COUNTY LEITRIM RESOURCE SURVEY

Part II — Some aspects of production :
Drainage, Machinery Use, Grass Production and Utilisation, Farming Systems, Animal Health, Fisheries

An Foras Talúntais

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FOREWORD

For many years it has been recognised that some of the worst features of western decline are represented in County Leitrim. Controversy has surrounded the county with regard to the possible means by which this continuing decline could be halted and reversed. Farming in the county is beset by many problems arising from natural, technical, economic and social forces.

The natural limitations of the county are those imposed mainly by a combination of heavy, poorly drained soils and a relatively wet climate. This dictates a predominantly grassland farming system which encounters serious problems such as poaching by grazing animals, short grazing season, the necessity for the conservation of large amounts of winter fodder, and poor trafficability for farm machinery. This latter problem is accentuated by the presence of many steep slopes associated with the predominant drumlin topography.

It is not surprising, therefore, to find serious sociological problems associated with these conditions. Farm size is small, off-farm employment is scarce, and the resulting outmigration has brought about a population structure dominated by the old and very young. This represents a very serious obstacle to economic development.

Against this background the Council of An Foras Taluntais decided in 1971 that the overall agricultural situation in Leitrim should be examined. It was realised that much of the information already available was related to situations of the past and was irrelevant in terms of future demands created by E.E.C. requirements. It was also realised that the positive way to progress is through identifying the resources available and, using those, to develop systems based on modern technology and innovation. Having completed an inventory of Leitrim's resources, recommendations could then be made with regard to alternative land-use systems. The objective is to bring about an overall improvement in the welfare of the people of. the county, and of the drumlin belt as a whole, to which the results should equally well apply.

The conduct of such a comprehensi\e resource survey presented a formidable task, demanding the collective efforts of people in a wide variety of disciplines and from a number of organisations. The experience gained on methodology and organisation in the course of two previous resource surveys. West Cork and West Donegal, was of great value. It is hoped that the report of the present survey will go further than the other two in making an economic assessment, from the basic output potential data, of the major alternative land uses, namely, grassland and forestry.

It is a pleasure to be associated with the acknowledgments given to those within An Foras Taluntais and those outside who co-operated in this survey. Finally. may 1 commend the efforts of the Working Party w ho embarked on and completed this task with such dedication and enthusiasm.

T. Walsh,
Director

PREFACE

The findings of the Leitnm Resource Survey are published in four parts:

Part 1 Grazing capacity, forestry potential and soils

Part II Some aspects >t production drainage, machinery use, grass production and utilisation, farm systems, animal health, fisheries

Part 111 Economics and sociology

Part IV Summary, conclusions and development proposals.

The background and objectives of the study are outlined in the introduction to Part I which deals mainly with the physical resources and their influence on grass production and forestry potential within the county. This section. Part II, deals with various aspects of agricultural production. It concentrates on major problems such as land drainage, machinery use on drumlin slopes, grassland production and utilisation, poaching, feed conservation, animal health and fisheries. It attempts to present the principal research findings and recommendations in relation to these major problems.

For their assistance in the work reported here grateful acknowledgment is due to the Agricultural Advisory Officers of the county especially Mr. J. Hennelly, C.A.O., Mr. H. McKearney. Deputy C.A.O., Mr. P. O'Loan (C.A.O. up to 1971) and Mr. A. Kilbane: to the Land Project Officers of the county: to Mr. J. Martin, County Development Officer and Mr. P. McHugh, Department of Agriculture and Fisheries: to Mr. A. F. Hamilton. Sligo Regional Laboratory for the section on Animal Diseases: to Mr. B. J. Kelly. Regional Veterinary Office. Sligo, for the section on Animal Health State Schemes: to Mr. M. J. Hope-Cawdlery for the section on liver fluke: to Dr. J. O'Shea and Mr. J. O'Dwyer, An Foras Taluntais, Dunsinea, and the Soils Laboratory. Johnstown Castle for chemical analyses of winter feed: to members of the Cartographic Section, Johnstown Castle for the preparation of figures: to Mr. P. Collins and Mr. P. Marren, An Foras Taluntais, Grange, for technical assistance.

Our thanks are due to the local people, especially the farmers who co-operated so willingly, and to the members of the Manorhamilton Development Company who gave the survey their full support.

Both the Economic Development Survey Report of County Leitrim compiled by the late Mr. S. Duke, then County Development Officer, and the Western Development Report of Dr. J. Scully, Department of Agriculture and Fisheries, were of considerable value to the resource survey team in providing useful background information.

Dr. P. Ryan, Deputy Director, An Foras Taluntais, was most helpful in his capacity as advisor to the working party, and Dr. T. Walsh, Director, gave the study his enthusiastic support.

Finally, thanks are due to those who assisted in the preparation of the report, especially to Mr. P. V. Geoghegan, Mr. B. Gilsenan and Mr. E. Wymes, for advice and editorial work.

M. J. Gardiner
Project leader

An Foras Taluntais.
June, 1975.

Members of the Project Team

Pro/eel Leader: Dr. M. J. Gardiner. B.Agr.Sc., M.S., *Head,* National Soil Survey Department.
Mr. M. Bulfin, B.Agr.Sc.. (Forestry), M.F.S.. National Soil Survey Department.
Mr. P. Broughan, B.Agr.Sc., Agricultural Liaison Department.
Dr. D. Collins. M. Agr.Sc. Animal Management Department.
Mr. J. Curry, M. A.. Rural Sociology Department.
Mr. M. Drennan. B.Agr.Sc., M.S., Animal Management Department.
Mr. M. Fleming, M.Sc. (Dairying). Dairy Microbiology Department.
Mr. L. Grubb. B.A., Hill and Marginal Land Department.
Dr. D. Harrington. B.Sc, M.E.S., *Head.* Statistics Department.
Mr. B. Hickey. B.Agr.Sc.. B.Comm., Farm Management Department.
Mr. J. Mulqueen, B.Agr.Sc.. M.S. *Head,* Hill and Marginal Land Department.
Dr. D. Poole, M.Sc. M.R.C.V.S., *Head,* Field Investigations Department.
Miss M. Prenderville, M.Agr.Sc., Vegetable Crops Department.
Mr. B. Stronach. B.A.. Game Research Unit.
Mr. M. Walsh, B.A., M.Sc., National Soil Survey Department.
Mr. E. Pitts, B.Comm, Secretary to the Project Team.
Dr. P. Ryan, Deputy Director, Advisor to the Project Team.

Contents

Because some of the earlier experiments reported on here were laid down using imperial measurements, both imperial and metric data are used in different parts of the text.

CONVERSION FROM METRIC TO IMPERIAL UNITS

	Metric	*Imperial*
Length	1 cm	0.39 in
	1 m	3.28 ft
	1 km	0.62 miles
A rc;i	1 cm-"	0.155 in sq
	1 m-	10.8 ft sq
	1 ha	2.47 ac
Volume	1 litre	0.22 Imp. gal
Volume per unit area	1 1 ha	0.089 Imp. gal ac
Weight	I g	0.035 oz
	1 kg	2.20 lb
	1 tonne (Mg)	0.984 ton
Weight per unit area	1 g m	0.0305 oz yd sq
	1 kg ha	0.89 lb ac

CHAPTER I

INTRODUCTION AND SUMMARY

*M. J. Gardiner**

Part I of this report showed that 84% of Leitrim land has poor drainage. Only 4% is suitable for cultivation and therefore the main farming enterprises are based on grass production. Because of poor drainage and poaching hazards, some 74% of the county has very difficult grassland utilisation and management problems.

In Part II, the major land drainage and reclamation problems are first discussed. It is shown that many of the soils have undesirable physical characteristics. Their average infiltration capacity is only one sixteenth that of soils in Grange, Co. Meath, and one thirtieth that of soils in Fermoy, Co. Cork. Average annual rainfall exceeds evapotranspiration (18 inches) by 52 inches in the high rainfall areas and by 22 inches in the low rainfall areas. Combined with the heavy impermeable soils, this is the principal cause of the drainage problem. Some 70-90% of heavy rainfall runs off the surface.

Experiments and experience have shown that moling is the only practical form of drainage. Tile drainage is effective only at very short distances from the drain. Pasture responses to drainage are of the order of 25% in wet years and 10-15% in dry years. Pasture utilisation and seasonal patterns of production can also be considerably improved although these are difficult to quantify. Guidelines for the best layout and design of mole drainage are given.

Machinery use is difficult due to the wet soil conditions. This problem is accentuated by small field and farm sizes and by the predominance of drumlins, many of which have slopes that are too steep for mechanised agriculture.

Grass production is poor because of low fertility, low fertiliser usage and poor botanical composition arising from bad grazing management and impeded drainage. Soil temperatures suitable for grass growth are attained one month later in spring at Ballinamore. than in more southern parts of the country. Nevertheless, herbage yields up to 9,000 lb dry matter per acre per annum can be achieved through increased use of fertilisers. Responses to optimum nitrogen, phosphorus and pottassium are of the order of 85%. Botanical composition (including rush control) can be greatly improved through drainage and controlled grazing.

Although herbage production can be greatly increased, its efficient utilisation is very difficult under Leitrim's soil conditions. Maximum utilisation and minimum poaching damage are examined in systems using light animals and short grazing seasons. The most common current systems are dairying and store cattle in south Leitrim, suckler cow and store cattle in north Leitrim and mountain sheep/suckler cow enterprises in the mountain areas.

Store cattle contribute over 50% to farm income but, as indicated also in Part 1,

•Project Leader and Head. National Soil Survey Department. An Foras Taltintais

stock numbers can be considerably increased. Intensive livestock enterprises would require a two-cut silage system and this can only be achieved where drainage has been carried out. It is also difficult in wet autumns. Overwintering on a large scale is not desirable because of the difficulties of making a sufficient quantity of good quality hay or silage. For these reasons flexibility in livestock numbers would be desirable.

At present, the quality of winter feed is poor, average dry matter digestibility of hay and silage being only 56% and 55% respectively. The quantity of winter feed conserved was estimated to be only 78% of that required to maintain the livestock population in 1971. Cow herds are small with over two thirds less than five cows Only half the farms have electricity while only 54% of cow byres are classified as good or fair. Milk assembly is mainly by the multican haulage system which is slow and costly. There is a serious milk quality problem which is related mainly to lack of cooling facilities and poor standards of hygiene.

The poor quality winter fodder accentuates the problems associated with parasitism and malnutrition. Liver fluke is an important problem not only at its present level but also as a disease which could become more serious under intensive farming conditions. Preliminary results from using molluscicides indicate that a reduction in liver damage can be achieved. If livestock farming is intensified, certain metabolic disorders associated with trace elements should also be anticipated.

Leitrim hill and mountain land has been divided into wet and dry categories, the latter having the most potential for development. Mountain sheep are carried mainly on the dry grassy hills but the overall sheep flock is small. Present stocking rates are low ranging from 1.5 ewes/ha to as low as 0.5 ewes/ha. The main problems associated with hill farming are drainage, fertility, accessibility, fencing, land ownership and ability of the farming population.

Although pig production is one way in which intensification of farming could take place it is carried out on only I7.8% of farms and contributes only 14% to farm income. Pig herds are small and the quality of breeding and fattening accommodation is very low. For these reasons the impact of pig production on farm income is only marginal.

In Chapter VII an outline of angling resources is given. Returns for 1970 show that angling visitors spent £100,000 in the county. A map and schedule of waters currently in use is shown and a discussion of the problems of re-opening the Ballyconnell Ballinamore canal is also presented.

CHAPTER II

LAND RECLAMATION AND DRAINAGE

*J. Mulqueen and A. Roche**

Introduction

Practical difficulties in farming in Co. Leitrim arise chiefly from surplus rainfall falling on essentially impervious soil on slopes As shown in Part I of this study, some of the land of the county is poorly drained with a use range limited to pasture or forestry. The main problems are trafficability, low soil fertility and rushes. Most of lowland Leitrim consists of heavy soils with a drainage disability which is both costly and slow to correct while most of upland Leitrim is peat-covered. The physical characteristics of the different soils and the most suitable reclamation and drainage techniques are discussed in this chapter.

Soil Physical Characteristics

Soil texture

As far as farming and land improvement are concerned the soils subdivided by Walsh in Part 1(1) can be grouped together according to texture as in Table I. Excluding the peats. 48% of the area of Co. Leitrim (51 % of the land area) consists of clays and loams (Ballinamore. Drumkeeran and Garvagh series) with very slow drainage properties. Since the subsoil below the shallow topsoil is not aggregated, the soils (Fig. 1) can be contrasted on a textural basis with a sand which is known to have a very rapid hydraulic conductivity (greater than 25 cm/hr). Fig. 1 shows that Co.

TABLE I—A textural classification of Co. Leitrim soils

Texture	Landform	Main Soil Series	% C0. Leitrim*
Clay	Drumlin Lowland	Ballinamore Drumkeeran	31
Gritty loam to gritty clay	Drumlin lowland	Garvagh	17
Peat	Valley Mountain	Allen Aughty	36
Various	Lowland	Corriga Wardhouseetc.	10
Waters	Valley		6

*** Based on Soil Survey Bulletin No 29 (Part I. Leu rim Resource Survey). An Foras Taluntais. 197.1.**

Leitrim subsoils at 45 cm depth have very high contents of silt and clay size material compared with the more uniform sorted Lough Neagh sand. Unfavourable physical

•Hill and Marginal Land Department. An Foras Taluntais.

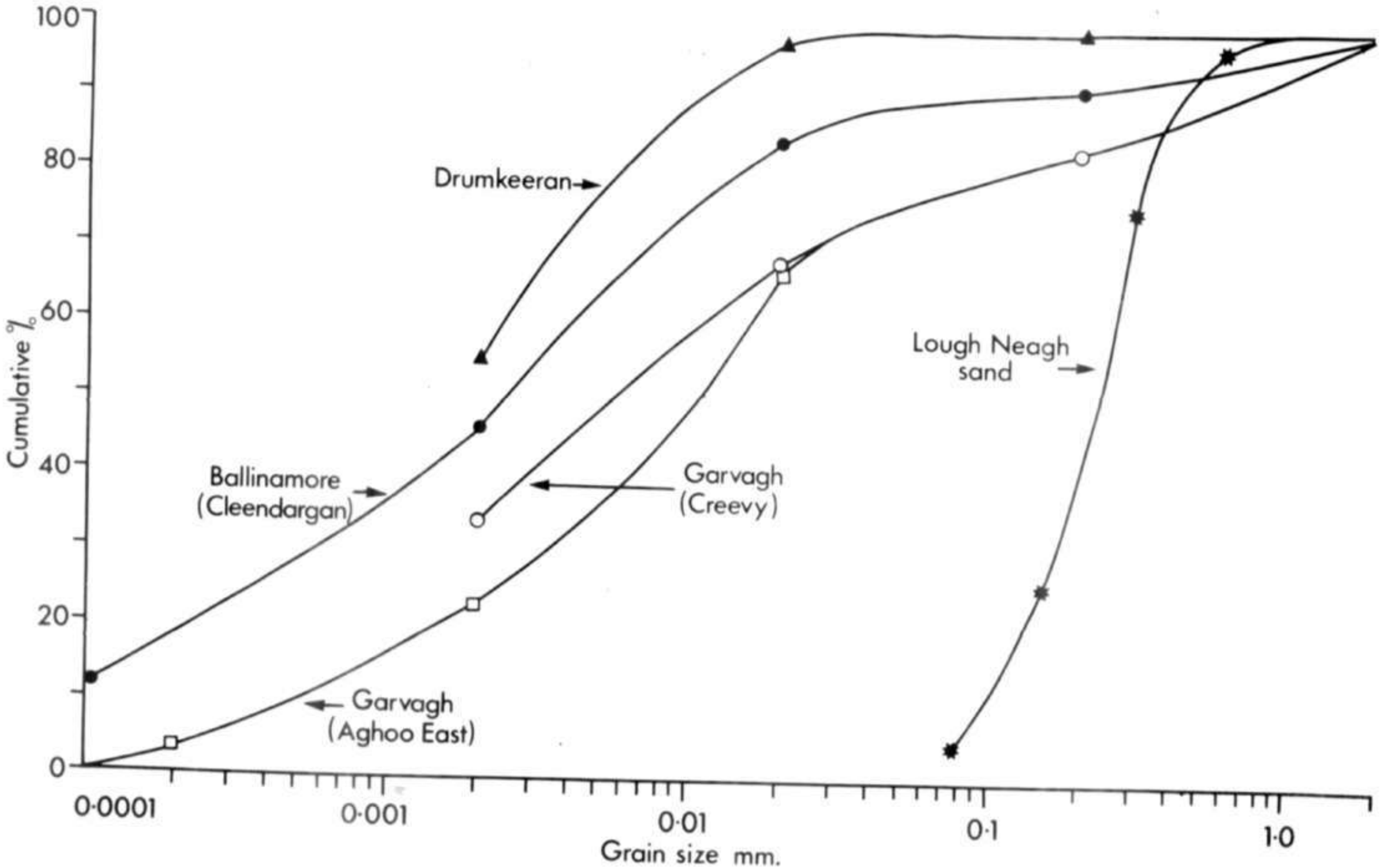


Fig. 1: Cumulative particle size distribution curves for four representative Leitrim subsoils (45 cm depth) compared with a free draining water sorted Lough Neagh sand.

properties result from very fine grained material which is not aggregated (structured). Garvagh series (Aghoo East) followed by Garvagh series (Creevy), Ballinamore and Drumkeeran series have increasing quantities of fines.

Drainage Properties

By using the concept of effective grain size, a qualitative idea of the hydraulic conductivity for the soils in Fig. 1 can be obtained. This method implies a close relationship between grain size and pore size. The effective grain size for the three soils that arc known are: Lough Neagh sand 100 u. Garvagh (Aghoo East)—0.5 u and Ballinamore (Cleendargan)—0.09 u. Estimated hydraulic conductivities are: Lough Neagh sand—34cm hr. Garvagh (Aghoo East)—3.7x10^{4} cm hr and Ballinamore—1.2x10^{5} cm hr. The latter two soils are essentially impervious. The measured value for the Ballinamore series (Cleendargan clay) is l.lfr^{4}cm hr and is about 10 times the estimated value. This is mainly due to fine cracks and occasional fine root holes in the clay.

Since the soil layer below the drain invert is not changed by any practical form of mole drainage known at the present time, good drainability of the soil requires that the soil acquire an induced hydraulic conductivity of the order of 1 cm hr. This is of the order of 10.000 fold the virgin hydraulic conductivity of the Cleendargan clay[1]. Drainage, to be effective, must therefore serve two functions: (a) increase the hydraulic conductivity of the soil slab overlying the drain invert (b) provide drainage channels at a close spacing of about 1-1 ½ metres. This can be achieved at least for the summer season by mole ploughing in favourable conditions (dry soil and dry weather subsequently). Technical issues relating to drainage have been discussed elsewhere.

Fig. I also shows that there is inter-series variation in texture among the soils of Co. Leitrim. Walsh (1) and Fig. 1 also show substantial intra-series variation in texture in the Ballinamore and Garvagh series although in the Ballinamore B horizon (30-40 cm thick) there is less variation with from 38-47% clay size material. The Garvagh series is a stratified soil. It has a shallow topsoil underlain by a tight layer of cherty gravel which is commonly 8-30 cm thick but may be much thicker (decalcified cherty limestone). The cherty gravel layer is commonly underlain by a cherty gritty clay (Creevy and Aghoo East). Textural variation has implications for mole drainage but normal textural analyses do not indicate the varying properties of soils within the clay size range (2). The plasticity index serves as an additional means of identification for these soils (Table 2).

Peats

Peats include the valley type (Allen series) and the blanket bog type (Aughty series). They vary in depth from a few cm to several metres in the Allen series. The Aughty series grades from 1-2 metre peat on Slieve Anierin to the peaty topsoils of the Drumkeeran and Ballinamore series. Deep uncut peats are usually soft and gelatinous below the surface fibrous layer and have a very low hydraulic conductivity of the order of 1.10- cm hr. They are difficult to drain sufficiently to give a satisfactory bearing capacity. Deep homogeneous gelatinous peats have a verj limited use in agriculture because of their low bearing strength and poor quality vegetation. Shallow and cut-over peats on the lowlands are usually cracked which

[1] The term Cleendargan clay is used as one sue location for soils belonging to Ihe Ballinamore Series (Part I).

-Mulqueen. J Drainage of Impeded Soils. An ForasTaluniais. Dublin. 76pp. 1974.

TABLE 2—Plasticity Index[1] at 45 cm depth[2] of some soils in Co. Leitrim

Site	Pl. Limit % H_2O	Liq. Limit % H_2O	Pl. Index (dimensionless)	Soil series
Jamestown	26	94	68	Ballinamore
Cleendargan 1	28	89	61	
Cleendargan 2	28	88	60	
Lislahy	24	70	46	• •
Leitrim 2	28	94	66	Garvagh
Carrigallen 2	26	85	59	,,(43-51 cm)
Leitrim 1	25	83	58	..
Creevy	24	71	47	>.
Mohil'l 1	21	65	42	..
Mohill2	23	59	36	,,
Mohill3	21	55	34	,,
Carrigallen 1	23	39	16	.,(36-41 cm)
Farnaught 1	18	64	46	Rinnagowna
Farnaught 2	19	40	21	»

[1] After the method described by Sowers. G. F. in Methods of Soil Analysis. Amer Soc. of Agronomy. Madison. Wis.. 1965.
[1] Note Carrigallen profile was sampled at two depths

makes drainage relatively easy where adequate outfalls are available. Shallow and cut-over peats of the Aughty series are also often cracked but since they are underlain by slow-draining peats and tight clays, sometimes with numerous boulders, each individual situation is a separate design problem. Sometimes the peat depth is quite variable in a field. Sometimes too. the peat has eroded and the peat banks are in this case quite dry with good quality mountain grasslands, as for example on Truskmore mountain. These dry grassy peats are suited to aerial topdressing. The main problems with reclamation of mountain peaty soils is the low payment capacity of the farm enterprise, the close drain spacing required and the topography. Often, all that is economically feasible is a skeletal drainage system and this may not be economically feasible on deep peats even when it is practically possible.

Mountain soils vary from the dry slopes of the Upper Carboniferous limestone mountains along the Glencar, Glenade and Middle Carboniferous limestone of the Lough Melvin valley to the mostly wet peaty topsoils of the lower slopes of the predominantly Upper Avonian shales of Slieve Anierin and Arigna mountain. Some of the drier slopes are particularly suited to hill sheep farming while the wetter slopes have little future in agriculture. Particularly, the Glencar, Glenade and Rosinver valleys are well served with a somewhat lighter textured soil of the Ballinamore series which could be used for winter feed requirements and grazing during critical periods.

