (42.7 percent) was exceeded where problems of iron pan, seepage and springs, and impervious layers were encountered.

Tile drains and stone drains were the only types of drain used in the solution of all drainage problems. Mole drains with tile catchments were found to a far greater extent on impervious subsoils and impervious topsoils than where other problems occurred. Subsoiling with tile catchments was used on iron pans and on impervious layers. However, less than half the area affected by these problems was treated by subsoiling.

Permeability measurements were not made. The placing of soil in any category was decided on the basis of an inspection of the excavated trenches by the Project Officer coupled with his knowledge of the district. The subjectivity of this method of assessment is appreciated. Generally, however, very little difficulty would be experienced in recognising extremes of high and low permeability. The fact that 68.8 percent

TABLE III: Variability (expressed as a percentage) of the occurrence of broken drains in different subsoil types and drainage problems and for different drainage depths

		Broken or choked old drains		Overall Occurrence
		Yes	No	
Occurrence on area surveyed		42.7	57.3	
Subsoil type	Mineral	43.9	56.1	94.4
	Peat	23.3	76.7	5.6
Drainage problem	Water table	40.7	59.3	21.8
	Seepage & springs	55.2	44.8	36.7
	Cemented layer	39.0	61.0	0.8
	Iron pan	72.2	27.8	0.3
	Imperv. subsoil	29.5	70.5	34.0
	Imperv. topsoil	33.2	66.8	2.1
	Imperv. layer	48.6	51.4	1.8
	Hollows	12.0	88.0	1.8
	Flooding	17.8	82.2	0.7
Drainage depth (inches)	21 - 24	28.1	71.9	20.7
	27	42.1	57.9	23.5
	30	43.1	56.9	21.6
	33 - 39	45.8	54.2	12.2
	42 - 54	55.1	44.9	19.0
	57 - 81	56.2	43.8	3.0

TABLE IV: Variability of subsoil permeability, type of drain and drainage depth (expressed as a percentage) for different drainage problems

		Drainage problem									
		Water table	Seepage & springs	Cemented layer	Iron pan	Imperv. subsoil	Imperv. topsoil	Imperv. layer	Hollows	Flooding	All problems
Occurrence on area surveyed		21.8	36.7	0.8	0.3	34.0	2.1	1.8	1.8	0.7	
Subsoil permeability	Low	9.5	8.8	24.3	36.4	44.9	58.6	24.3	6.6	5.7	22.7
	Medium	78.2	77.0	75.7	63.6	55.1	39.9	73.3	70.0	77.4	68.8
	High	12.3	14.2	—	—	—	1.5	2.4	23.4	16.9	8.5
Type of drain	Open	35.6	14.4	—	—	4.6	8.1	3.3	23.4	91.4	15.9
	Tile	43.6	65.3	47.2	37.1	32.4	28.3	60.2	55.9	3.2	47.7
	Tile+moles	1.4	1.9	1.4	6.3	38.3	40.3	19.0	1.2	—	15.2
	Tile+subsoiling	5.8	4.4	32.4	41.2	9.2	5.0	4.7	6.8	5.1	6.7
	Stone	7.2	13.1	18.7	7.0	14.6	15.5	12.1	11.5	0.3	12.3
	Sod	3.8	0.9	—	—	0.5	1.7	0.3	1.0	—	1.4
	Misc.	2.6	—	0.3	8.4	0.4	1.1	0.4	0.2	—	0.8
Drainage depth (inches)	21 - 24	12.1	13.2	16.8	31.6	34.9	29.1	14.4	21.9	—	20.7
	27	19.1	14.0	69.8	39.3	35.6	39.6	49.7	28.0	—	23.5
	30	20.2	24.1	—	—	17.8	16.9	17.9	15.6	2.5	21.6
	33 - 39	13.0	16.2	4.1	29.1	—	3.7	12.2	1.2	9.7	12.2
	42 - 54	28.8	28.3	9.3	—	8.0	10.7	5.8	33.3	84.4	19.0
	57 - 81	6.8	4.2	—	—	3.7	—	—	—	3.4	3.0

TABLE V: Variability (expressed as a percentage) of drainage depth, first backfill and second backfill for different types of drain