Plasticity index is directly related to the clay size fraction and the clay mineral composition. Table 2 shows that the plasticity index of the soils examined ranges from 16 to 68. Carrigallen 1 and 2 show that in stratified soils plasticity index can vary quickly with depth. Non plastic moling layers are common enough in the Garvagh series. Mole drains were unstable in Carrigallen 1 in field tests under good conditions. Farnaught 1 and 2 show the variation in Rinnagowna series over a short distance of 1 km (½ mile). Field and laboratory tests indicate that structural collapse of mole drains will take place if the plasticity index drops below about 35.

While in general the subsoils are sticky plastic clays and tight hard cemented cherty gravelly sand with massive structure (structureless), sometimes the clay is cracked (columnor structure) and aggregated (blocky structure). The lower the plasticity index (except where this is due to cherty sand) the greater the tendency to structure formation and consequently the deeper the resulting topsoil which in this chapter is defined as the effective rooting zone with any underlying structured layer.

The physical properties of Co. Leitrim soils reflect their textural and mineralogical composition. Shallow rooting results from very low hydraulic conductivity and gas diffusion. This is confined to the top region and is caused by drying to the shrinkage limit. This results in air entry and structure formation (3). Topsoils usually have a very high organic matter content which decreases with depth (Fig. 2).

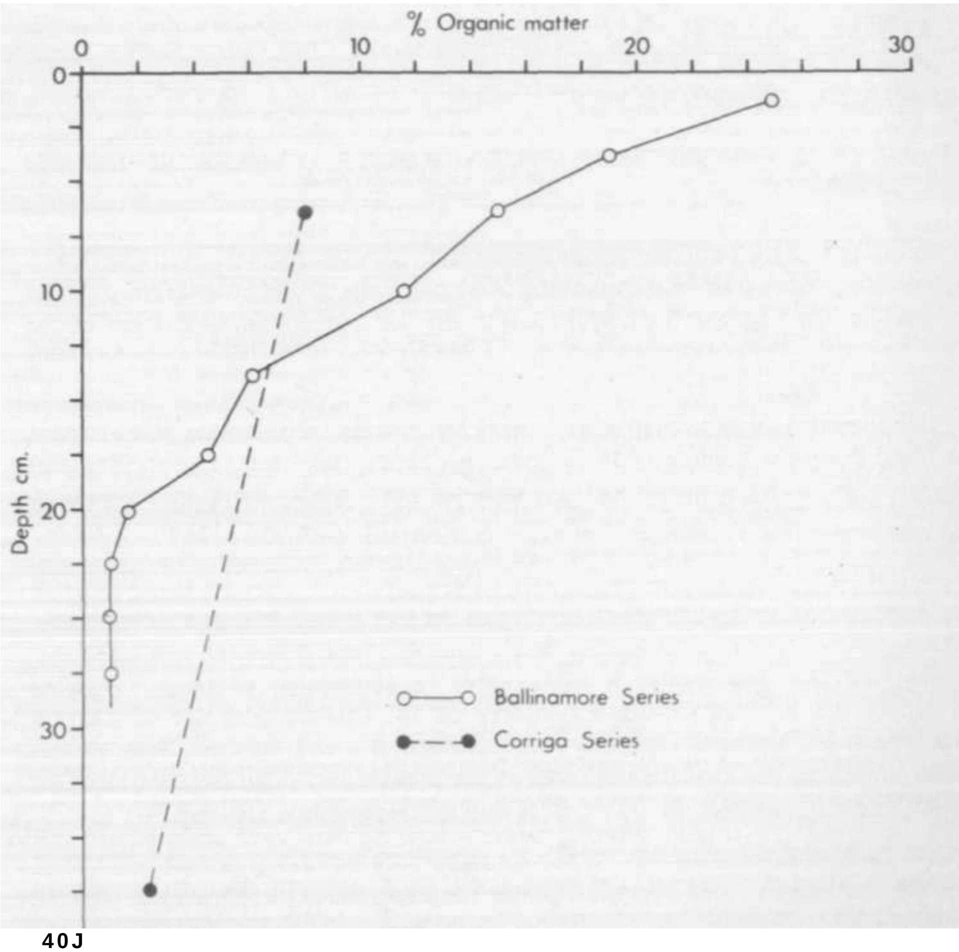


Fig. 2: Organic mailer distribution with depth in very slow draining soil (Ballinamore series) and a free draining soil (Corriga series).

In the free draining Corriga series the organic matter content is 2.5% in the 25-48 cm layer compared with less than 1% in the Cleendargan clay (Ballinamore Series).

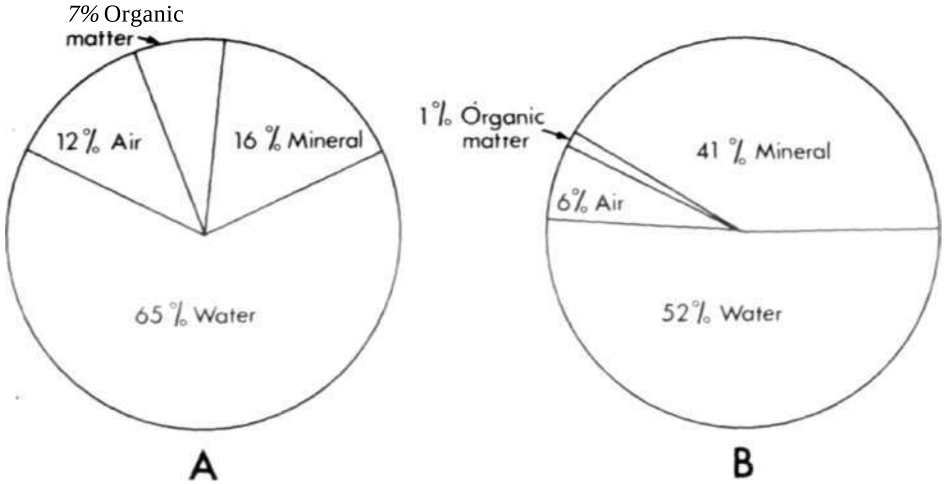


Fig. 3: Volumetric composition of Drumkeeran topsoil - A and subsoil - B at field capacity.

As a result of high organic matter content (7% compared to 1%) the topsoil has a high porosity compared with the subsoil. The porosities of the Drumkeeran topsoil and subsoil are 77% and 58%, respectively. As the organic matter content of the topsoil increases towards the surface (Fig. 3), so too does the total porosity, to about 90% in the surface 2.5 cm layer.

The porosity can go as high as 88% in the Drumkeeran series (peaty phase) where the organic matter content is 36% in the top 12 cm (5 inches). Deep valley and mountain peats have porosities in excess of 90% while some reclaimed and mineralised peats have porosities as low as 75%. The topsoils of the predominant soils in Co. Leitrim have a high void ratio (ratio of porosity to solid filled space) and as a result have a very low bearing capacity when saturated. They are easily poached and puddled by animals and machinery when wet and especially if there is free water ponding the soil surface. Poaching and puddling break down the soil structure, weaken the soil and render it more liable to subsequent poaching. Wheeled machinery can be immobilised. Experience on the Cleendargan clay shows that poaching in the spring is especially to be avoided; if a wet May and June should follow, poaching can escalate and result in the break-down of an intensive stocking system. Some poaching is inevitable in the autumn, especially in October.

Some physical characteristics which are important in soil management are shown in Table 3. Since the field capacity exceeds the plastic limit for the soils mentioned (Table 3) they are liable to deformation by poaching. Good grazing management should match the grazing season to the soil moisture status and to the rate of grass growth. If the grass growth rate exceeds the rate of consumption there will always be a grass cover to protect the soil. This can be achieved by allowing only early-calving cows to grass in April or, in a store cattle system, by controlling the stocking rate early in the season.

TABLE 3—Some physical characteristics of Co. Leitrim soils

Soil Series	Depth (cm)	Porosity Cr vol.)	Field capacity (rr vol.)	PI. limit (%vol.)	Liq. limit (%vol.)
Ballinamore	0-8	67	53	50	62
(Cleendargan clay)	37^*5	52	47	39	123
Garvagh	0-10	68	53	48	66
(Creevycherty clay)	37^t5	51	45	31	94
Drumkeeran	0-10	77	58	—	—
(Drumduliy cla>)	38-50	59	53	—	—

As far as reclamation is concerned, a high frequency of boulders would interfere with mole drainage but gravel tunnel drainage would be feasible and surface reinstatement may be necessary in some cases to smooth the land surface for machinery. Boulders tend to be numerous around Drumkeeran and Killarga (Drumkeeran series).

Climate and Farming

Effects of average Rainfall and Potential Evapotranspiration (Epot)

With the predominance of very slow draining soils in the county, rainfall and potential evapotranspiration are the two important climatic factors. Average annual rainfall varies from a high of 1750 mm (70 in) around Truskmore mountain in north Leitrim to a low of 990 mm (39 in) around Cloone-Carrigallen in south Leitrim where most of the free draining soils are. Most of the lowlands get between 1,000 and 1,250 mm while the mountains receive 1,500 mm or more. Average annual E pot amounts to about 425 mm. Annual rainfall increases towards the mountains from Carrigallen (990 mm) to Ballinamore (1193 mm) to Manorhamilton (1476 mm). Monthly rainfall follows the annual trends (Fig. 4). Average monthly rainfall at the three points exceeds the E pot estimated from the Class A pan in all months. The excess is least in May and June and for the Carrigallen area.

The estimated effective rainfall (rainfall less estimated surface run-off) on a 23% (10°) undrained slope on the Cleendargan clay is less than the E pot from May 10 to July 25 (Fig. 5). The soil dries out during this period, i.e. the moisture content is less than saturation. By contrast, in a free draining Co. Meath soil there is a moisture deficit on average from May 2 to September 7 amounting to 33 mm while in central Holland the deficit amounts to 120 mm and lasts from April 1 to November 15. This means that free draining soils like those in Co. Meath or drained soils in central Holland are less than field capacity for the periods shown in Fig. 5. If the Cleendargan clay is effectively mole drained virtually all the rainfall infiltrates but with drainage the soil moisture content is less than field capacity from May through August on average. From September onwards the soil is at field capacity on average. Under effective drainage at Carrigallen there would be a deficit similar to that in Co. Meath while there would always be a surplus of rainfall over drainage at Manorhamilton. Figs. 4 and 5 point to the need for effective drainage in south Leitrim in all months except May, June and early July on average and in all months at Manorhamilton. Otherwise, the soil is near saturation except during dry spells.

As far as date of first grazing is concerned Fig. 5 indicates that this should take place in early May when evapotranspiration exceeds rainfall on average. If drainage is-installed, the first grazing can be started in late April when evaporation and grass growth become significant. Fig. 4 also indicates that grazing should commence later at Manorhamilton, by as much as one month, than at Carrigallen where a moisture

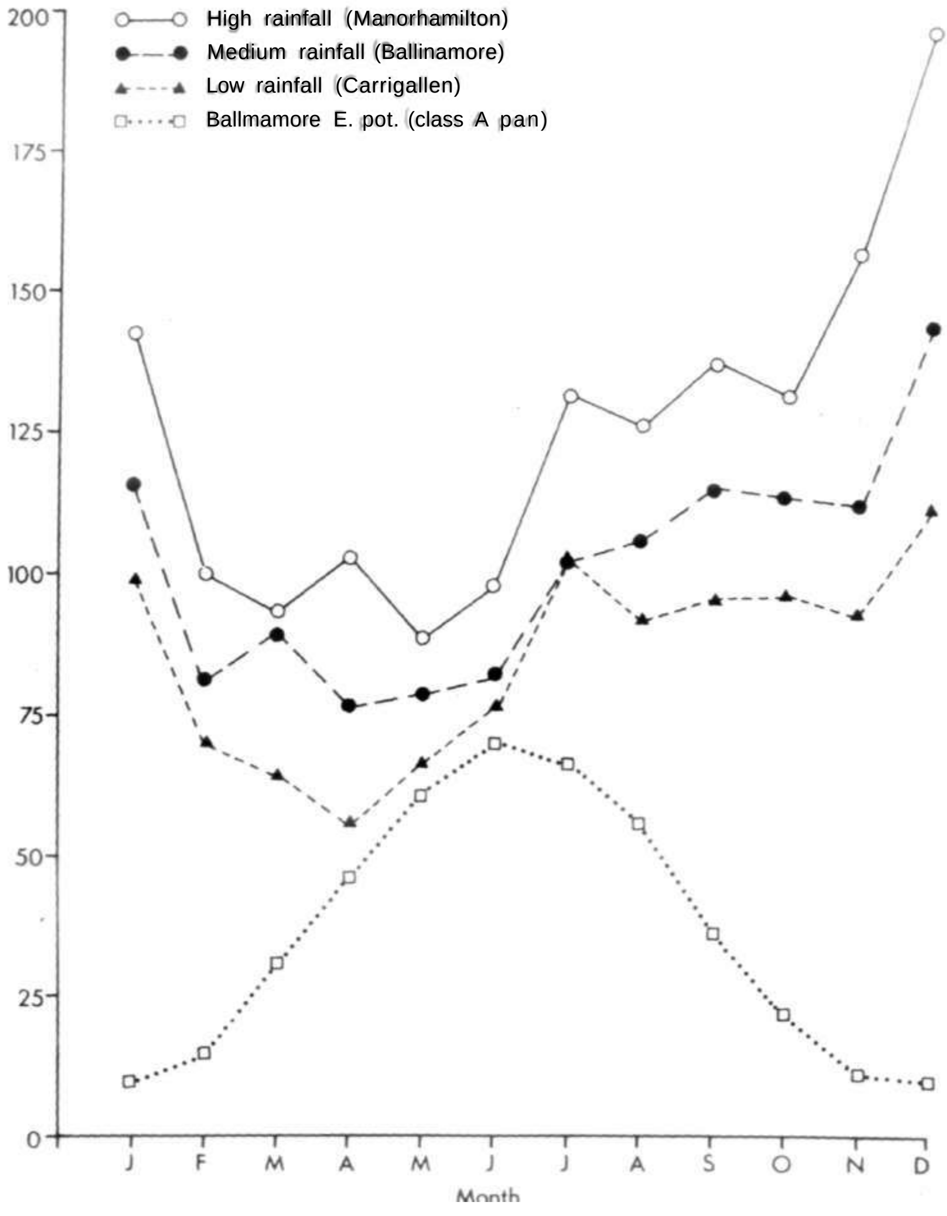


Fig. 4: Monthly rainfall at low, medium and high rainfall points in Co. Leitrim compared with the estimated monthly potential evaporation (Class A pan) at Ballinamore.

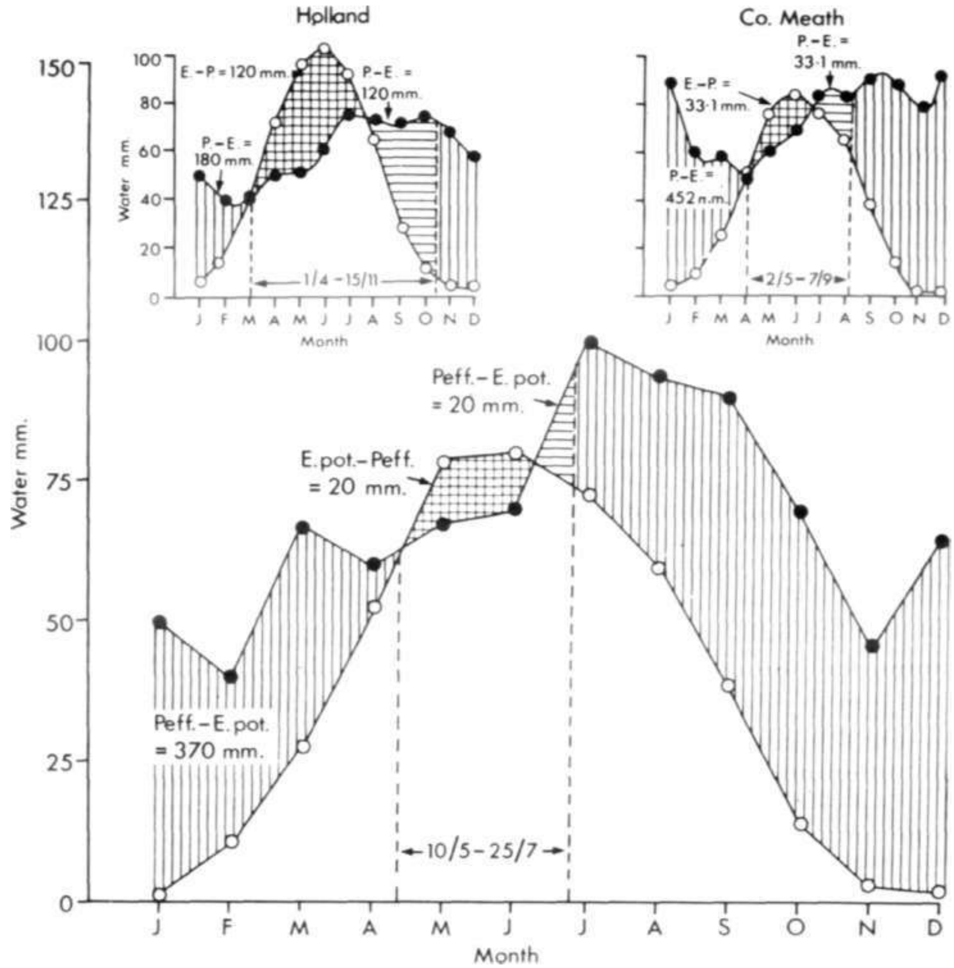
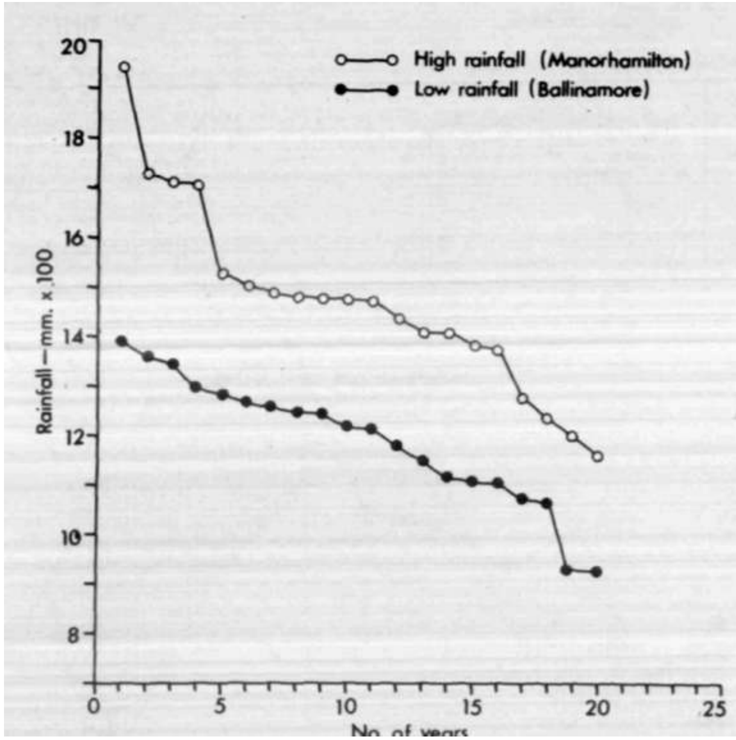


Fig. 5: Effective rainfall and potential evaporation (Penman's formula) at Ballinamore showing average duration of dry period compared to Co. Meath (top right) and Holland (top left).

deficit develops on average about May 1 under free draining, and drained conditions. On soils with impeded drainage, grass growth tails off rapidly about November 1 when the grazing season finishes on average. With the excess of rainfall some poaching is inevitable in late September and October. Figs. 4 and 5 also emphasise that it is necessary to have sufficient winter feed to keep cattle to May I, i.e. a 6 month winter on average.

Rainfall Variation from year to year

Monthly rainfall is very variable from year to year and it appears that E pot is more uniform. While rainfall variation is not so important on free draining soils, it is very important to farming policy on slow draining heavy clays. Farming policy is normally matched to average conditions but steps must be taken to cope with



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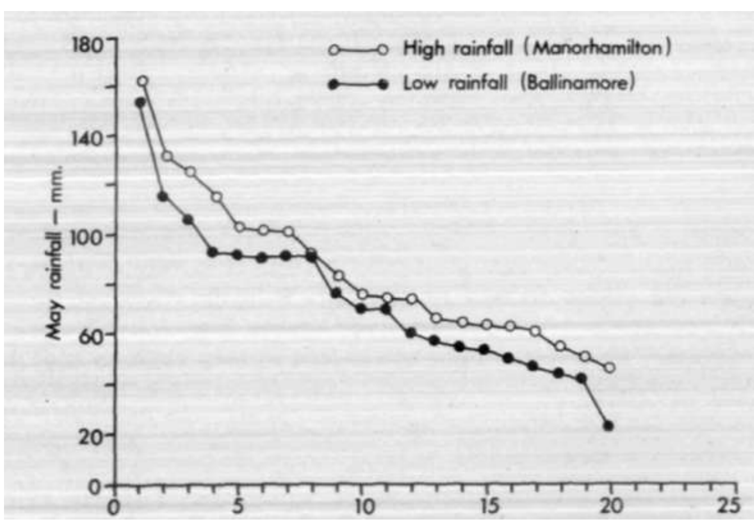
0 5 10 15 20 25

Na of years

6: Variation in annual rainfall at a medium (Ballinamore) and high rainfall points (Manorhamilton) over 20years.



No. of years

I ariation in May rainfall at medium (Ballinamore) and high rainfall points (Manorhamilton) over 20 years.

extremes of rainfall. Fig. 6 shows that over the 20 year period (1947-66) annual rainfall at Ballinamore (mean 1193 mm) ranged from 900-1400 mm and from 1160-1950 mm at Manorhamilton (mean 1476 mm). The range was 500 mm (20 inches) at Ballinamore and 790 mm (31 inches) at Manorhamilton. For the drier months expected rainfalls (Fig. 7) do not differ greatly at both places. From July onwards the rainfalls for given return periods diverge at the wet end of the scale (Fig. 8).

If a risk of failure in farming every 5 years is accepted then the July rainfall which must be taken into account when designing farming programmes, is 140 mm at Ballinamore and 182 mm at Manorhamilton. The implication of this for grazing management, hay making and drainage requirements is indicated in Table 4. On impeded soils, it is obvious that unless effective drainage is installed there will be poaching and machine difficulties (Fig. 9). Large quantities of hay cannot be made under these climatic conditions. The necessary change to silage making can be phased

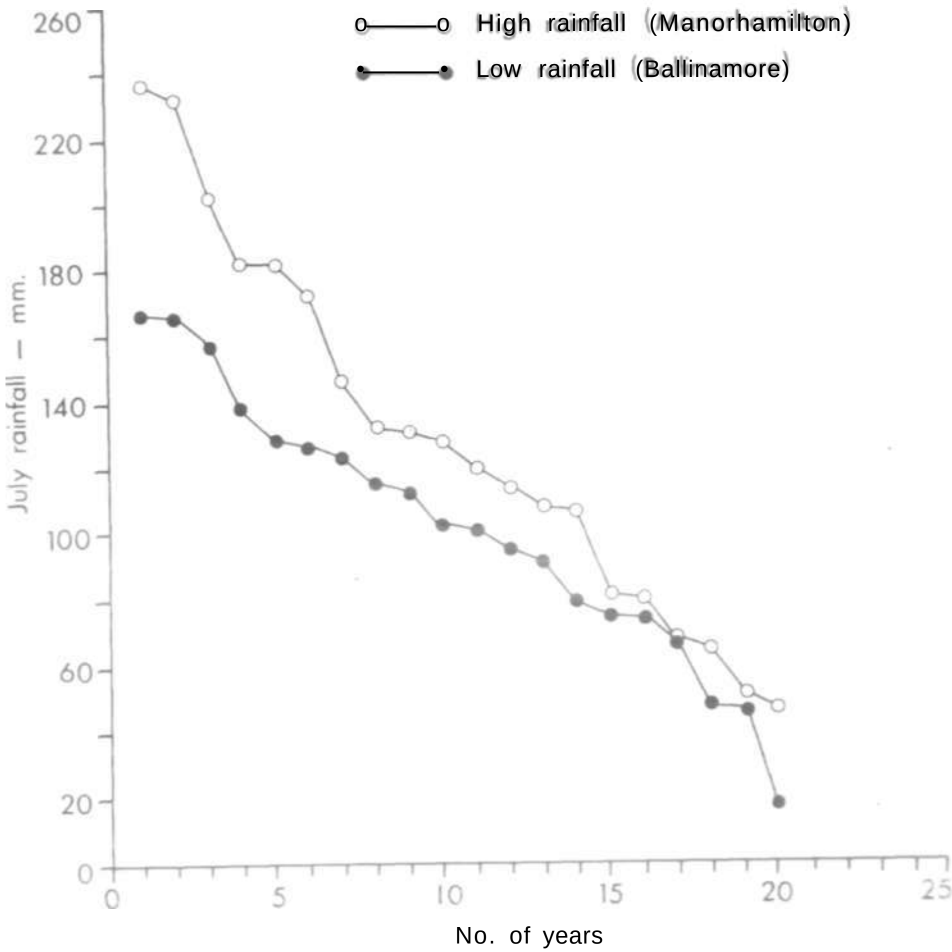


Fig. 8: Variation in July rainfall at medium (Ballinamore) and high rainfall pi (Manorhamilton) over 20 years.

TABLE 4—Expected July rainfalls and wet days (for a return period of 5 years) at Ballinamoreand Manorhamilton

Ballinamore			Manorhamilton		
Rainfall (mm)	Wet Days — 2 mm	2l 5 mm	Rainfall (mm)	Wet Days >, 2 mm	2l ^ mm
140	18	12	182	24	17

through buckraked silage to silorator and forage wagon silage. Drainage is a prerequisite for silage making. Experience indicates that if the monthly rainfall in May and June is 100 mm or more then there will be poaching and machine difficulties on undrained land and since no moisture deficit develops there will also be difficulties in July unless it happens to be a dry month (50 mm or less rainfall).

Fig. 9: Damage from muck spreading on undrained land compared to undamaged drained plots, August 1972.

Land drainage

As already pointed out, most of the difficulties associated with farming in Co. Leitrim arise from a combination of soil, climate and landforms. A combination of very slow draining soil, frequent rainfalls of moderate intensity and relatively low potential evapotranspiration, a weak topsoil and sloping land give rise to trafficability problems with livestock and machinery. These cause poaching and puddling which result in bogging in of grass and immobilisation of machinery in wet periods. The risk of failure with second cut silage is high unless drainage is installed and this has been borne out at the Research Station of An Foras Taluntais at Drumboylan. In addition to land drainage, surplus and overgrown fences and open watercourses greatly intertere with ease ol tarm management. Scrub invasion is often a feature of steep slopes. In any programme of intensification of farming, scrub, overgrown fences and unnecessary watercourses must be removed. It is estimated that overgrown fences and watercourses take up about 10% of the land area at present.

Drainage Design Criteria

Drainage design criteria have been traditionally evaluated in relation to the welfare of crop growth although recently in Ireland (4), Holland (5) and in other countries it has become obvious that the main benefits of drainage are attributable to improvements in trafficability (earlier cultivation and grazing, reduced animal damage to soil structure, low risk of immobilisation of machinery and improved utilisation of pasture by grazing and cutting etc.). Since the relationship of drainage to trafficability is only now being investigated, virtually all the experimental results presented here are in relation to pasture growth and quality.

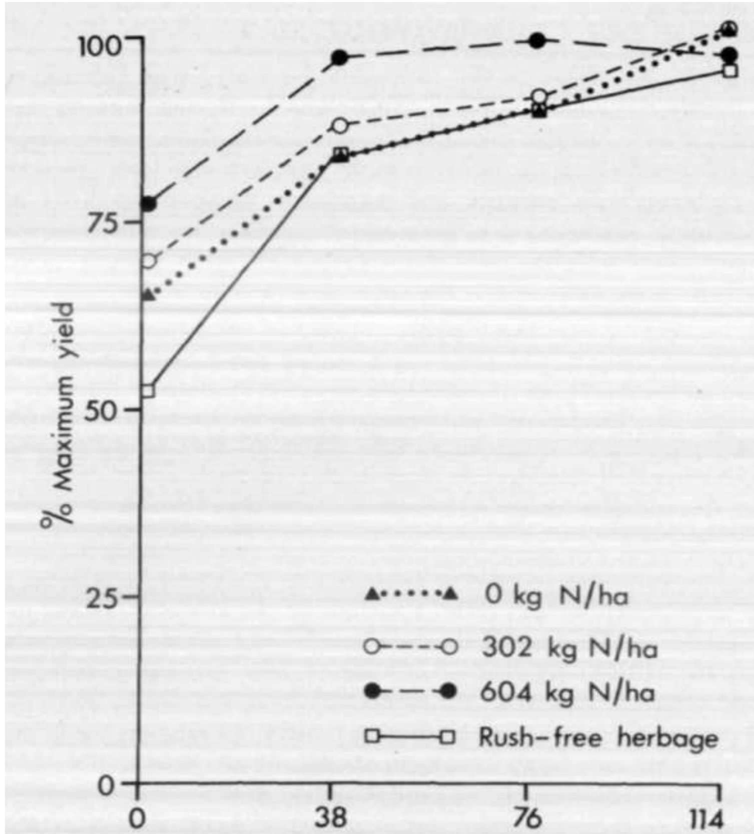
In Co. Leitrim soils, criteria in addition to discharge rate must be used since mole drainage is the only practical form of drainage. These criteria are: 1) depth of mole to render it safe from treading damage (40-45 cm). 2) spacing required (1-1½ metre) to loosen and crack the soil slab above the mole inverts between two adjacent parallel mole drains (where this is required in shallow topsoil soils), and 3) considerations of the structural stability of moles in soils of low plasticity.

Experiments and experience have given the following results on drainage criteria:-

1. A water table of 38 cm (15 in) below the ground surface is adequate for pasture growth, rush suppression and trafficability during the growing season in a year of near average rainfall. Responses in pasture growth and quality to deeper design watertables are limited (Fig. 10).

2. In addition to raising the level of the annual yield, drainage also changes the seasonal growth pattern of pasture (Fig. 11).

In Fig. 11 the change in seasonal growth is accentuated by a continuously saturated topsoil simulating a very wet growing season and by the differing pasture composition in the drained and saturated plots, 6% and 26% rushes, respectively. Fig. 11 shows that 45% and 28% of the annual yield was obtained on the drained and saturated treatments, respectively, on July I or, expressed another way, 45% of the annual pasture growth is obtained more than one calendar month later on a



Water table depth cm.

Fig. 10: Effect of water-table depth on yield and quality of herbage under 3 levels of nitrogen

waterlogged plot than on a drained plot. Similar results were obtained with 302 kg N/ha. In field experiments on drained and undrained pasture, drainage advanced seasonal growth (up to mid May) by 6% of the annual pasture growth (Table 5). Poaching is accentuated on undrained land in spring by slow and low production and increased amounts of bare soil. Low and slow growth rate results in late cutting of winter feed and restricts the stocking rate that can be employed. In wet growing seasons management schedules can be greatly upset on undrained land even with high N applications.

3. Response to drainage is only obtained in wet portions of the growing season (Table 5). In dry growing seasons depression of growth is likely to result from drainage (Autumn 1969, Table 5). However, trafficability and crop growth should not be endangered in a wet growing season to counteract depression in a dry season.

Circumstantial (Fig. 12) and direct evidence (Fig. 11) indicate that pasture responses to drainage in wet years are likely to be of the order of 25% coupled with

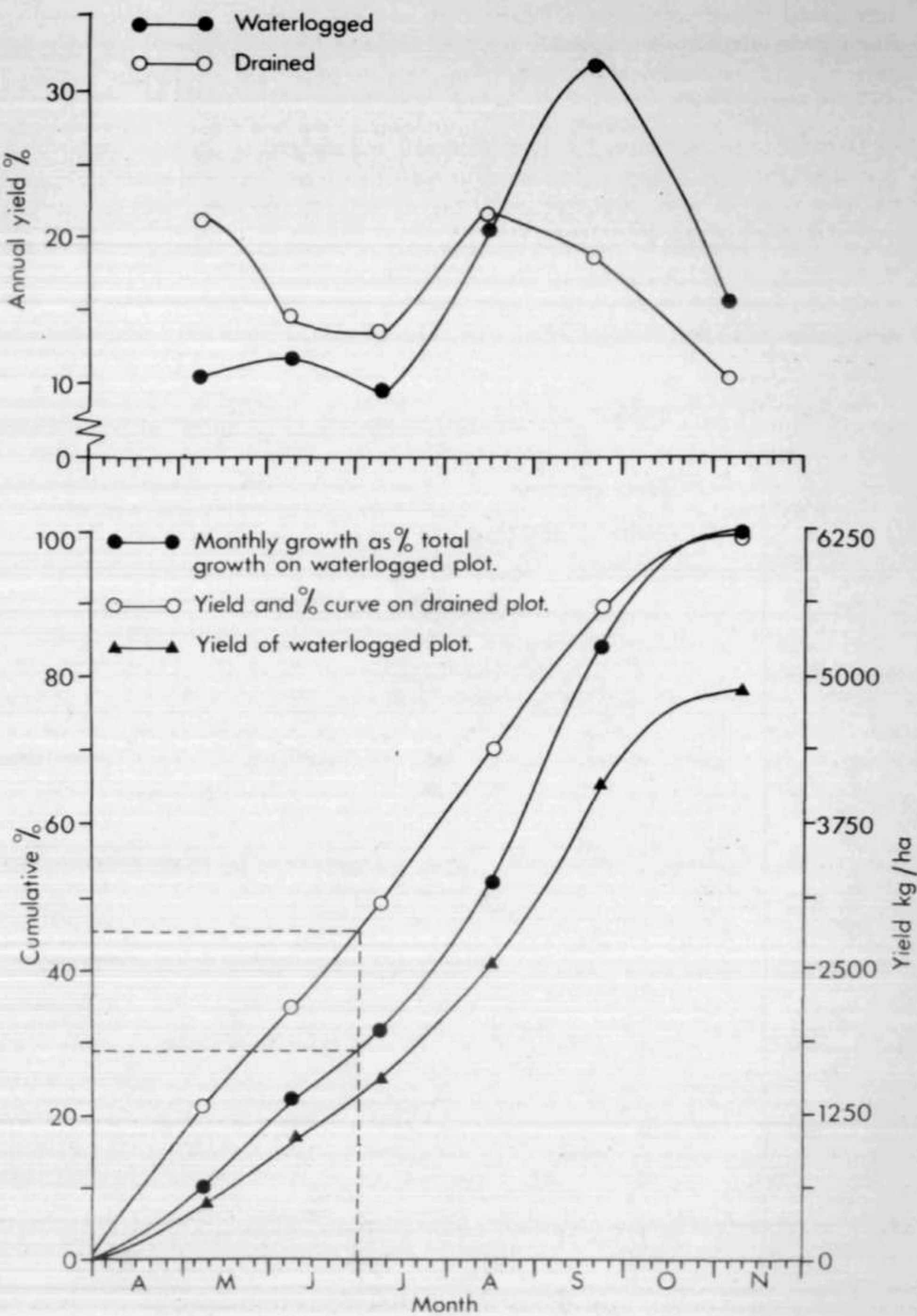


Fig. 11: Effect of drainage and waterlogging on seasonal growth of herbage on grassland.

substantial improvements in utilisation. In average years the overall response to drainage in annual pasture growth is of the order of 10-15% (Table 5) but seasonal patterns and improvements in utilisation are very important advantages although difficult to quantify.

4. Damage to soil structure by grazing animals and machinery is minimised by good drainage (Table 6). Where heavy machine traffic such as silage and muck spreading equipment is in use, drainage is a prerequisite to prevent bogging in and immobilisation of machinery (Fig. 9).

5. Drainage is also important to silage quality by minimising contamination during wheel sinkage. Even if silage harvesting must be deferred on a wet day, drained soil dries quickly and silage schedules are not greatly disrupted.

Mole Drainage Design Criteria

Soil texture and liquidity index (a measure of field moisture content) of the soil

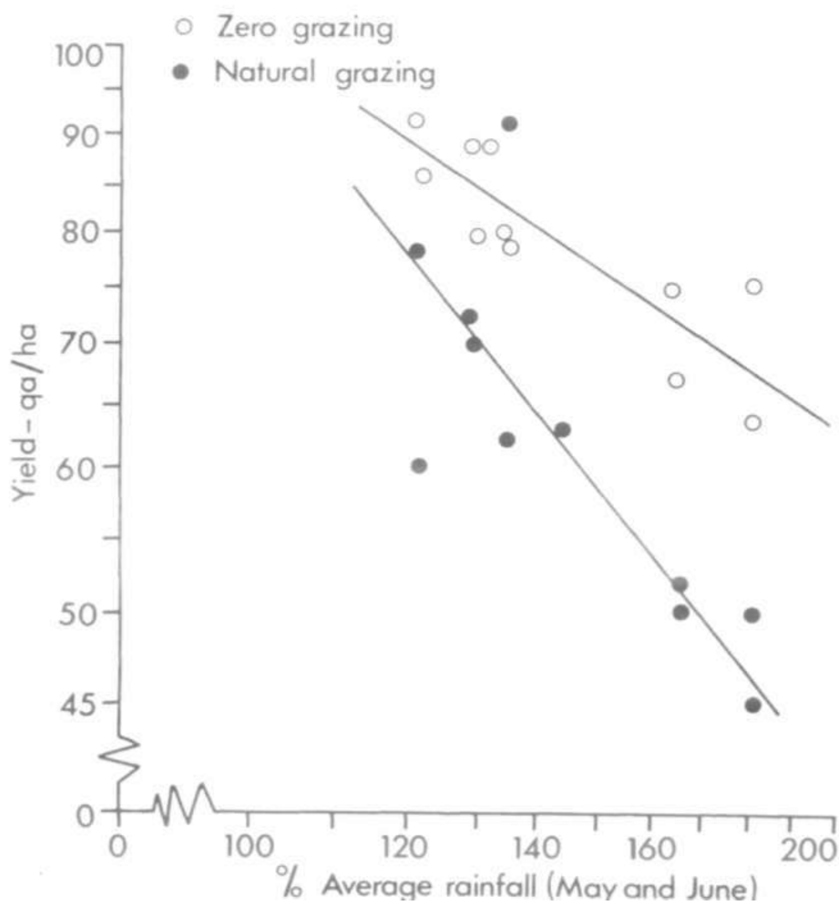


Fig. 12: Effect of wet growing seasons (May and June) on grass production at Castle Archdale, Co. Fermanagh, (8).

slab above the mole drain invert are the important factors affecting the improvements in hydraulic conductivity that can be obtained from mole drainage. In heavy clay soils such as the Ballinamore and Drumkeeran series, mole ploughing should be done when the ground is dry and with prospects of dry weather afterwards. The ground is then thoroughly cracked and good drying conditions contribute to structure formation in the clay. Aggregate hydraulic conductivity was increased to 3 cm hr in the Cleendargan clay on test plots with a drain spacing of 108 cm. Discharge was 5 mm hr (over a half hour) under ponded conditions and discharges of 1 mm hr are common. Since the mole drain is resting on an essentially impervious layer of subsoil, high hydraulic conductivities in the soil slab over the mole invert are indeed required to control the water-table (Table 7). The data in Table 7 have been calculated for a drain spacing of 137 cm which is normally employed in practice. Further calculations show that if the water-table is to be controlled at 30 cm below ground level, a hydraulic conductivity of 50 cm day is required and this will take 15 mm/day of rainfall at steady state. Higher rainfall intensity and lower hydraulic conductivity will cause waterlogging.

TABLE 5—Response of grass growth to effective mole-drainage on Cleendargan Clay[1]

N lb ac	Application date	Cutting date	Growing period (W-orD)	U-' (lb ac)	Dr. (lb ac)	'"< Change
77	II.1.67	16.5.67	W	I860	2498	+34
52	19.6.67	14.7.67	D	3030	2684	-II
52	31.7.67	1.9.67	W	2181	2515	+ 15
		Total	—	7071	7697	+ 9
		2.8.68	D	2768	2690	3
		16.10.68	W	1516	1895	+25
		Total	—	4284	4585	+ 14
58	3.3.69	13.5.69	W	2741	3141	+ 15
		24.6.69	D	2560	2408	- 6
		22.9.69	D	3010	2510	-17
		Total		8311	8059	3

i he pattern ol fertilising in this experiment was adopted for reasons other than grass production
***a* I) = dry**
'I = undraincd L)r = drained

TABLE 6—Moisture content of undrained and mole-drained treaded plots May 21,1968 (after 7 consecutive dry days), % oven dry weight

	Depth (in.)	
Drainage Condition	0-1	0-3
Undrained	115	101
Drained	93	83
Field capacity (undisturbed)	—	80

TABLE 7—Water table, hydraulic conductivity and drain discharge[1]
(Mole drains at 137 cm centres and at a depth of 46 cm)

Water table (cm below ground level)	Hydraulic conductivity (cm day)	Drain discharge (mm day)
0	1	1
	10	7
	100	73
10	1	1
	10	6
	100	57
20	1	0.4
	10	4
	100	40
30	1	0.2
	10	2
	100	22
40	1	0.03
	10	0.4
	100	4

Computed after Tokso/. S. and Kirkham. D (1961). / ***Geophyx. Res.*** **66509 516**

Field analyses of water table and discharge on Cleendargan type clays are complicated. Hydraulic conductivity changes over the year in response to swelling and shrinking of clay. Fields which appear to be well drained in summer can be ponded in winter. Also cracks which can empty in summer have been found filled with water for prolonged periods in winter. Under dry conditions a polished mole wall is formed in heavy clays, in wet soil a greasy walled mole is formed, cracks are narrow and few. There is little improvement in hydraulic conductivity.

In Garvagh ('channel') soils with a gravel band, grading gradually downwards to clay, experience shows that improvements in hydraulic conductivity are easier to obtain but it is important to locate the mole in a stable layer to avoid structural collapse. If the mole drain collapses, flow through the drains will be greatlv slowed down in time, resulting in prolonged waterlogging in wet weather. Care must also be taken to ensure that the mole plough stays down at the design depth because of the hardness of the gravel layer. Where a stable moling layer is not available the mole may be supported with permeable gravel, otherwise mole drainage is essentially subsoiling, yielding an inclined slab of fractured soil between parallel field drains at 20-30 m. Except with steep slopes lowering of the water table will be slow. It is not possible at present to specify a discharge rate for mole drains from experimental work but experience suggests that 1 mm hr (about 1 in day) may be a threshold for drainability to cope with wet growing seasons.

Layout and design of mole drainage

Conditions for mole drainage in Co. Leitrim differ from those of eastern England

and New Zealand because of differences between rainfall and potential evapotranspiration during the summer period. For example, the soil moisture deficit in Essex is similar to that for central Netherlands (Fig. 5). This is especially important for heavy clay soils since frequent rainfall and high soil moisture content limit the period of effective mole drainage in these soils. There are also poor traction conditions on wet soil. Experience on Garvagh soils shows that mole draining of wet soil leads to structural collapse of the mole. Mole drainage should not be carried out in the October-April period in Co. Leitrim. Boulders, particularly numerous near mountains, may render mole drainage impractical because of the need for frequent repair of the mole channel and the cost of reinstatement of a smooth land surface. In Garvagh soils, care has to be taken to locate the mole in a plastic layer or to use gravel filled moles where a plastic layer does not occur within 60 cm of the soil surface. Steep hills are difficult to drain and drainage is impractical on many steep slopes.

There are a number of possible layouts for mole drainage including open discharge, minor-major mole drain systems, mole drain-collector pipe drain systems. Mole drains may be drawn up and downhill or at an acute angle to the contour. Water flow in mole drains with steep gradients results in scouring and in silting at the junction, if drawn through the gravel overlay of a collector drain.Except with open discharge and close spacing of collector drains the gradients of mole drains should be kept less than about 10% where possible.