		Type of drain							
		Open (only)	Tile	Tile+ mole	Tile+ subsoiling	Stone	Sod	Misc.	All drains
Occurrence on area surveyed		15.9	47.7	15.2	6.7	12.3	1.4	0.8	
Drainage depth (inches)	21 - 24	—	24.5	11.4	0.3	58.5	2.3	17.1	20.7
	27	0.6	21.3	65.3	26.8	10.2	4.4	3.4	23.5
	30	0.6	25.8	23.3	42.6	17.5	24.8	24.0	21.6
	33 - 39	8.2	14.5	—	29.3	7.7	63.2	32.9	12.2
	42 - 54	71.7	13.9	—	1.0	6.1	5.3	16.8	19.0
	57 - 81	18.9	—	—	—	—	—	5.8	3.0
First backfill	Subsoil	—	0.5	—	—	0.3	6.9	—	0.4
	Topsod & topsoil	—	84.6	1.0	85.2	34.4	81.2	—	61.9
	Organic	—	3.5	—	0.2	4.1	11.6	—	3.0
	Clinker	—	1.3	1.3	—	0.3	—	—	1.0
	Loose stones	—	0.4	4.3	—	49.1	—	—	8.2
	Broken stones	—	2.8	37.6	0.5	11.8	0.3	—	10.2
	Chips	—	0.7	10.1	0.3	—	—	—	2.4
	Screened gravel	—	3.5	32.7	7.6	—	—	—	8.5
	Naturally occurring gravel	—	2.7	13.0	6.2	—	—	—	4.4
Second backfill	Subsoil	—	86.1	1.8	87.2	34.8	61.1	—	62.8
	Topsod & topsoil	—	13.3	97.4	12.8	61.3	12.1	—	35.7
	Organic	—	0.5	0.6	—	3.4	26.8	—	1.4
	Misc. porous fills	—	0.1	0.2	—	0.5	—	—	0.1

of all soils were classified in the medium range indicates that only the extremes of high and low values were excluded from this range. A further breakdown of the medium range into specific permeability categories would be most desirable, but facilities to do this are not at present available.

The survey is continuing and a more detailed analysis will be carried out on a larger number of cards in due course.

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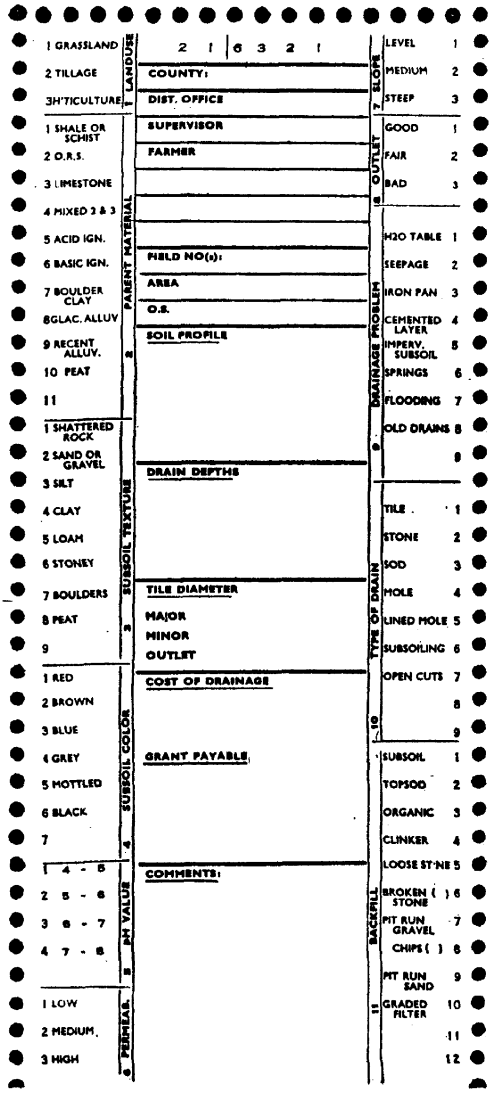
APPENDIX I: Punch card used on pilot survey



APPENDIX II: Card used on countrywide survey