Open Discharge Mole Drainage ("Moling into the Sheugh")

.. Experience has shown that long lengths of open discharge mole drain (conventionally referred to as "mole drainage into the sheugh") can be drawn on gradients up to 20% in heavy clay of the Cleendargan type with good results, (Fig. 13). lip to 102-metre (110-yard) long mole drains have been drawn. Open discharge permits discharge of any scoured material. They have also been successful in suitable Garvagh and Rinnagowna soils. Where the mole drain is structurally unstable they have been unsuccessful (Fig. 14). It is advisable that there should be a clearance of at least 20 cm between the mole drain invert and the ditch invert and it is essential that the outlet should be lined with a plastic tube (50 mm bore) with a 15-cm overhang. Two embodiments of open discharge mole drainage are shown in Fig. 15. Illustration B is particularly useful where unnecessary fences and open watercourses have been removed and where the topography is suitable.

In order to reduce the number of outlets a modification of open discharge mote drainage may be employed. This consists of short lengths of major mole drains over which minor mole drains are drawn, the inverts of which are at least 17 cm shallower than that of the major. A connection can be made by augering or spearing. Since outlets are few they can be built up and lined to protect them if required. This method is well described in (6). Very limited experience here, coupled with extensive experience on remoling, suggests it is feasible in Ireland in suitable areas.

Open discharge mole drainage is particularly suited to Ballinamore, Drumkeeran and suitable moling soils of the Garvagh, Kiltyclogher and Rinnagowna series. It is particularly suited where the farm enterprise has low payment capacity such as suckler cows and hill farming enterprises. It is also very useful with dairy farming. Its chief advantages are low cost and speed of installation.

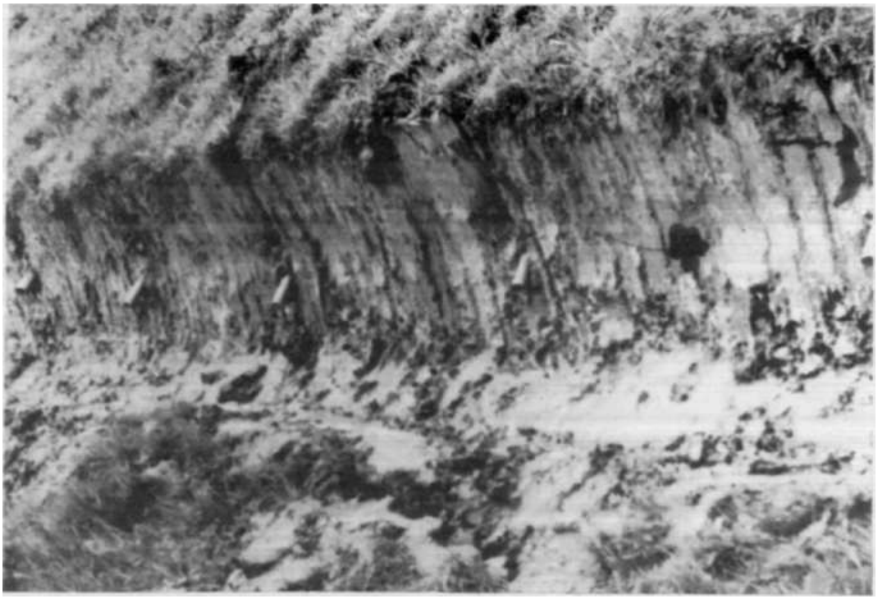


Fig. 13: Mole drainage from open watercourses showing linings at mouth of mole.

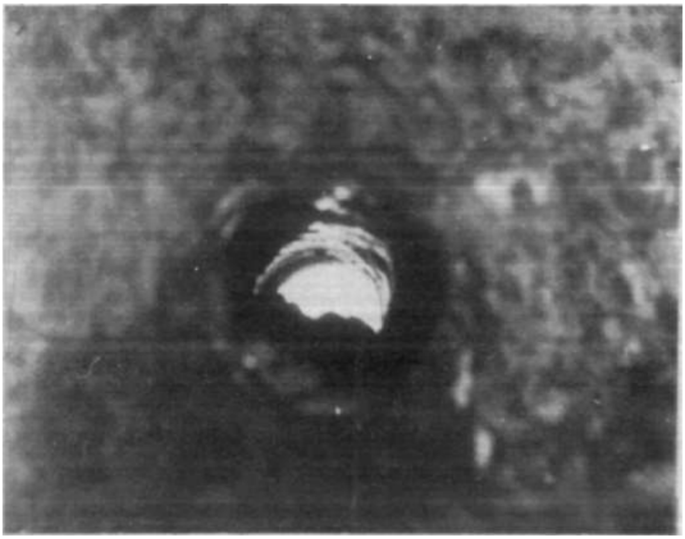
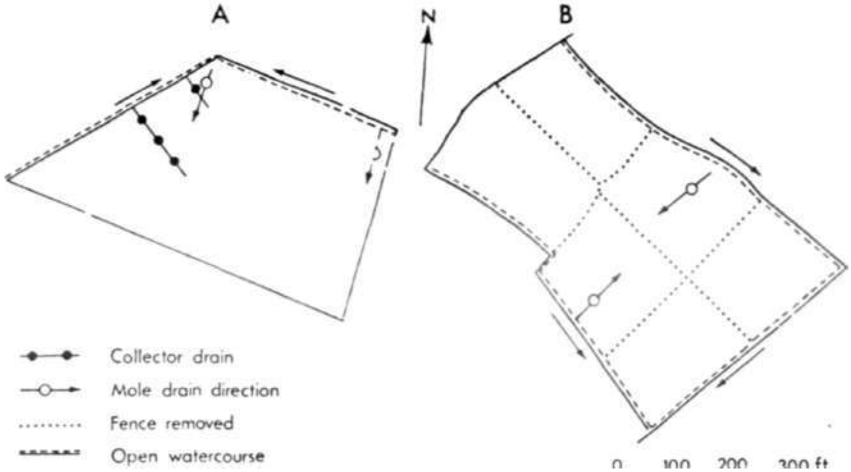


Fig. 14: Structural collapse of a mole drain after two hours draining in soil with a plasticity index of 22 (laboratory test).



• Open watercourse 0 K)0 200 300 ft.

Fig. 15: Two design plans for mole drainage into open watercourses. Design B eliminates the necessity to pipe old open watercourses.

Mole Drainage into Piped Collector Drains

This is the standard method of drainage employed by the Land Project Section of the Department of Agriculture and Fisheries, under the scheme of grant aid for land improvement works. In this system mole drains are drawn up and downhill across the gravel overlay of collector drains which are shown in elevation in Fig. 16. Collector drains are laid at an acute angle to the contour and they discharge into perimeter open watercourses. An average of 130 metres (140 yards) of collector drain is installed per acre and the average length of mole drain is 28 metres (30 yards). This design of mole drainage works well where the mole is stable in Garvagh soils and in Cleendargan and Drumkeeran series when the moling is done in dry conditions giving a near polished mole. When the mole drains are drawn on slopes in excess of 10f7. silting occurs at the junction. They become waterlogged for a short distance above the collector and in the area downhill of the lowest collector. When moles are drawn across newly laid collector drains some fouling of the gravel by clay from the trench wall may take place and this is important in downhill moling and in heavy clays.

Experience has shown that where mole drainage has not been carried out under reasonably favourable conditions the pipe drains have little advantage. However, in many borderline cases especially in Garvagh soils where instability of the mole drain is likely to cause blockage, pipe drains result in significant improvements mainly by reducing the length of the path of water-flow. Under such a condition long mole drains would be unsuccessful. Backtracking in order to roll the disturbed mole slit at the surface on most Co. Leitrim soils (except Garvagh soils with thick cherty gravel layers) is not advisable for a month or so after drawing the moles.

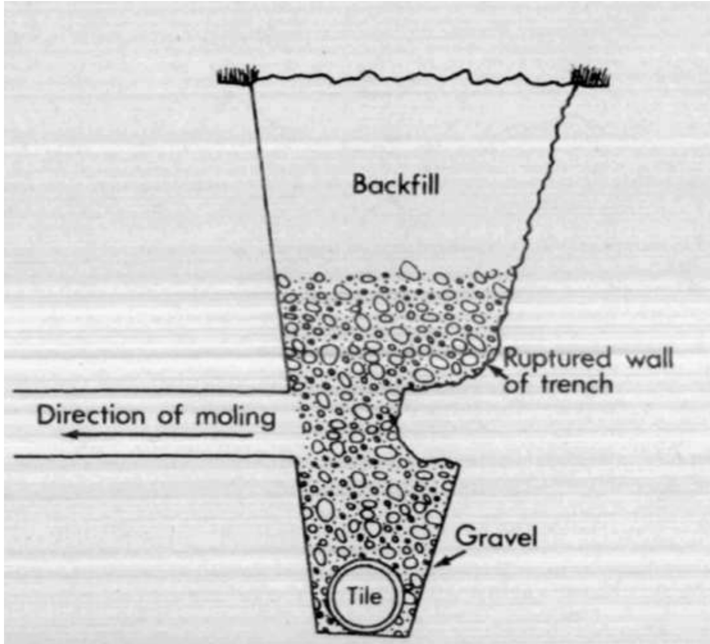
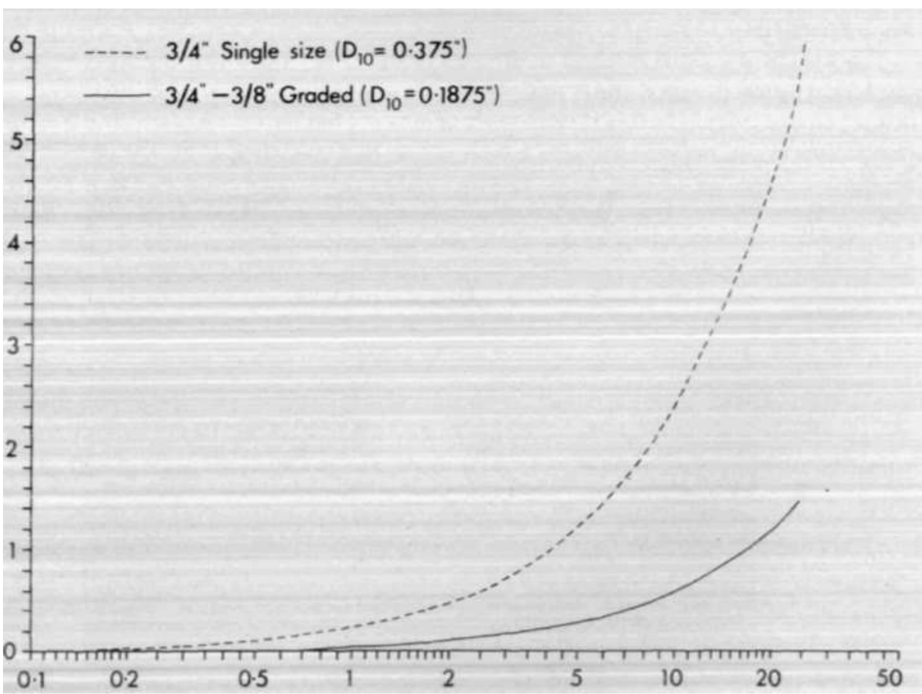


Fig. 16: Transverse section of a collector drain after drawing mole drain through the gravel overlay.



Gradient - ft/100 ft.

Fig. 17: Effect of nature of gravel and surface gradient on length of gravel tunnel drain that can he drawn without hack pressure.

This design of mole drainage has wide application in Co. Leitrim but it is time-consuming and costly. It must also be borne in mind that piped collector drains can only be justified if indications are that mole drainage will receive water rapidly and w this water to flow away rapidly and if land gradients are moderately steep. erience nas shown that this condition will fail to hold if there is generalised collapse of the mole drain or in heavy clays if mole drainage is carried out when the lowed by poor drying conditions and frequent rainfalls. The cost of thi< design of drainage depends on the length of collector drain installed. Where ' failure of the mole channel is suspected (Fig. 14). the channel may be filled ind may be drawn Irom an open watercourse or over a piped collector drain. Long lengths of gravel-filled mole are feasible (Fig. 17) except in stony soils re they should not exceed 70 to 100 metres in length.

Progress in Land Drainage in Co. Leitrim

About 19.000 acres or *5%* of the total land area were drained in Co. Leitrim between 1949-1973 (Table 8). Over the 10-year period 1962-1972 the average annual drainage was 940 acres. Some of this drainage in the early years was by conventional

TABLE 8—Land drainage requirements in Co. Leitrim

		Total	Mountain	Dry land	Drained	In need of drainage
Area	ha	150.000	36.000	15.000	8.000'	91.000
		000	90.000	37,000	19.000	224,000
	inty[2]	100	**26**	8	5	61

' Source - Dept. of Agriculture.
' Based on Soil Survey Bulletin No. 29(Part I. Leilrim Resource Survey), An Foras laluntaiv 1973

field drain at 7-10 metre spacing with soil backfill only and was ineffective. Remoling is also required on some of the early mole drainage works. Furthermore, much of the existing drainage has not been fully tested because stocking rates are generally low. Major factors in the slow progress of land drainage in the county have been (a) the unwillingness of many farmers to incur the expensive and time consuming work of collector drain installation (b) an acute shortage of land drainage contractors (c) lack of grant-aid for open discharge mole drainage and (d) a relatively low level of grant-aid especially where excavation of heavy clays is necessary. This is expensive due to failure of the clay to scour, resulting in heavy wear and tear on excavation machinery.

CHAPTER III

FACTORS AFFECTING MACHINERY USE

*M. Walsh**

Farm and field size

Farm and field size are serious obstacles to agricultural output since they reduce potential for development and mechanisation. In Leitrim, both are small. There is a total of 8,872 holdings in the county but about 57% of these are less than 12 hectares (30 acres) (Table 9). Some 40% are between 12 and 40 hectares (30-100 acres) while only 2.6% are greater than 40 hectares (Table 9).

TABLE 9—Percent farm size distribution. Co. Leitrim

1-2 ha (l-5ac)	2-4 ha (5-IOac)	4-6 ha (10-15 ac)	6-12 ha (15-30 ac)	12-20 ha (30-50 ac)	20-40 ha (50-IOOac)	40-61 ha (100-150 ac)	61-81 ha (150-200 ac)	81-121 ha (200-300 ac)	121 ha (300 ac)
2.1	5.3	10.6	39.1	26.6	13.7	2.0	0.2	0.2	0.2

With regard to field size an investigation of two similarly sized areas (24 square miles), one in Co. Leitrim and one in Co. Meath showed that the average field size in Leitrim was 0.66 hectares (1.6 acres) whereas it was 3.33 hectares (8.0 acres) in Meath (Fig. 18).

Drumlin Slopes

The shape and size of drumlins as well as the percentage occurrence of steep slopes can also seriously influence agricultural development. Where steep slopes are frequent, especially under the poorly drained soil conditions in Leitrim, the use of mechanised equipment even for silage and hay making can be seriously affected. For these reasons, an attempt was made to quantify the problem in terms of drumlin shape, size and slope.

Drumlins occupy almost all the lowland area of the county up to the 500 ft. contour. Although they are distinctive glacial features, they vary significantly in size and shape. They seldom occur separately as single, distinct features and are generally coalesced groups of two, three or four. Two of the drumlins examined—Dromore and Bellanaboy—are double drumlins. The gently sloping end or drumlin 'tail' is sometimes divided in two as for example at Drumgownagh, Dromore, Drumbreanlis and Cleendargan. Ten drumlins representing the main variations in size and slope pattern were studied in some detail.

The location of the representative drumlins studied is shown in Fig. 19. Drumlin size varied from 16 to 61 ha (39 to 150 acres). The larger drumlins are mainly in the southern half of the county.

•National Soil Survey. An horas I aluniais. Belclare. Co. Oalway

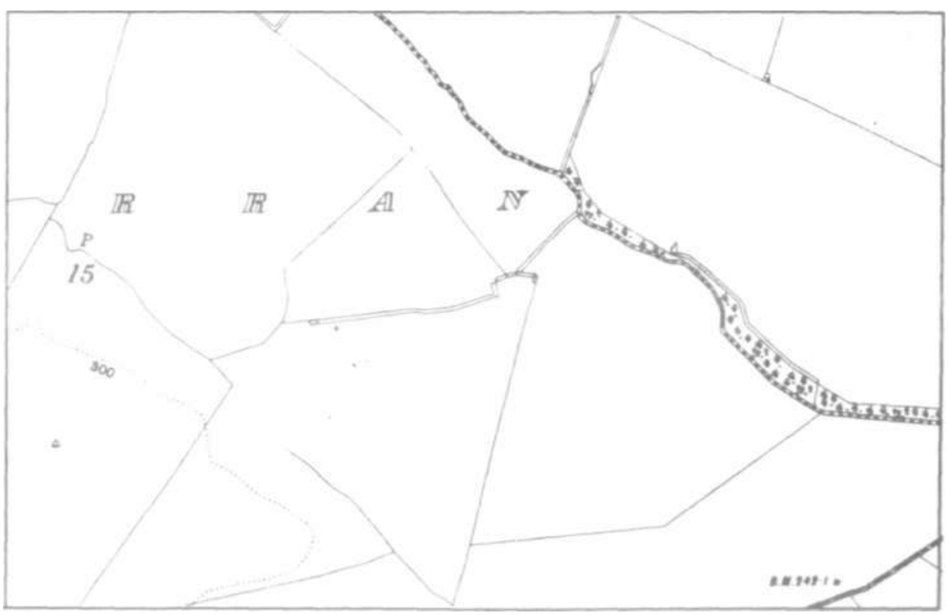


Fig. 18: Comparison of field sizes in Co. Leitrim (upper) and Co. Meath (lower).

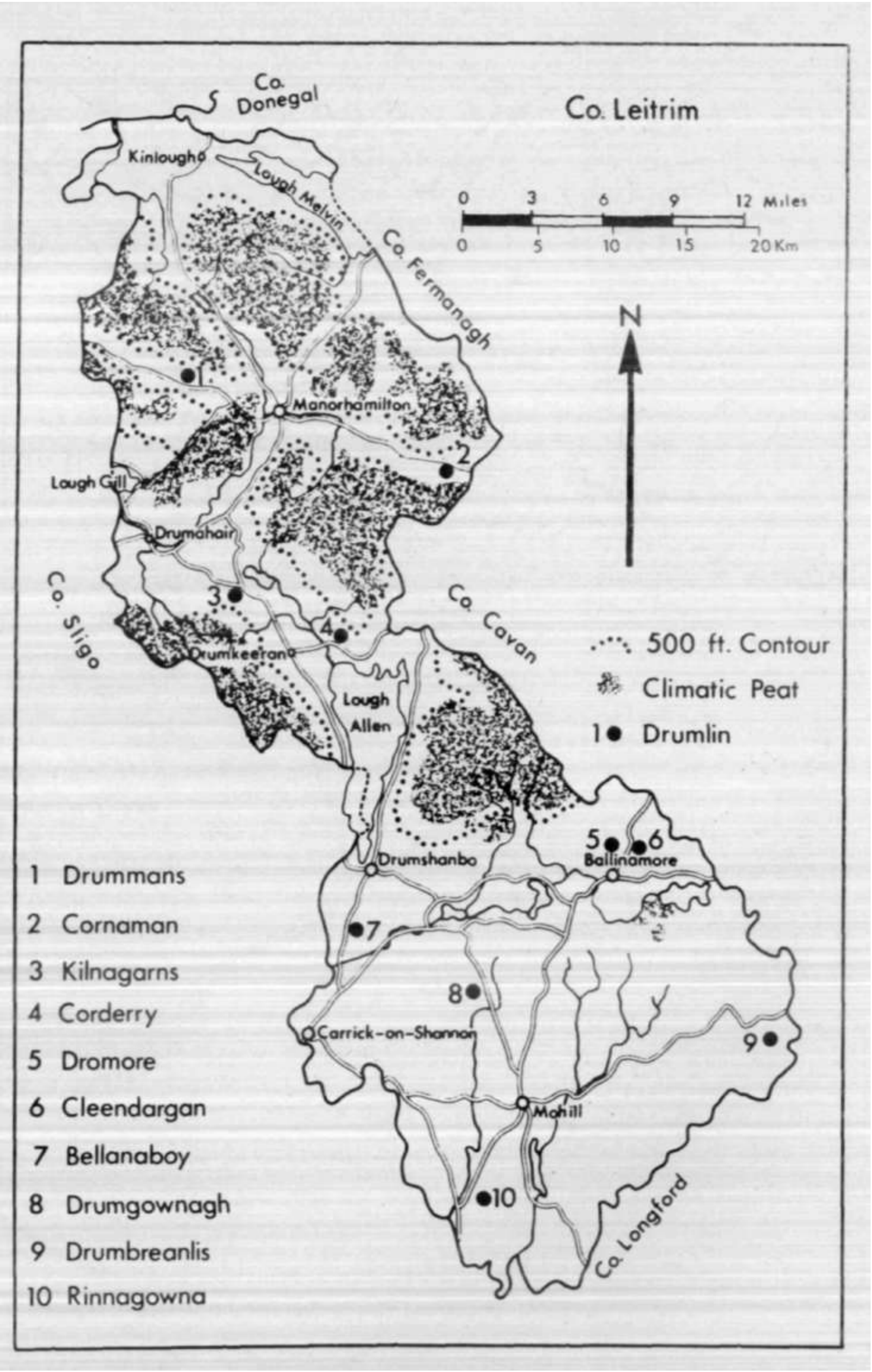


Fig. 19: Location in Leitrim of drumlins studied.

Slope patterns are complex because of the smooth, convex form of the drumlins. This causes slopes to grade imperceptibly from gentle to steep. Four slope categories were used in the study—0 to 5°, 6 to 12°, 13 to 20° and over 20° (Table 10). Slope aspect was also recorded.

TABLE 10—Percentage total drumlin area occupied by the various slope categories

Drumlin under name of principal townland	Percentage area in each slope category				Drumlin area	
	0-5°	6-12°	13-20°	> 20°	ha	acres
Drummans	10	53	37		17	42
Cornaman	75	16	9		26	65
Corderry	9	30	61		20	50
Kilnagarns	19	44	37		16	39
Dromore (Double drumlin)	18	60	21	1	36	90
Cleendargan	38	43	14	5	50	121
Bellanaboy (Double drumlin)	48	28	24	—	32	78
Drumgownagh	61	25	14		61	150
Drumbreanlis	29	60	11	—	25	62
Rinnagowna	%	4		-	21	53

TABLE II —Summary of slope analysis on some soils iri Co. Leitrim

Soils	Percentage area in each slope category					Av. Drumlin area	
	0-5°	6-12°	13-20°	> 20°	Drumlin	ha	<icres
Ballinamore Series Gar\agh Series and Areas of Rinnagowna Scries adjacent to Garvagh Series	41	39	18	2	Dromore Cleendargan Bellanaboy Drumgownagh	45	110
Drumkeeran Series (a) Drumkeeran- Belhavel area	14	37	49		Corderry Kilnagarns	18	45
(b)Glenfarnearea	75	16	9		Cornaman	26	65
Ballyhaise-Cornga Complex	29	60	11		Drumbreanlis	25	62
Mortarstown-Kinvarra Complex (Glencararea)	10	53	37		Drummans	17	42
Rinnagowna Series (Area south of Rinn Lough)	96	4			Rinnagowna	21	53

The drumlins studied are discussed under the name of the principal townlands in which they occur. Cornaman represehts the drumlins occupying the lowlands from near Glenboy to Glenfarne. The soils are the very fine-textured gleys of the Drumkeeran Series. Approximately 9% of the area is too steep for mechanised agriculture (Fig. 20).

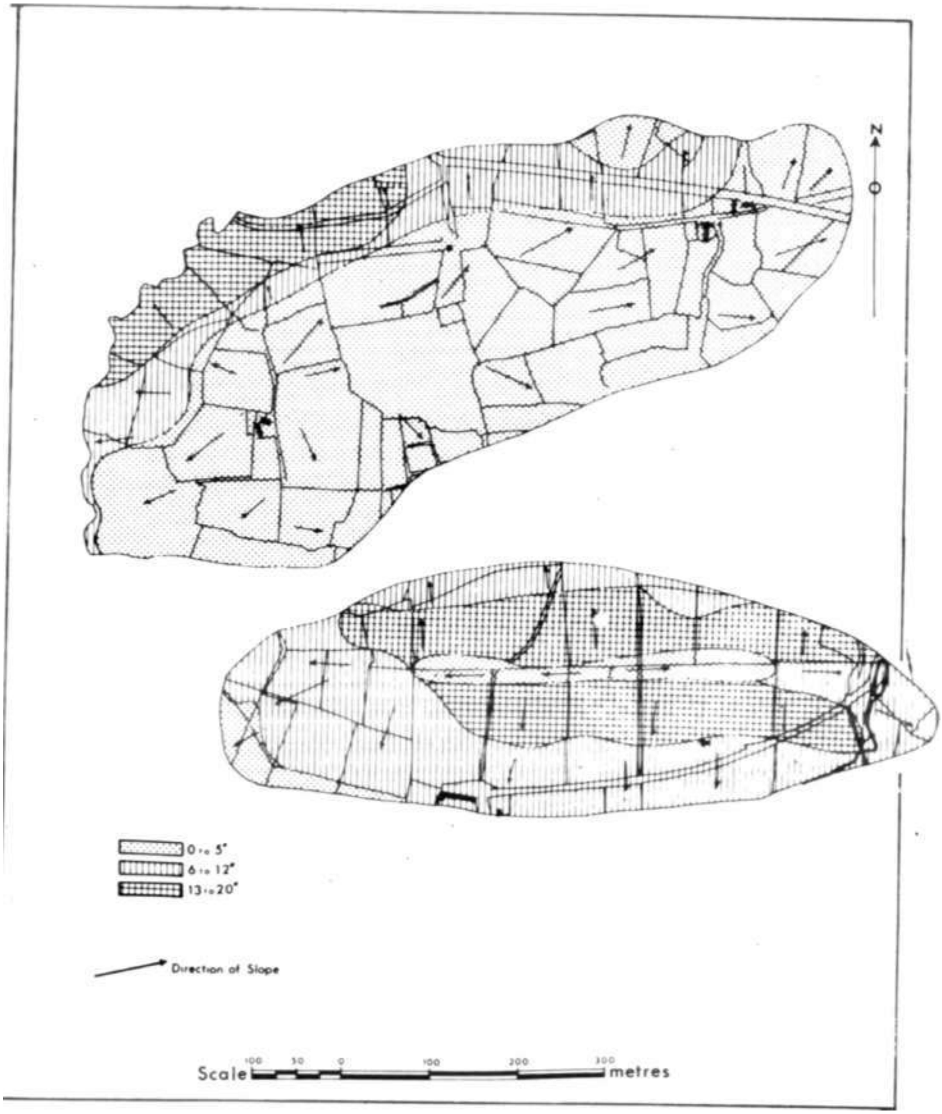


Fig. 20: Slope map Cornaman and Drummans Drumlins.

Drummans is representative of a small number of drumlins which occur between Manorhamilton and Glencar lake. They are among the few drumlins in the county which have well drained soils and are included with the Mortarstown—Kinvarra complex. Approximately 37% of their area is, however, too steeply sloping for mechanised agriculture (Fig. 20).

Corderry and Kilnagarns represent the drumlins in the Drumkeeran—Belhavel Lough area. The soils also belong to the Drumkeeran Series.

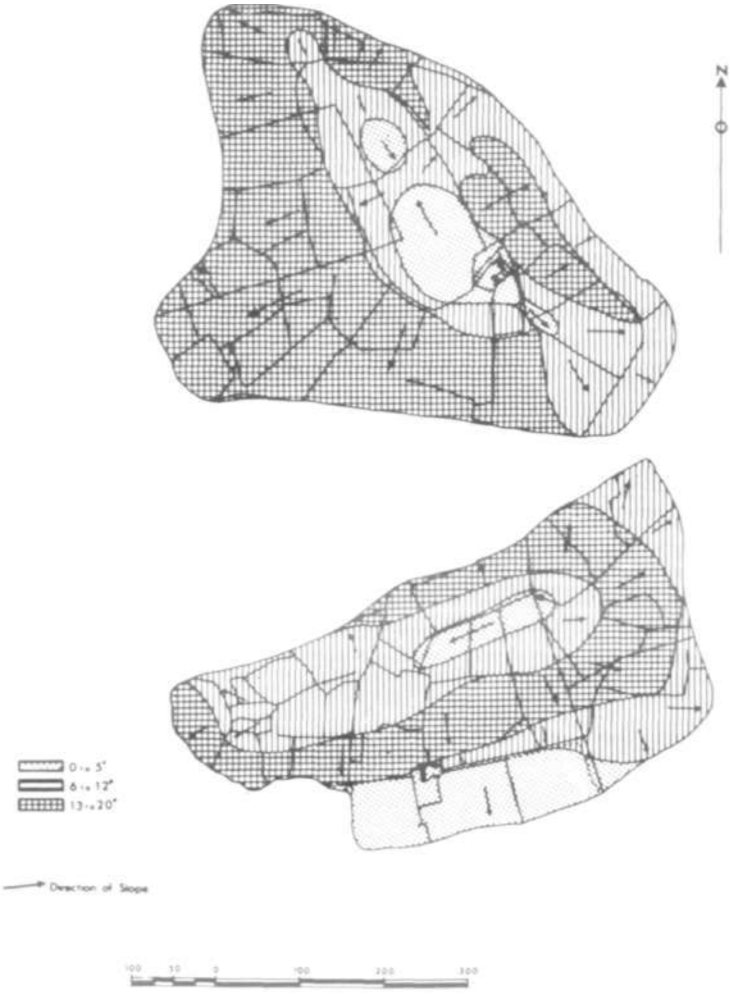


Fig. 21: Slope map Cx>rderry and Kilnagarns Drumlins.

Steep slopes are much more prevalent than in the Glenfarne region and approximately 49% of the area (Table 11) is not suitable for mechanised agriculture (Fig. 21).

Dromore, Cleendargan, Bellanaboy and Drumgownagh represent the drumlins in the areas occupied by the Ballinamore and Garvagh soil series. They occupy the greater part of southern Leitrim and many of the valleys in northern Leitrim. The landscape variations are similar in both series and thus the four drumlins form one group. Approximately 20% of the area is too steeply sloping for mechanised agriculture (Figs. 22, 23 arid 24).

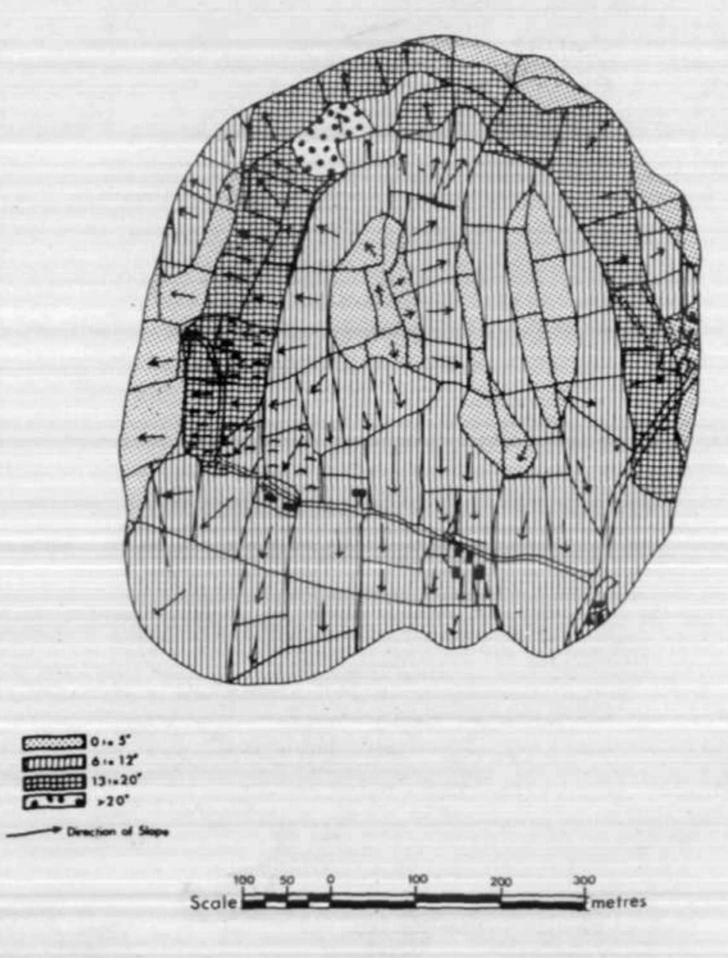


Fig. 22: Slope map Dromore Drumlín.

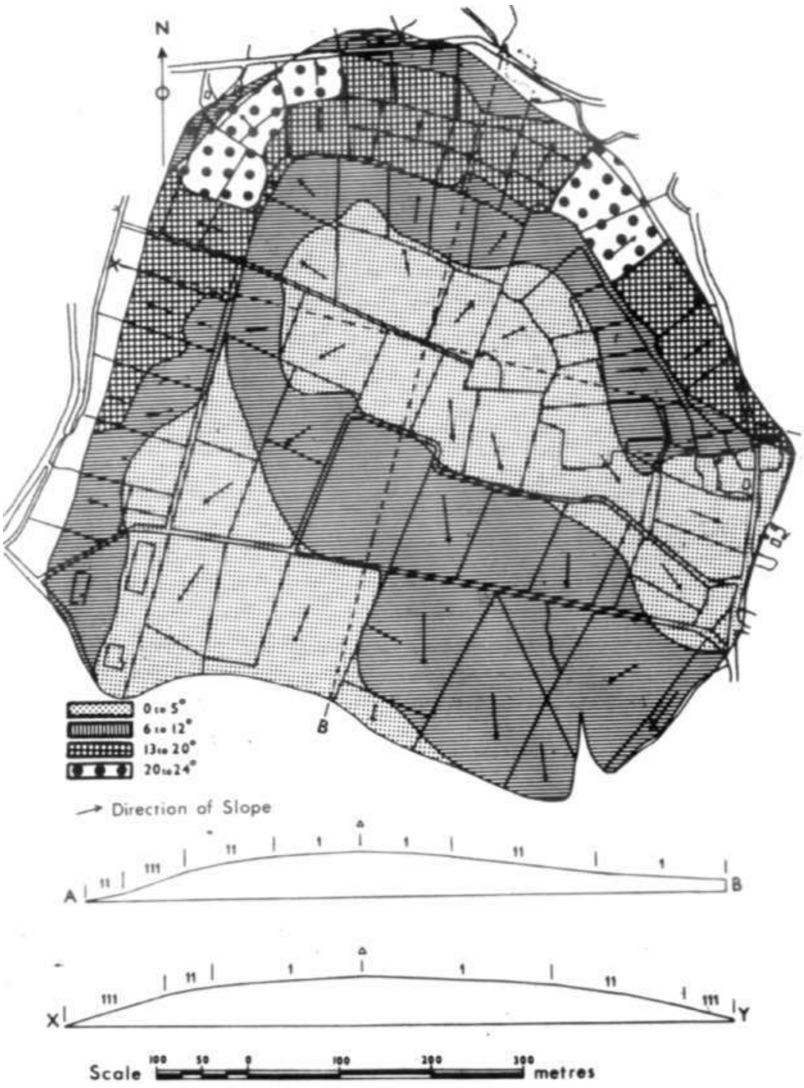


Fig. 23: Slope map Cleendargan Drumlin.

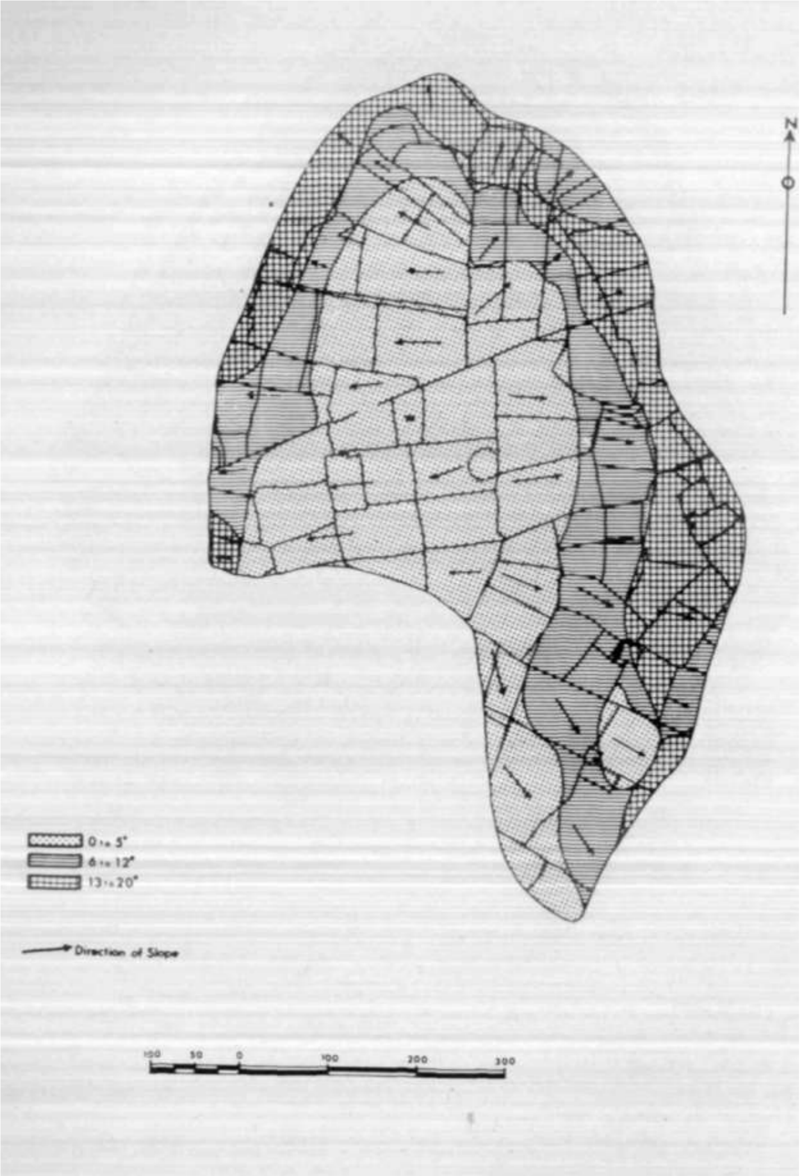


Fig. 24: Slope map, Bel/anaboy Drum/in.

Drumbreanlis represents the drumlins in the Carrigallen-Killyvehy area. The soils belong to the Ballyhaise-Corriga Complex which is a mixture of well drained Brown Podzolics and poorly drained Gleys. Approximately 11% of the area is too steeply sloping for mechanised agriculture (Fig. 25).

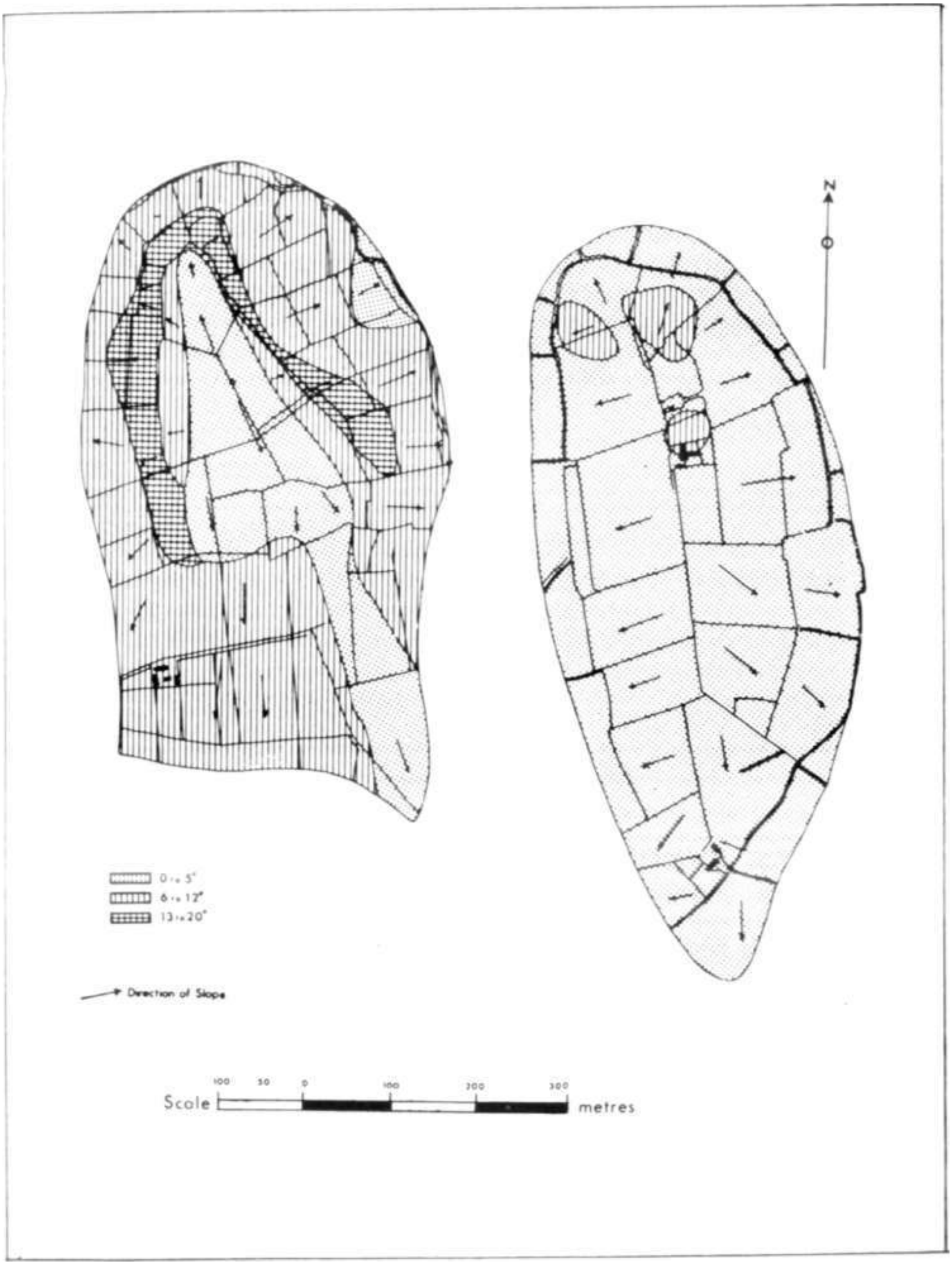


Fig. 25: Slope Map Drumbreanlis and Rinnagowna Drumlins.

TABLE 12—Average, minimum and maximum percentage area occupied by each slope category forthe ten study drumlins

	Percentage area of each slope category				Drumlin area	
	0-5°	6-12°	13-20°	> 20°	ha	acres
Average	40	36	25		30	75
Minimum	9	4	9	1	16	39
Maximum	%	60	61	5	61	150

Rinnagowna represents the drumlins south of Rinn Lough in the southern tip of the county. The soils are Gleys of the Rinnagowna Series. Generally, mechanised agriculture is possible in all areas. Most of the drumlins in the area occupied by the Rinnagowna Series however, are similar to those in the Ballinamore and Garvagh Series, i.e. approximately 20% of the area is too steeply sloping for mechanised agriculture. A summary of slope analysis on a range of soils in the county is presented in Table 11.

Variations in Drumhnform and size

The average area occupied by each slope category was calculated for the ten drumlins (Table 12). Comparison between these figures and the minimum and maximum figures for each slope category shows a wide variation in drumlin form. A similar variation is present in drumlin size.

CHAPTER IV

GRASSLAND

*D. Collins**, M. Drennan[1], L. Grubb[:].

Because of its combination of wet climate and poorly drained soils, Leitrim has the highest percentage of grassland of any county in Ireland. Some 99% of the land which is farmed (277.000 acres) is under grass. There is a further 70,000 acres of rough grassland on the hills and mountains. With the absence of tillage farming, there is little or no establishment of new swards, consequently the grassland is all old permanent pasture.

Grass Production

Even with the same management, grass production on wet soils in Co. Leitrim is about 72% that on free draining Cork-Waterford soils (7). This is mainly due to growing conditions, chiefly the moisture, oxygen and temperature status of the soil during the growing season. It is well known that clay soils heat slowly in spring and never reach the same temperature as drier soils in summer. Spring growth of grass on wet soils in Co. Leitrim is slow (Fig 11).

Soil Temperature

Soil temperatures taken at depths of 5, 10 and 20 cm at Ballinamore are compared with those at Mallow, Co. Cork and at Johnstown Castle, Co. Wexford (Table 13).

The monthly averages for the period 1954-1968 were consistently lower at Ballinamore than at either of the other stations.

Effect of drainage

Production curves (Fig. 26) for Leitrim grassland show that dry matter production increases from about 3300 kg ha (3000 lb ac) on undrained land to about 11.200 kg ha (10,000 lb ac) on small drained test plots.

Production as high as 15,000 kg ha is possible but 13,000 kg ha is an economic maximum, with a favourable shift to a more uniform rate of growth throughout the growing season. There was also a big improvement in response to N with drainage; under waterlogged conditions the response to N was 6 and 9 kg dry matter kg N at the cuts of May 8 and June 8 compared with about 19 kg dry matter kg N for the drained treatments at each cut. Although response to N is low in spring on wet land, it has a strategic importance in producing early grass which can outweigh its low efficiency.

Stocking Rates

A livestock unit requires about 3.825 Jcg (8,400 lb) dry matter per year to maintain it in production. This estimate is based on a daily intake of 42 kg (92 lb) fresh grass, a

Animal Management Department. Orange Research Station. An Forai Taluntais.
Hill and Marginal land Department. Glcnamoy Research Station. A I I

TABLE 13—Soil temperatures at Ballinamore, Mallow and Johnstown Castle (1954-68)

Month	Average 1954-1968								
	5 cm			10 cm			20 cm		
	B*	M**	J***	B*	M**	J***	B*	M**	J***
Jan.	3.1	4.3	4.1	3.4	4.5	4.2	3.8	5.0	4.6
Feb.	3.6	4.8	4.7	3.7	4.9	5.0	4.1	5.3	5.1
Mar.	6.0	7.3	6.8	6.0	7.3	6.8	6.0	7.3	6.8
Apr.	8.6	10.2	9.9	8.6	10.1	9.7	8.5	10.0	9.6
May	12.2	13.5	13.2	12.1	13.3	13.2	11.8	13.0	12.9
June	15.5	16.6	17.0	15.4	16.6	16.6	14.8	16.5	16.2
July	15.9	17.9	17.8	16.0	17.8	17.7	15.7	17.3	17.3
Aug.	15.6	16.9	16.8	15.6	16.6	16.8	15.4	16.6	16.8
Sept.	13.1	14.5	14.3	13.3	14.4	14.5	13.4	14.8	15.0
Oct.	•9.8	11.3	11.3	10.2	11.3	11.4	10.5	11.9	11.7
Nov.	5.9	7.2	7.5	6.2	7.6	7.7	6.8	8.1	8.3
Dec.	4.1	5.5	5.3	4.3	5.8	5.7	4.9	6.2	6.1

B* Ballinamore. Co. Leitrim
54°04"N07°48'W-GndRef HI48134 Height 80m
Soil Type: Poorly-drained gley of clay loam texture

M" Mallow. Co. Cork
SrOW 08°42'W Grid Ref. W5I0972 - Height 53 m
Soil Type: Free-draining sandy loam

J"* Johnstown Castle. Co. Wexford

grazing efficiency of 80% and an average dry matter of 20% over the growing season. We can now get a quantitative idea of potential stocking rate for the different levels of grass production. At 3,300 kg/ha (3,000 ib, ac) dry matter production (no fertiliser usage) it takes 1.1 ha (2.8 acres) to maintain a livestock unit (LU).

However, if *Vi* and *V2* the area is infested with rushes the area required will rise to 1.7 and 2.3 ha (4.2 and 5.6 acres), respectively. These latter stocking rates are common on undrained and unfertilised land. In an average year it appears that with 224 kg ha (200 lb ac) of N, 1 LU/0.4ha (1 LU/ac) is theoretically feasible. Actual stocking rates achieved are 1 LU'0.57 ha (1 LU'1.4 ac) on Cleendargan[1] clay (Ballinamore series) and 1 LU 0.51 ha (1 LU/1.25 ac) on a sandy clay at Castle Archdale[2] (8) with 134 and 290 kg/ha (120 and 258 lb/ac) of N, respectively. About one third of the Cleendargan farm is effectively drained while very limited drainage has been done at Castle Archdale (8). Dairy cows/calves and suckler cows/calves are managed at Cleendargan and Castle Archdale respectively. About one eighth of the Cleendargan farm is not trafficable and the achieved stocking rates would have to be adjusted for average conditions where twice this area would not be trafficable.

Experience at Cleendargan and Drumboylan (Co. Roscommon) shows that in the absence of drainage, stocking rates of 1 cow/0.6 to 0.7 ha (U/2 to *VA* ac) will break down, chiefly because sufficient winter feed cannot be made and poaching becomes uncontrollable. Most of the wet soils of Co. Leitrim, e.g. the Garvagh series, are intermediate between the Cleendargan clay and the Castle Archdale sandy clay.

1. The Cleendargan farm is part of the Research Station. An Koras Taluntais. Ballinamore.
2. Castle Archdale is a N. Ireland Ministry Research Station in Fermanagh.

Based on present knowledge a stocking rate of 1 LU/0.6 ha (1.4 ac) and less is feasible on the trafficable land. However, on individual farms, particularly on the Drumkeeran series, the amount of winter feed that can be procured depends on the acreage of trafficable land. Available winter feed determines the number of livestock that can be carried. All that is possible on steep land is to remove surplus fences and watercourses, to fertilise and lime by hand or, if a large enough area was in question, aerial fertilisation would be feasible. It would not be feasible to apply lime from the air because of the cost of application, so basic slag or potassic basic slag (depending on soil analysis) would be the fertilisers of choice.

Soil Analyses and Fertiliser Requirements

Virtually all Leitrim soils are low in lime and deficient in the fertiliser nutrients phosphorus (P) and potassium (K). Some soils are potentially deficient in cobalt and some have a potential surplus of toxic molybdenum. In mountain areas only,cobalt shortage produces clinical symptoms of disease (pine in sheep and cattle) as far as is known at present. Cobalt deficiency can be remedied by applying 2 lb cobalt sulphate per acre on about *Vi* the farm area or by dosing sheep.

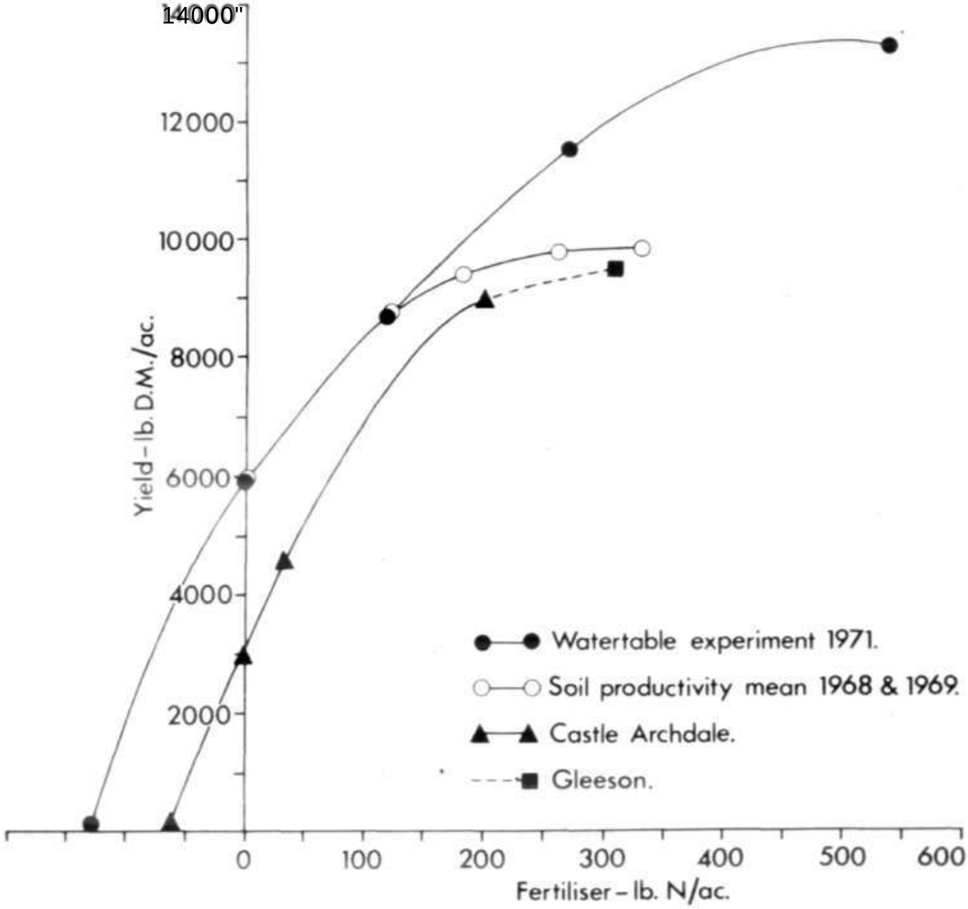


Fig. 26: Effect of nitrogen fertiliser on grass yields.

The pH of most topsoils varies from 4.7 to 5.7 and lime recommendations based on soil analyses range from 11 to 17 tonne ha (5-7 tons ac of ground limestone. This application is usually phased over 2 or 3 applications. Levels of P commonly range from 1-3 kg/ha available P. A dressing of 550 kg ha (4!/: cwt ac) of 8V P superphosphate is required to bring the soil level of P to a satisfactory state. Available levels of K vary around 40 kg ha of K. About 200 kg ha (1 *Vi* cwt ac) of muriate of potash is normally recommended. After the soil has been brought to a satisfactory state of fertility, maintenance dressings only are required for grazed land and in the case of land devoted to silage the amount of nutrients taken off in the grass must be replaced by fertiliser according to the recommendations of the Fertiliser Manual (9). Heavy applications of basic slag year after year are wasteful. After the application of lime and fertilisers the soil softens and management practices must be planned to takethis effect into account in undrained situations.

Nitrogen (N) requirements depend on the stocking rate and on the season (Fig. 27). Growth is slow in April when the soil is wet and applications of 125-250 kg ha (1-2 cwt ac) of 26% N fertiliser are beneficial for early grass in late April. Applications of 250-300 kg ha (2-2½ cwt ac) of *269c* N fertiliser are required for silage. Native white clover does not seem to persist as farming intensifies but more research is needed on methods of introducing improved strains and on its performance.

Due to lack of data regarding the productive potential of Leitrim grasslands, apart from those already quoted from An Foras Taluntais Research Stations at Ballinamore and Drumboylan, a number of short-term fertiliser experiments were undertaken in 1971 and the question of utilisation by animals was not taken into account. The experimental sites were selected to represent the different soil types in the county. They were undrained and the swards were all, except one, old permanent pasture.

The objective of the experiments was to provide data on the following aspects.

a) Actual and potential production of grassland in the county
b) The differences in productivity between different Leitrim soils in terms of herbage yields
c) The effects of fertilisers and lime on herbage yields.

Actual production data were obtained from two sites in 1971 and six sites in 1972.

The following fertiliser treatments (cwt acre) were applied:

\	Control	
B.	Phosphorus	2 cwt (16% P) acre annum
C.	Phosphorus	2 cwt (16% P) acre annum
	Potassium	1 cwt (50% K)/acre cut
D.	Nitrogen	2 cwt (26% N) acre cut
	Phosphorus	2c\vt(16% P) acre annum
	Potassium	lcwt(50%K) acre cut
E.	Nitrogen	4cwt(26 N) acre cut
	Phosphorus	2cwt(16%P) acre annum
	Potassium	lcwt(50%K) acre cut
•F.	As at E. with ground limestone	3 tons acre

Botanical composition

From a general soils point of view, the grassland could be classified either as dry grassland or wet grassland. A well known feature of Co. Leitrim is the presence of rush species in the grassland. Most of the sites in this study were located on wet grassland but two sites were on dry grassland areas which represent only a small portion of the county.

A botanical study of the sites in June 1972 showed that the following were the grass and weed species in order of dominance.

a) *Wet grasslands*

Grasses — Rough Stalked Meadow Grass, Crested Dogstail, Sweet Vernal, Yorkshire Fog.

One site at 500 ft. O.D. was dominated by Sweet Vernal and Crested Dogstail whilst a second site, which was a reseeded sward, was dominated by Perennial Ryegrass but it also contained small amounts of Sweet Vernal, Crested Dogstail, Yorkshire Fog and Soft Brome.

Weeds — Creeping Buttercup, Rush *(Juncus articulatus* and *Juncus effusus).* Meadow Sweet, Sedge, Horsetail, Forget-Me-Not, Sheep Sorrel, Catsear.

At one site Common and Creeping Buttercup *(Ranunculus repens-acris)* was the dominant species whilst at another site Rush *(Juncus articulatus)* comprised most of the sward.

*In 1972, nitrogen fertiliser was not used on this treatment.

b) *Dry grasslands*

Grasses	Rough Stalked Meadow Grass, Yorkshire Fog, Meadow Foxtail, Sweet Vernal, Crested Dogstail, Red Fescue.
Weeds	Common and Creeping Buttercup, Sorrel, Creeping Thistle, Ribworth Plantain, Rush *(Juncus effusus),* Meadow Sweet, Daisy.

At one of the sites Common and Creeping Buttercup were co-dominant in the sward.

Clover

At all sites there was little or no clover and when it did occur, it was usually *Trifolium repens,* although some *Trifolium pratense* occurred on two sites. The previous management of the sites, namely, cutting for hay or silage, possibly contributed most to the absence of clovers in the swards.

Dry matter yields and fertiliser response

Table 14 shows the herbage dry matter yields recorded at the two sites in 1971 .

TABLE 14—Effect of fertiliser applications on grass production, 1971
(100 lb DM acre)

Site	Tawnylea			Kilclare		
Soil type	Peaty Gley			Gley		
Treatment	1st Cut	2nd Cut	Total	1st Cut	2nd Cut	Total
A	40.0	7.6	47.6	32.8	12.9	45.7
B	36.6	10.7	47.3	34.9	12.0	46.9
C	45.6	10.3	55.9	33.1	15.8	48.9
D	56.3	22.3	78.6	50.3	26.1	76.4
E	54.4	26.0	80.4	58.9	32.8	91.7
F	. 55.7	25.2	81.0	62.7	33.3	96.1
S.E.±	2.74	1.29	I I I	2.13	1.62	1.00

At both sites, spring grazing was allowed to continue until late April before the swards were rested for hay production. The first cut was taken in late July when the swards were about to be cut for hay. This accounted for the high D.M.yields recorded at that time. The second cut was taken in late September.

At the first cut, there was only a small response to the combined application of phosphorus and potassium but at the second cut the response was considerable. This meant a highly significant increase (1% level) in the total D.M. yields on the peaty gley soil and a significant increase (5% level) on the gley soil.

Fertiliser nitrogen produced highly significant increases (1% level) in herbage yields on both soil types. On the peaty gley, however, there was no response to the 4-cwt application over the 2 cwt, whereas on the gley soil there was a response (5% level) at the individual cuttings which was very significant (1%) in the total dry matter production.

'Two sites only were recorded in 1971 and six sites in 1972.

Liming of the gley soil, at 3 tons/acre, gave a significant increase (1% level) in total dry matter production but no response on the peaty gley.

In 1972, the treatments were laid down on new plots at six sites. Swards were cut in June and September at the silage stage of growth but the Glenboy site was only recorded at the June cutting. Five of the six sites were grazed until April before they were rested for conservation purposes. This management reflected itself in the poor yields of the control plots at the first cutting, especially on the sites grazed with sheep at Tawnylea and poached by cattle at Kildare. Table 15 gives herbage yields for the first and second cuts in 1972 and Table 16 gives total dry matter production.

At the first cut, phosphorus application (treatment B) increased grass production but the results were only marginally significant at a few sites. The same was true at the second cut. Application of potassium with the phosphorus did not significantly increase yield at any site in the first cut, but at the second cut it did increase production at all sites. Liming improved grass yields at three of the sites in the first cut but had little effect at the second cut.

At all sites, fertiliser nitrogen increased the herbage yields significantly (5% level) and in particular, the 4 cwt acre cut application 1%). At two of the wetter sites, however. 4 cwt/acre/cut (treatment F) did not significantly increase the yield above that achieved with 2 cwt acre cut. Responses to nitrogen were slightly higher in June than in September.

TABLE 15—Effect of fertiliser applications on herbage yields, 1972
(100 lb DM/acre)

Site	Glenboy	Tawnylea	Drumkeeran	Kilclare	Mohill	Newtowngore
Soil type	Podzol	Peaty Gley	Gley	Gley	Peaty Gley	Shallow Brown Earth
			First cut — June 22, 1972			
Treatment						
A (Control)	26.5	9.6	26.0	14.1	26.5	43.9
B		10.9	29.8	15.7	30.4	50.1
C	31.7	11.4	27.2	17.1	32.2	48.6
D	41.8	12.5	38.5	32.3	46.2	69.8
E	48.7	15.0	43.4	36.0	54.1	85.0
F	27.5	11.0	32.1	21.4	31.3	53.8
S.E.	2.32	0.64	1.84	2.38	1.78	4.10
			Second cut — September 17, 1972			
A		24.6	23.1	25.0	22.0	27.5
B		25.0	24.1	24.4	23.9	32.7
C		27.1	25.2	31.4	27.8	30.9
D		34.0	37.6	32.4	39.3	42.7
E		43.8	38.7	39.5	44.8	48.5
F		26.5	25.2	26.8	28.3	31.0
S.E.		2.50	1.57	2.47	1.61	1.35

TABLE 16—Total dr> matter production, 1972 (100 lb DM acre)

Site	launvlea	Drumkeeran	Kilclare	Mohill	Newtowngore	Mean five sites
Soil type	Peaty Gley	Gley	Gley	Peat> Gley	Shallow Brown Earth	
Treatment						
A	**34.2**	**49.1**	**39.0**	**48.5**	**71.4**	**48.4**
B	**35.9**	**53.9**	**40.0**	**54.5**	**82.8**	**53.4**
(	**38.4**	**524**	**48.3**	**60.0**		**55.7**
F)	**46.4**	**^{7}61**	**64.8**	**85.5**	**112.5**	**77.0**
E	**58.8**	**82.1**	**75.5**	**98.9**	**133.5**	**89.8**
F	**37.5**	**61.2**	**48.2**	**59.6**	**84.8**	**58.3**
S.E.	**2.41**	**2.66**	**3.41**	**1.96**	**3.83**	

Total dry matter production for the two cuts (Table 16) showed that responses to phosphorus and potassium were variable but the mean results for all sites showed that phosphorus had a significant effect (5% level). The addition of potassium made yield increases very significant (1% level) and liming in addition to P and K was Highly significant (0.01% level). Overall phosphorus increased the yield by I phosphorus plus potassium increased it by 15% and liming with Pand K increased it by 20%.

With fertiliser nitrogen, the mean response over all sites using 2 cwt N/acre/cut was a 32% increase in herbage yield above what was achieved with PKL (treatment D). There was a 54% increase in production when 4 cwt N acre cut was applied. Responses in lb of dry matter per lb of nitrogen applied were: 19.3 with 2 cwt N (treatment E) and 15.5 with 4 cwt N (treatment F) at the first cut; 15.3 and 12.7, respectively, at the second cut; 16.2 and 13.6 for the two cuts combined. When adequate lime and NPK was applied, herbage yields were increased over all sites by an average of 85^{r}r.

Herbage digestibility

In 1972. herbage dry matter samples for the individual fertiliser treatments, at each site, were composited and subsampled in order to analyse for digestibility. On both cutting dates, dry matter digestibility (DMD) was reasonably high for almost all sites but particularly on the ryegrass *(L. perenne)* dominated sward. Fertiliser treatments had little or no effect on digestibility (DMD) but the sward type had an influence. In the June cut, the DMD for five of the six sites (old permanent sward) was 67.6 ± 0.3%, while the sixth site which was dominated by perennial ryegrass (L. perenne), was 69%. In the September cut, the DMD on the three sites was 68% ± 0.8%, 74.2% on the ryegrass sward, and 65.9% on a sward dominated by rushes *(Junius articulatus).*

Rate of grass growth

Some details regarding the rate of grass growth (lb. DM acre day) between cuts are given in Table 1 7.

The rate of grass growth between cuts was markedly influenced by fertiliser application. There was a mean growth rate of 50 lb acre day over all sites for the NPK. application. This can be compared to the findings of Ryan and Murphy (10) with both Gley and Acid Brown Earth soils in West Donegal and with the findings of Collins and McCarrick (11) for grass growth from July onwards on a Brown Earth soil in Meath.

Chemical composition of herbage

Fertiliser applications not only increase herbage dry matter production but also change its chemical composition. Levels of N, P and K. in herbage depend on the stage of growth at which it is cut as well as soil fertility and fertiliser applications. For sward cut at the silage stage of growth, levels of 2.2-2.5% N, 0.30% P and 2.0% K. in the herbage dry matter are considered the minimum levels for optimum production (12). Where swards are continually cut for conservation purposes, there is a severe depletion of nutrient reserves in the soil unless returned either through fertiliser applications or farmyard manure. Table 18 shows some of the levels of N, P and K recorded on unfertilised swards (treatment A) compared with the levels on fertilised swards (treatment E).

TABLE 17—Daily dry matter growth (lb acre) between cuts, 1971-72

	Peaty Gley		Gley		Acid Brown Earth	
	Control	Max	Control	Max	Control	Max
Treatment	A	E	A	E	A	E
1971	12.0	41.3	20.5	52.0		
1972	29.3	52.1	29.7	47.0	32.7	57.7

TABLE 18—Chemical composition* of herbage from control and NPK plots (% of DM)

Soil type	Control			NPK		
	N	P	K	N	P	K
Gley	2.1	0.28	2.2	2.5	0.31	2.4
Peaty Gley	2.3	0.37	1.8	2.1	0.36	2.1
Acid Brown Earth	2.2	0.35	1.8	2.6	0.34	2.4

'Minimum levels needed for optimum production are N 2.2-2.59. P0.30%. K 2.0%.

Grass production potential compared to other areas

Quantity

As seen in the previous section, the unfertilised, undrained, or poorly drained pastures and meadows of the gley soils of Leitrim are not very productive. The herbage, in which normal agricultural grasses constitute only a small proportion, is generally of poor quality.

Many factors affect herbage production, but the fertility of the soil has a major influence. As a result of a national trial, it was possible to compare the production (under cutting conditions only) from the gley soils at Ballinamore with those from soils of other parts of the country. Table 19 shows the production for permanent pastures under high fertility, at Ballinamore and at Clonroche. Co. Wexford, but with a variation in the application of nitrogen. The overall production was high for both soils. With normal nitrogen levels the Clonroche soil yielded 10% higher than the Ballinamore soil, but where high levels of nitrogen were used the difference was increased to over 40%

TABLE 19 Potential grass production of two soils (based on data from Soil Productivity Trial 1968-1970), 1000 lb DM acre

	N acre. lb			
	0	150	300	450
Wet DrumlinGley (near Ballinamore)	5.2	8.4	9.3	8.0
Clonroche soil type (near New Ross)	6.0	9.3	11.8	11.5

These yield differences are probably due to differences in both soil and climate. As indicated previously, soil temperatures are lower and the growing season shorter at Ballinamore than in better drained soils in the south of the country (Fig. 27). The difference in yield was least at the intermediate level of nitrogen application.

Because of poor drainage, rushes and weeds are a major problem in Leitrim pastures. Increasing fertility alone does not necessarily eliminate all undesirable grassland species. Intensity or frequency of grazing and drainage are important ecological factors and influence the type of vegetation and its quality. Intensive grazing encourages pasture species with a low growth form, and poor drainage encourages moisture-loving species.

Rush control

The Ballinamore soil, unless artificially drained, can have a high proportion of moisture-loving species such as *Juncus effusus* —the common rush. This rush has a tall growth form, and therefore can thrive in conditions of undergoing. In fertilised but undergrazed pasture at Ballinamore, rushes contributed 26% of the total dry matter. In a typical w$t, unfertilised meadow where rushes and weeds formed the bulk of the herbage, regular cuttings of up to five times a year reduced the content of rushes from 33% to *25%* over two years. Where frequent cutting was accompanied by the application of lime, phosphorus and potassium, the rush content was reduced to

Where nitrogen was applied as well, rushes disappeared altogether after three years.

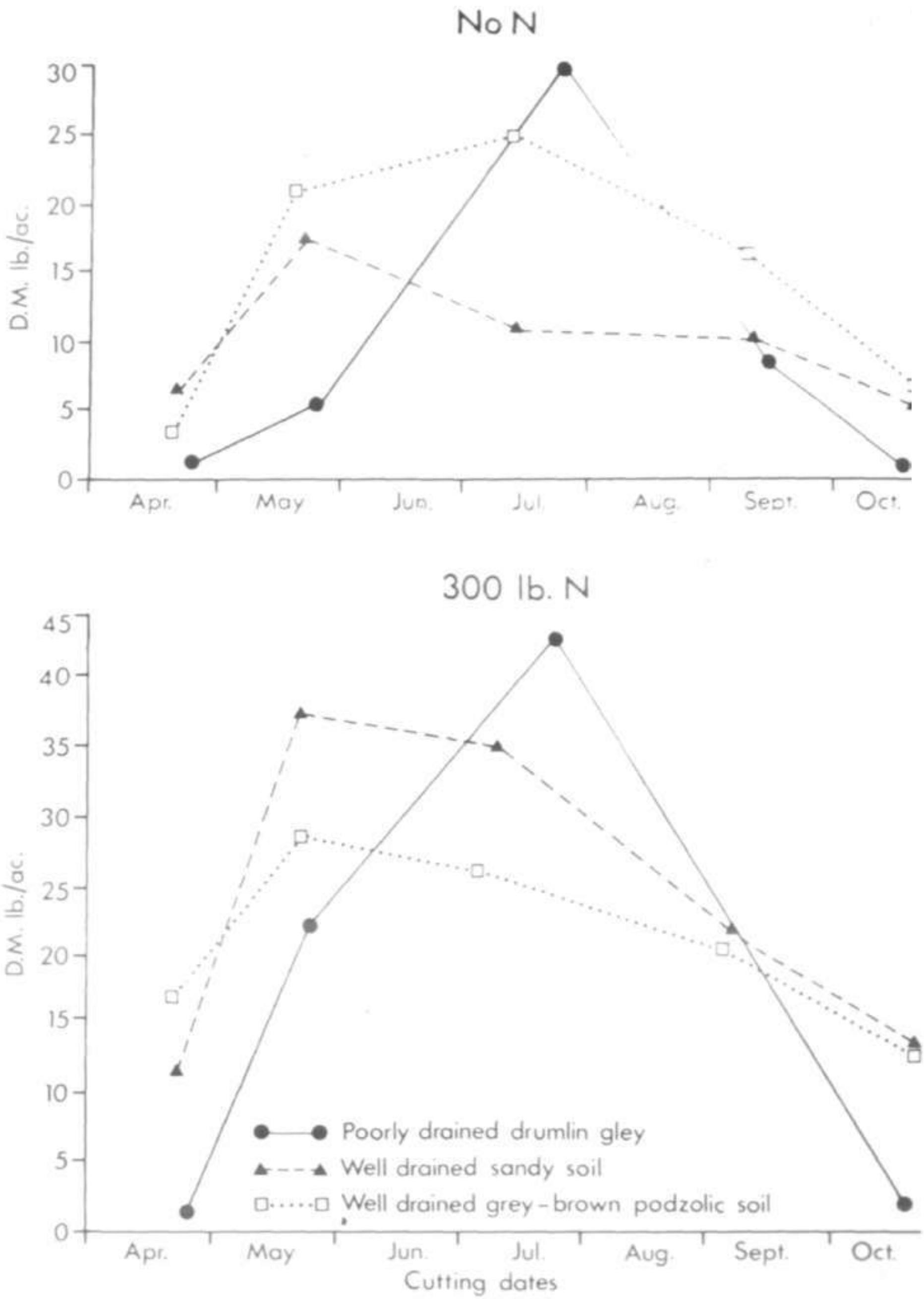


Fig. 27: Seasonal growth of grass on poorly drained and well drained soils (1968).

Frequent cutting simulates intensive grazing. Fertilising and intensive grazing (where this is possible without poaching damage) or regular cutting, improve the quality of the herbage by reducing the proportion of weeds.

Drainage affects the quality of the herbage by changing the flora. The botanical composition of drained land was examined and compared with undrained land, which otherwise received identical management. Results (Table 20) show a higher proportion of grass and clover in the drained soil, and a corresponding decrease in rushes and other weeds.

TABLE 20—Botanical composition of drained and undrained pasture, %

	Grass	Clover	Rushes	Weeds
Drained	59.0	33.0	7.1	0.7
Undrained	43.0	27.4	26.0	3.0

Seasonal growth and overall production

Apart from soil and climate, which have already been discussed, various factors affect the length of the growing season and the ultimate overall production.

(1) Species

Seasonal growth pattern and overall potential production vary with the different grass species. The results of a cutting trial (Table 21) show the performance of various common commercial strains of grassland species tested at Ballinamore. Overall production was best with S 23 perennial ryegrass with an average annual dry matter production of 10,100 lb. per acre. Table 22 demonstrates the extreme variations that can occur, especially in the early part of the growing season.

The variation between different ryegrasses throughout one whole season is shown in Figure 28. Clover has a different growth pattern, being confined to a shorter growing season but where well established, midsummer production from a good clover sward can be appreciable (Fig. 29).

(2) Drainage

The growth curve for a drained and undrained pasture at Ballinamore is shown in Figure 30. As can be seen, growth is only marginally earlier, and marginally greater with drainage. This is probably due to the fact that, as explained in a previous section, the effectiveness of drainage on many Leitrim soils is only moderate. Where the water table can be completely controlled the effect is large. This effect is shown in Table 23.

(3) Fertiliser

Nitrogen encourages earlier season growth of grass (Table 24). These results were obtained from an old permanent pasture. A trial with Irish Commercial Perennial Ryegrass gave a slightly more encouraging result (Table 25).

TABLE 21 Potential production of different grassland species on Ballinamore type soil

	Timothy S. 48		Cocksfoot S. 26		Creeping bent		Yorkshire fog		Rough stalked meadow grass		Perennial ryegrass S. 23		Reed canary grass (Commercial variety)		White clover N.Z.		Italian ryegrass (Irish)		Tall fescue (Kentucky 31 strain)		Perennial ryegrass (Irish Commercial)		Reed canary grass (Frontier variety)	
	N_1	N_0	N_1	N_0	N_1	N_0	N_1	N_0	N_1	N_0	N_1	N_0	N_1	N_0	N_1	N_0	N_1	N_0	N_1	N_0	N_1	N_0	N_1	N_0
Persistence, % purity sward, September 1970	88	56	90	37	56	40	39	28	41	47	94	61	55	21	22	37	88	59	95	95	86	71	25	13
1970 yields (100 lb DM/acre)	93	62	98	66	93	60	91	69	84	66	100	65	100	70	86	68	95	69	93	70	84	73	103	73
Average yields (100 lb DM/acre, 1968-1970)	79	42	91	52	76	49	85	56	72	54	101	49	81	53	72	59	97	48	87	61	85	57	81	61

N_1 = Receiving nitrogen
N_0 = Not receiving nitrogen

(4) Annual variation

The commencement of the growing season can vary greatly with the year. This is demonstrated by the results of a trial for two consecutive years (Table 26).

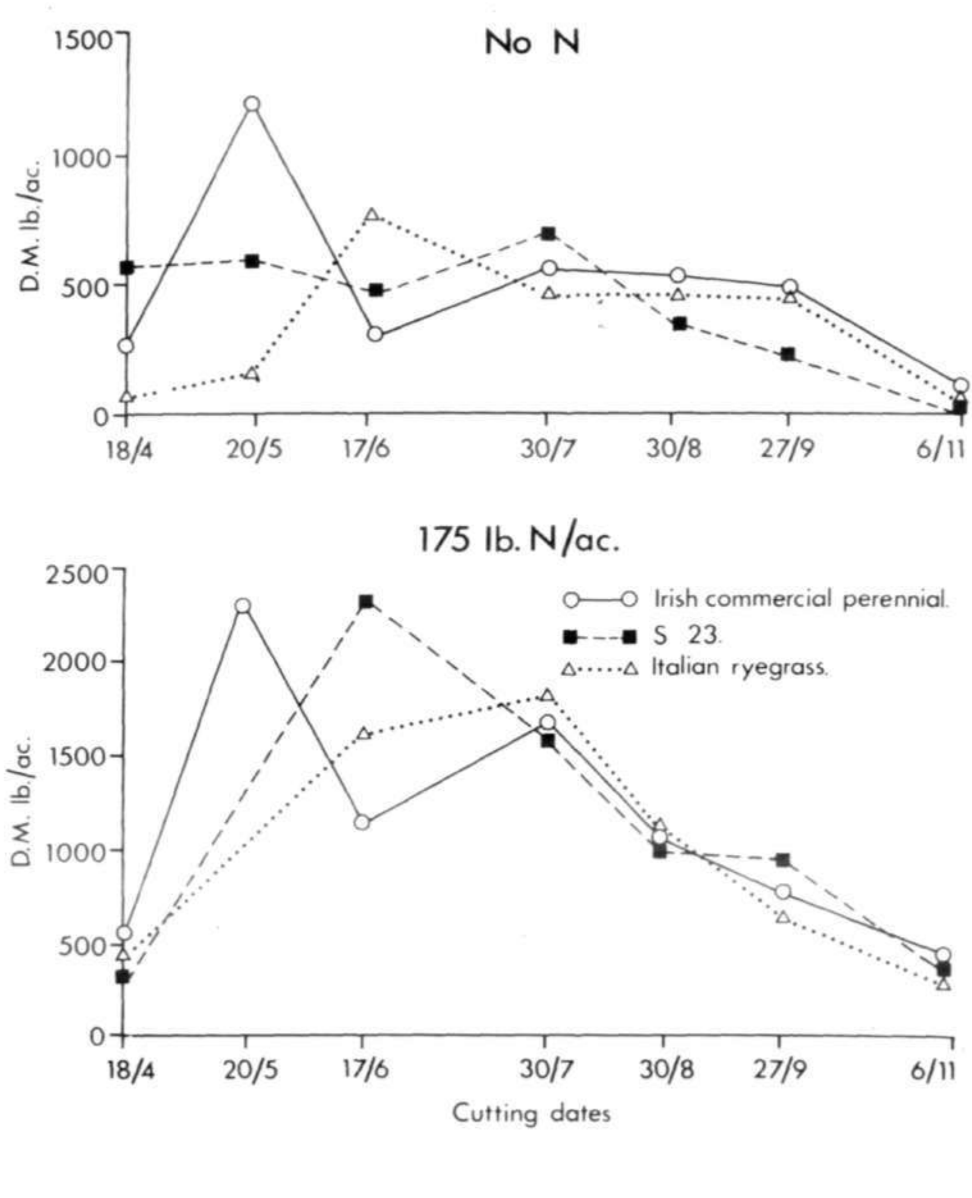


Fig. 28: Seasonal growth of ryegrass with and without nitrogen

TABLE 22—Early season growth of different species, available herbage May 1-7 (lb. dry matter per acre), mean of 1969 and 1970

	Italian ryegrass	Tall fescue	Common bent
No nitrogen applied	100	450	
50 1b. \ applied per acre	750	1300	250

TABLE 23 Effects of drainage on early season growth, available herbage (lb. dry matter acre). May 5, 1971

I b. \ applied per acre	Undrained	Drained	'7 Increase
0	110	280	170
44	210	430	105
87	340	570	68

TABLE 24—Available herbage from old permanent pasture showing response to nitrogen

Nitrogen (lb. N per acre) applied 1.3.68	Available herbage April 4. 1968 lb. dr\ matter per acre
0	12
30	25
60	194
120	210

TABLE 25—Available herbage from a perennial ryegrass sward (lb. dry matter per acre), showing response to nitrogen. May 1-7

I b. \ applied per acre	0	25	100
1968 (N applied March 14)	640	1470	2270
I970(N applied March 10)	100	270	270

(5) Mid-season production and silage

Whether silage should be taken only once (mid-season) or twice (early and late season) is an important question if intensification of stocking is considered. Reference has already been made (Fig. 27) to the shorter growing season of the Ballinamore type soil compared with some other soils. This means that there is a short but productive mid-season growth with less spring and autumn production. Such mid-season growth is valuable for silage conservation. This mid-season production was measured for several years at Ballinamore with different levels of fertiliser application. For comparison early and late season silage harvesting was measured (one year) and the results summarised in Table 27. As might be expected from the growth curves shown in Figure 27, there is a high yield from mid-season harvesting and a good response to nitrogen application. The response is slightly less for earlier seasonal production and late seasonal growth. In all cases, the grass was harvested at the optimal stage, nitrogen being applied six to eight weeks before cutting. It is obvious, therefore, that a higher total yield of silage can be obtained from two cuts (early and late season) than from one mid-season cut. However, trafficablity difficulties with the second cut have to be seriously considered.

Grassland production on many acres of mineral soil in Co. Leitrim is unsatisfactory because of inherent poor fertility, low fertiliser usage and poor botanicial composition arising from bad grazing management and bad drainage. Substantial improvements in herbage yields can be achieved through adequate usage of fertilisers. Grass yields obtained on both Gley soils and Acid Brown Earths were similar to those on the same soil types in West Donegal (10) and in Limerick (13).

A control yield of 7140 lb acre on the Shallow Brown Earth soil was high and suggested a satisfactory level of soil fertility initially. The potentially high yield of 13.300 lb DM acre recorded with this soil was comparable to the highly productive soils of Limerick and Meath (13, II). Because of their shallow depth these Shallow Brown Earths are known as 'rock' land in Co. Leitrim and are highly valued. Unfortunately, they comprise only a very small proportion of the agricultural land in the county. They are shown as the Mortarstown-Kinvarra Complex on the soil map (F'art I).

Responses to fertiliser usage had some notable features. Potassium application gave only small responses, probably because the swards were cut only once annually and the subsequent grazing plus the return of farmyard manure helped to recycle this nutrient'. With more intensive management e.g. two or more silage cuts, such soil reserves of K are quickly removed and greater responses with K are obtained (14). The necessity for fertiliser nitrogen to achieve high herbage yields was understandable because in most swards there was a complete absence of clovers.

Responses to phosphorus fertiliser, which were second only to nitrogen in achieving high herbage yields, confirmed previous findings on gley soils in Leitrim (14). With liming, the results were variable and depended on the particular site. However, it takes a number of years for liming to be significantly effective (15. 16). Various grass species can give earlier seasonal growth and in the absence of nitrogen, clover can give a productive mid-season growth.

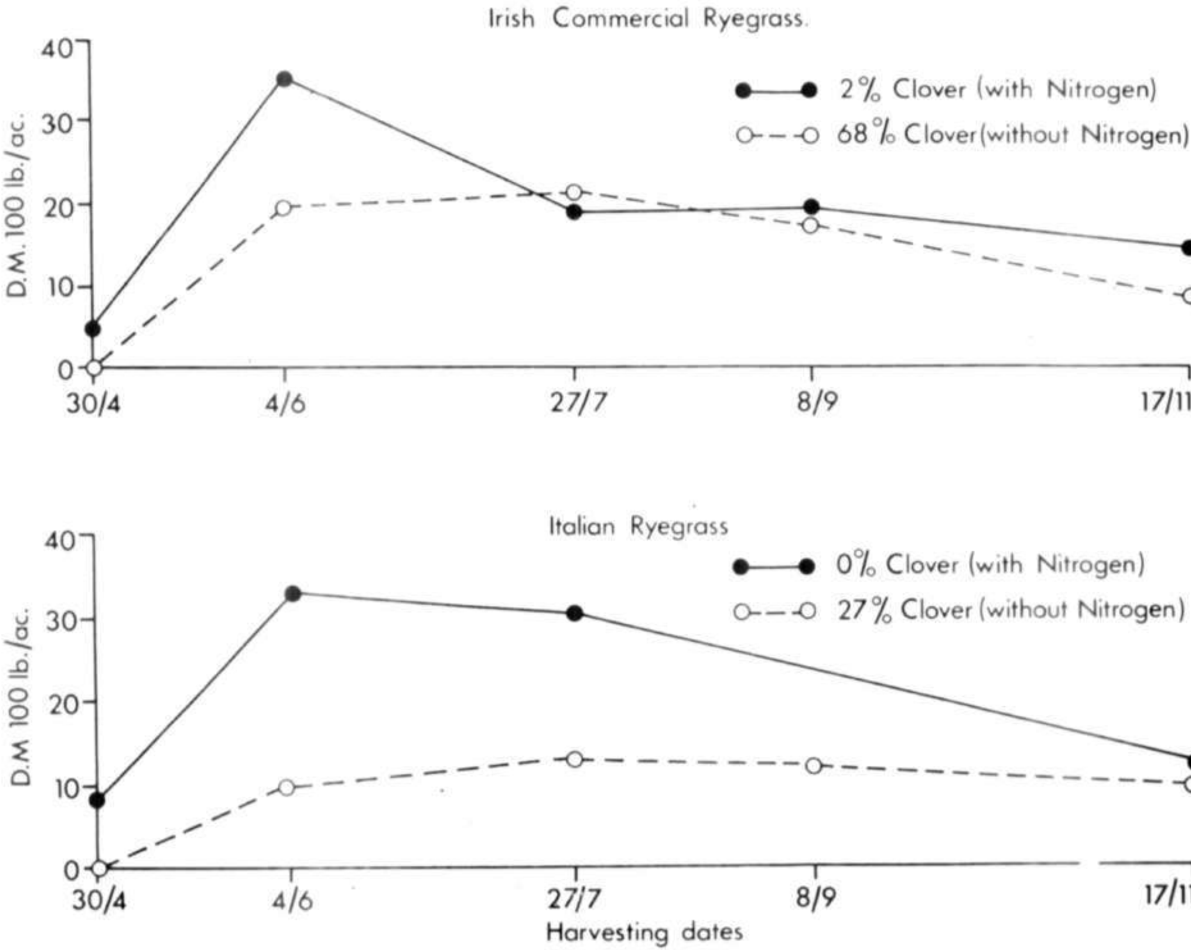


Fig. 29: Effects of nitrogen and clover in two different types of sward.

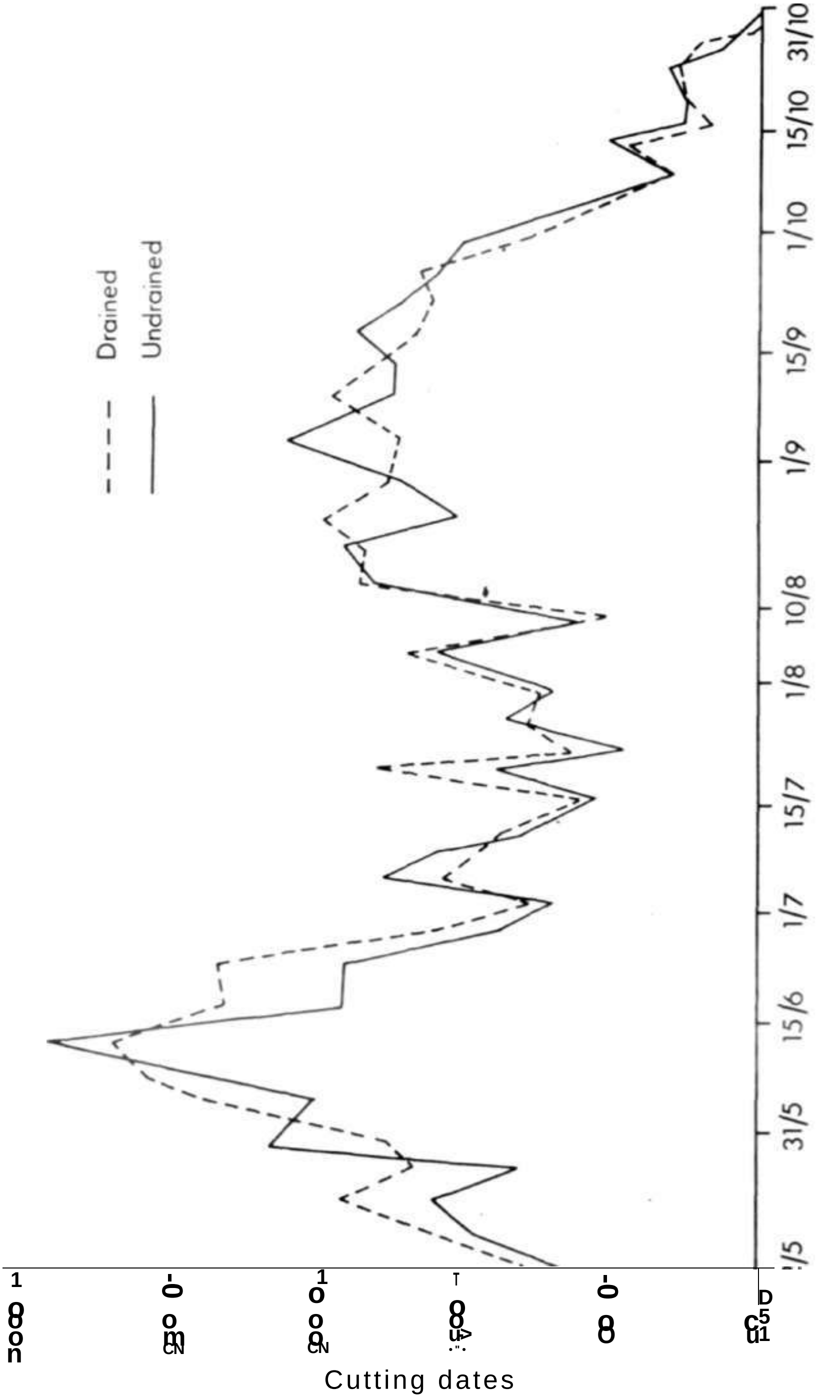


Fig 30: *Seasonal growth of a well fertilised old sw'ard under grazing management (drained and undrained).*

TABLE 26—Variation in spring growth for two years, available herbage May 1
(lb. dry matter per acre)

	1970	197!
No nitrogen applied	0	170
1501b. N per acre applied March I	320	1810

TABLE 27—Seasonal and nitrogen effects on silage yields (Ballinamore)
(lb. dry matter per acre)

	Two cut system		One mid season cut system
Cwt26 N	Early June	August	End of June early July
0	2200	2600	2800
i/S	2900	2900	3300
1	3300	3000	4100
1 '/$	3600	3200	
2	3900	4000	4500
3	4800	3700	4800
4	4900	3800	5300

Considering that most Leitrim soils under a cutting system have a grassland potential of 9,000 lb of dry matter/acre, then other factors must be responsible for the generally low level of farming production in the county, because the production potential is comparable to that of permanent pasture in better known farming areas. Whilst many areas of Co. Leitrim need drainage, because of the predominanceof gley soils, the factor of grazing and grassland management is of greater importance and needs rectifying before there is an overall improvement in farming output. This aspect is dealt with more fully below.

Grass utilisation

As already pointed out, grass has a short growing season with a single peak period of rapid growth on the wet drumlin soils of Leitrim. This growth pattern can be slightly modified, (but not completely changed) by factors such as drainage, species composition and types and quantities of fertiliser applied. All these, apart from affecting the overall growth pattern, effect the bearing capacity of the soil surface. This in turn helps to govern the system of grass utilisation practised.

The bearing capacity of grassland, following different treatments, was measured in an experimental programme at Ballinamore. Treatments and results are outlined in Table 28.

The resistance to penetration was measured using a cone penetrometer. The control was a sward with vegetation adjusted to low fertility. The rushes, sedges, and

TABLE 28—Resistance to poaching following different treatments (Ballinamore)

Sward type	Cone penetrometer reading (January I,1971)
Control	67.8
Old sward with PK and lime	52.8
Old sward with NPK and lime	**41.3**
•Surface seeded + PK and lime	43.1
Surface seeded +NPK and lime	35.7
Standard error of means	1.88
F. test	

•Carried out after slight scarification with a tine harrow

poor grasses associated with such vegetation all tend, by their growth form, to aid the physical strength, or bearing capacity of the topsoil. When, through the application of fertiliser, these are replaced by grassland species capable of higher dry matter production, the bearing capacity or resistance to poaching (treading damage) is reduced.

Table 29 shows in more detail the effect of various individual fertilisers. All fertilisers were tested using an adequate supply of the complementary fertilisers. In this context, a lower resistance is expected than when testing individual fertilisers on a sward of natural low fertility without complementary fertilising. From the table it can be seen that applications of nitrogen significantly reduced the bearing capacity.

Applications of lime and phosphorus reduced the bearing capacity somewhat but not significantly. In all cases the main effect of any of the fertilisers seems to take place with the low applications. Intermediate rates of application did not greatly affect the bearing capacity, and only with excess or high levels was a further reduction recorded.

A characteristic, therefore, of the Co. Leitrim gley soils is that as grassland production increases with application of fertiliser, a reduction in bearing capacity takes place. This trend is not peculiar to Co. Leitrim and is common to most agricultural soils in Ireland. In Co. Leitrim, however, the effect is more pronounced on the gley soils due to their poor natural structure. Bearing in mind the grass

TABLE 29—Cone penetrometer readings from fields receiving incremental amounts of fertilisers

Fertiliser application	None	Low	Medium	High	S. E. of means	F. test
Nitrogen*	**40.1**	23.4	23.8	17.5	1.5	•*•
Phosphorus*	31.7	27.4	27.0	29.5	2.1	N.S.
Lime*	47.6	38.9	39.4	31.8	3.1	N.S

*** Each treatment received an adequate basal dressing of the other two nutrients and of potassium**

utilisation problems involved, a number of alternative farm systems are considered in Chapter V and their advantages and disadvantages discussed.

Winter feed conservation*

As the proportion of land in the county devoted to cereals and root crops is extremely small, animals depend mainly on conserved grass and foggage as a source of feed in winter. With such reliance on conserved grass it is important that the quality of the material is high if good animal performance is to be obtained. This is particularly true in view of the relatively short grazing season brought about by the adverse soil and climatic conditions of the area.

Feed quality

Hay

Surveys (17, 18, 19, 20. 21. 22, 23) carried out to determine the quality of Irish hays have consistently shown that the feeding value was poor. A summary (Table 30) of the results obtained from some of these studies shows that average dry matter digestibility was only about 56% and there has been no improvement over a period of approximately 20 years. In a recent survey (24) of farm silages carried out in four counties in Leinster, the dry matter digestibility was somewhat better, though still low. the mean figure obtained being 62.8%

TABLE 30—Dry matter digestibility (%) of Irish hays

RetL-rcnce (Year)	I)r\ matterdigestibilin		Numberof samples
	Mean	Range	
Ryan (1947)	57.3[1]		36
Rutledge& Common (1948)	52.0'	—*	10
Sheehanrr 0/(1967)	57.8-	46.9-66.3	78
Wilson *etal* (1968)	54.0[1]	45.6-68.8	21
	57.8'	45.4-64.2	24

In MUI results
In MUD results

Silage

Hay forms the major part of the conserved fodder in Co. Leitrim and, although silage making has shown considerable increase in recent vears, onlv 158 farmers made silage in 1970 (25). With more intensive farming, reduction in the labour force involved in agriculture and increased mechanisation it is likely that silage making will continue to increase at the expense of hay.

For these reasons it was decided to obtain information on the quality of silage made in the county. The results show (Table 31) that the average dry matter digestibility was only 55.4% and was, therefore, quite similar to the results from the hay surveys referred to previously. It can be assumed that the hay conserved is also of poor quality and onlv sufficient to provide maintenance plus small liveweight gains in

• **Contributed by M Drennan. An Foras Talunfais. Grange.**

mature dry stock. When fed alone this fodder would be too low in energy to meet the demands of milking cows or young growing animals.

TABLE 31 — Dry matter digestibility of Leitrim silage

	Dry matter	Dry matter digestibility. in vitro.%	PH
Mean	22.4	55.4	4.3
Standard deviation	3.24	6.11	0.6
Range	16.8-30.8	36.6-67.1	3.8-6.6

Sixty-eight percent of the silages in the present survey were well preserved as shown by a pH reading of 4.2 or less. A high success rate of preservation would be expected since the majority of silages were made from grass at an advanced stage of maturity which is readily preserved without the use of an additive. However, a somewhat higher success rate would be expected since an additive was used on 26% of the crops. All farmers involved in the survey used polythene for sealing the pits.

Quantify of feed

The total acreage of grass devoted to hay and silage in Leitrim in 1970 was 62,949 acres (Table 32) i.e., I5.8% of the county.

TABLE 32—Area (acres) under crops and pasture in Leitrim —June 1970

Corn crops	Root and green crops	Fruit crops	Hay and silage	Pasture	Other land
1.304	2.236	37	62.949	210.042	100,206

Source: Irish Statistical Bulletin XI \ I No 4 i Dec I97|)

When the quantity of fertilisers used, the dates of closing and cutting and the losses involved in conservation are considered, then the expected quantity of dry matter fed per acre of conserved grass would be about 3,000 lb (26). Thus, a total of approximately 189 million lb. of poor quality dry matter in the form of hay and silage is available to feed stdck in winter. As oats and potatoes form a large proportion of the corn and root crops, respectively, neither of which is fed to ruminants to any great extent the contribution of these crops to the winter feed supply is negligible.

Livestock numbers

Total cattle numbers in Co. Leitrim have shown a slight increase during the 1960's (Table 33). Sheep numbers over the same period, however, have tended to fall slightly (Table 34).

Assuming that the fodder conserved is utilised only for feeding cattle and horses and that sheep graze foggage over the winter then the quantity of feed available relative to what is required can be calculated for 1970.

TABLE 33—Numbers of cattle in Co. Leitrim I960, 1965 and 1970 ('000)

				Cattlt				
	Bulls	Cows	Heifers in calf	Over 3 yrs	2-3 yrs	1-2 yrs	Under 1 year	Total
I960	0.3	29.3	2.4	3.2	14.3	21.6	24.6	95.5
1965	0.2	33.2	2.8	2.6	**12.4**	21.8	26.6	99.7
1970	0.2	33.1	2.8	2.7	**14.0**	22.5	28.5	103.8

Source: Irish Statistical Bulletin

TABLE 34—Numbers of sheep in Co. Leitrim 1960, 1965 and 1970 f000)

			Other sheep		
	Rams	Ewes	Overl yr.	less than 1 yr.	Total
I960	0.7	22.1	2.9	15.8	41.5
1965	0.7	21.7	1.8	17.1	41.4
1970	0.5	18.4	1.7	15.3	35.9

The total number of livestock unit equivalents for cattle and horses calculated according to the figures of Attwood and Heavey (27) is 80,981. One livestock unit would consume approximately 20 lb of dry matter per day of the quality available. Therefore, the total fodder requirements for a 150-day winter period is 241 million lb of dry matter. The 189 million lb of fodder available is only sufficient to provide for the animals for a winter period of approximately 117 days. As has been shown in earlier sections, because of poor soil and climatic conditions, the grazing season on a very high proportion of Leitrim soils must be largely confined to the summer period. Therefore, the amounts of hay and silage conserved fall far short of those required.

Stocking rates

The total number of livestock unit equivalents in the form of cattle, sheep and horses in June 1970 was 85,541. The area devoted to pasture, hay and silage was 272,991 acres. Therefore, the stocking rate was in the region of 3.19 acres per livestock unit. In addition, there were 100,206 acres of "other land" in the county which includes rough grazing, woods, plantations, turf bog, marsh, water, roads, towns and building ground, etc. If an allowance were made for the contribution of rough grazing to the figure for pasture, hay and silage land, then the figure for stocking rate would be lower. These figures show that what is achieved in practice is far lower than the potential of this land for livestock production (28, 29). However, at such a low stocking rate the quantity of feed available in winter may not be limiting to the extent shown as the winter period will be shorter due to the availability of foggage. The results, however, are in general agreement with findings obtained by McCarrick (23) in the resource survey of West Donegal.

Undoubtedly, the overall stocking rate is low and this can be increased by greater use of fertilisers, drainage and improved pasture management. However, as pointed out earlier, due to the uneven topography prevailing and its unsuitability for machinery, there is a limit to the acreage which can be readily devoted to hay or silage. This limitation could be partially overcome by developing systems in which most of the pasture would be utilised *in situ* and a minimum of livestock (e.g. breeding animals) retained during the winter period. Such systems would involve either purchase of animals in spring and selling at the end of the grazing season or keeping dairy or suckler cows and selling the progeny in amumn and retaining only dry cows in winter. The latter alternatives would seem the most logical in these circumstances.

CHAPTER V

FARMING SYSTEMS

M. Fleming[1], L. Grubb[2], J. Mulqueen[2], M. O'Toole[2]

Farming systems in the county are built around the following enterprises: dairying, suckling, calf rearing, store cattle, mountain sheep and pigs. These, together with other enterprises such as lowland sheep and store lambs are discussed below.

Three common systems are dairying and store cattle raising in south Leitrim, suckler cow and store cattle in central and north Leitrim and mountain sheep suckler cow enterprises in the mountainous areas of central and north Leitrim. There is little dairying in north Leitrim. The bulk of the dairying is carried out on the Corriga, Garvagh and Ballinamore soil series around the towns of Ballinamore, Carrigallen, Mohill and Carrick-on-Shannon. Suckler cow systems are also common in south Leitrim but are most common on the Drumkeeran and Ballinamore series in north Leitrim.

Mountain sheep farming is most intensive in the Glencar, Glenade and Lough Melvin valleys with their associated dry hill and mountain land. The livestock density on predominantly wet mountain slopes (Drumkeeran peaty phase and Aughty series) is low. This is associated with a predominance of rushes on the lower slopes and wet bog at higher elevations. The prospects for farming improvement are lowest on the Aughty, Drumkeeran and Ballinamore series associated with wet mountains such as Arigna and Slieve Anierin. Furthermore, suckler cow store cattle and sheep systems even at high intensity have a lower payment capacity and can therefore bear less costly solutions to farming difficulties than dairy farming.

Dairying

Farming systems of the county (30) can also be classified according to type of stock (Table 35).

TABLE 35 Farming systems in Co. Leitrim

	Per cent
Farms with cows only	20.2
Farms with cows + cattle	35.4
Farms with cows + cattle + other livestock	27.4
harms without cows	16.0

While a high percentage of farms carry other cattle and livestock as well as cows, only a small percentage (20%) depend on cows alone. Most of the cow herds in the county are very small (30) as can be seen from Table 36, with over two thirds of them having less than five cows.

[1] Dairy Microbiology- **Dept.. Moorcpark Research Centre, A.F.T.**
•" Hill and **Marginal Land Dept.. Western Research Centre. A.F.T.**

TABLE 36—Distribution of herds by cow numbers

No. cows in herd	Percent of herds
0-5	67.7
6-10	24.5
II -15	5.5
> 15	2.3

A study (31) of representative farms in 1972 and 1973 showed that the most common system of farming was some variant of single suckling. The percentage of dairy enterprises making a significant contribution to farm output was relatively small. The data collected in these studies are shown in Table 37.

TABLE 37—Dairying and single suckling on a sample of farms in Co. Leitrim during 1972 and 1973

	1972	1973	
	Dairying	Dairying	Single suckling
Stocking rate	2.7 ac/ cow	2.2 ac/ cow	2.5 ac/ L.U.
Yield cow (gals.)	366	392	
Av. herd size	8.0 cows	8.7 cows	10.1 cows 18.9/ L.U.
Output (£)		125.3/ cow	54.8/ L.U.
Direct cost (£)		19.36/ cow	9.29/ L.U.
Gross margin (t)		106.0/ cow	45.59/ L.U.

Cattle numbers in the county (milch cows, in-calf heifers and others) have been increasing steadily since 1965, Table 38 (32).

TABLE 38—Increase in cow and other cattle numbers since 1965

	Milch cows	In-calf heifers	Other cattle	Total
1965	33.200	2.800	63.700	99.700
1970	33.000	2.800	68,000	103.800
1971	35,500	3,500	68,600	107.600
1972	37.600	3.700	67,800	109.100

It is significant that 21,900 of the milch cows (66.4%) and 65,800 of the total cattle (63.4%) were in south Leitrim. Based on the 1970 figures, 66% of the milch cows were of the Shorthorn breed and 10% were of the Friesian or Friesian X breed.

Impact of beef incentive scheme

Since the introduction of the beef incentive scheme in 1969, there has been a steady increase in the number of participating herds. This, as well as average cow numbers per herd are shown in Table 39.

TABLE 39—Number and size of herds in beef incentive scheme.

Year	Total herds	Cow average
1969	1200	6.33
1970	2065	7.50
1971	2439	8.73
1972	2614	9.45
1973	2917	10.10
1974	3172	

Participation in the scheme varies between different regions in the county, probably reflecting herd size, soils and topographical features and returns from milk. The number of herds participating (33) in 1974 in four regions of the county i.e. North, Central. South and Ballinamore, and the percentage of the herds in those areas which changed over from dairying are shown in Table 40.

TABLE 40—Distribution of beef herds and swing from milk to beef.

Region*	No. herds in beef scheme	Per cent swing from milk to beef (1969-1974)
North	1300	50.0
Central	457	28.3
South	604	51.0
Ballinamore	811	31.5

North MI districts, north of Dromahair including Dowra and Ballinagiera.
Central From Dromahair to Drumshanbo.
South South of line from Drumshanho to Vtohill to Dromod.
Ballinamore Remainder of county

Farm output and incomes

The total output from livestock and livestock products in 1969 was 3.5 million (30) of which milk made up 23% (Table 41).

Dairy winter feed and fertiliser use

In a recent study of dairy farms in the county (31) it was found that the average weight of concentrates per gallon of milk produced was 1.25 lb in 1972 and 1.1 lb in 1973.

Over half the farms did not use any fertiliser in 1967 while only one tenth of all farmers made an application of greater than £1 worth of fertiliser per acre (30)-Table 42.

TABLE 41— Output from livestock and livestock products in Co. Leitrim (1969)

	£(m)
Cattle	1.8
Milk	0.8
Pigs	0.5
Sheep	0.1
Other	0.3
Total	3.5

TABLE 42—Fertiliser use per adjusted acre

Expenditure adjusted acre	Percent of farms
None	51.5
51 p or less	22.5
51p- £1,	15.6
> £1	10.4

Farm amenities and facilities

For a number of reasons an adequate supply of water is essential on dairy farms. In 1967. only I 1.2 % of farms had piped water supplies. This includes regional or group schemes (4.2%) and private piped supplies (30). Hence, a very high percentage of farms rely on other sources of water such as surface wells, streams etc. Approximately 159r did not possess a water supply within the farm.

The major problems in well engineering in Co. Leitrim (4) are: (a) the limited radius of a drumlin which limits the area for water collection; (b) the low permeability of the shales and limestones; (c) the relatively low specific yield; (d) the large heads against which water must be pumped and (e) the high levels of impurities. Water supplies are generally hard with total hardness ranging from 100 to 400 ppm CaCO 3 and levels of iron are very high in some areas. Table 43 shows analyses of five typical water supplies (4).

TABLE 43—Analysis of typical water supplies

Location	pH	Total hardness (ppm $CaCO_3$)	Total iron (ppm)
Cavagh. Co. Leitrim	8.6	365	49.0
Moher, Co. Cavan	8.0	100	84.0
Aghoo, Co. Leitrim	8.0	276	0.8
Derradda. Co. Leitrim	8.5	212	3.1
Lambfield. Co. Cavan	8.2	270	2.8

Electricity

Only half (52.5%) of farms in the county have electricity (30). However, the proportion of farms which have electricity increases with farm size (Table 44).

TABLE 44- Percentage of farms (by size) which use electricity

Farm size. acres	Percent
5-15	38.7
16-30	46.1
31-50	58.3
51-75	78.6
> 75	81.5

The standard of farm buildings and farm output are major factors in determining electrical power usage.

Cow-byres

Only a little over half (54%) of cow-byres are classified as good or fair (30)—Table 45. The absence or inadequacy of cow-byres and other basic farm buildings is a major constraint on further expansion in dairying in the county.

TABLE 45—Structural quality of cow-byres

Good	181
Fair	35.3
Poor	30.1
V. Poor	16.5

Milking machines

In 1970, there were 36 milking parlours and 170 bucket milking machines in the county (32). The distribution of these mechanical milking systems, by herd size, is shown in Table 46.

TABLE 46—Distribution of milking machines by herd size

Herd size (cows)	Per cent with milking machines
1-5	8.4
6-10	33 3
11-15	• 33.3
> 15	25.0

Hence, almost half (42%) of all milking machines are on very small farms i.e. less than 11 cows.

Structure of the processing industry

Milk intake and processing facilities

The milk from Co. Leitrim is assembled mainly to Killeshandra (Co. Cavan)and Kiltoghert Co-ops. Kiltoghert Co-op. is located near Carrick-on-Shannon in Co. Leitrim but a high proportion of its milk comes from Co. Roscommon. It has six branch creameries, three of which are in Co. Leitrim i.e. Mohill. Bornacoola and Letterfine.

Killeshandra Co-op. has 16 branch creameries, three of which are also in Co. Leitrim, i.e. Ballinamore. Longfield and Gortermone. However, only one third of the milk supply to Gortermone is from Co. Leitrim. There are two other very small Co-ops, in the county, Kilasnett and Dowra. A very small number of suppliers in the northern part of the.county deliver to the North Connacht Farmers Co-op (N.C.F.). The branch creameries and the small independent Co-op creameries are used only for milk intake and storage prior to delivery in bulk to the respective central creameries for processing. A number of the branch creameries are old and both buildings and plant equipment are unsuitable for milk handling. An outline of the county's milk supply and quality is presented in Table 47.

Milk assembled to Killeshandra and Kiltoghert central creameries is manufactured into butter. The skim-milk in Killeshandra is processed by McCormack Bros, (also located at Killeshandra) while the skim from Kiltoghert is transported for processing to the recently formed Shannonside Co-op. plant at Ballaghadereen, Co. Roscommon, now owned jointly by North Connacht Farmers, Midwestern, and Kiltoghert Co-ops.

TABLE 47 - Creameries and milk supplies in Co. Leitrim

	Annual milk intake from Co. Leitrim (gal.)		No suppl iers		Percent failing 3hr. MBRI			
Creamery	1972	1973	1972	1973	1972		1973	
					Sup!:,.	Milk	Supls.	Milk
Kiltoghert								
Central	233.000	250.000		200			42	48
Mohill	430.000	391.000		250			46	52
Bornacoola	370.000	375.000		200			56	62
Letterfine	2X8.000	252.000		220			45	51
Killeshandra								
Ballinamore	i.027.qpo	960.000	477	447	54	68	49	64
Gortnamore	500.000	500,000	170	170	59	70	55	67
Longfield	680.0(H)	650.000	183	170	69	80	66	77
Kilasnett	495.000	430.000		325	51	68	56	72
Dowra	30.000		42		32			
N.C.F. Co-op.		100.000		50				
		3.908.000		2.032				

The plant at Ballaghaderreen has a throughput of 25,000 gal. per hour and in 1974 is expected to process 30 m. gallons of skim milk. The basic products made are skim milk powder and a whole milk substitute (vegetable fat-filled milk). The annual factory output is expected to exceed 12,000 tons.

Milk supplies, turnovers, numbers of shareholders (1973) and the areas serviced by the four major dairy co-operatives around Co. Leitrim are shown in Table 48. All milk suppliers in Co. Leitrim have now available to them centralised milk processing facilities which have the necessary potential to expand and diversify in product output in the future.

TABLE 4X Dairy co-operatives servicing the Leitrim catchment area

Co-op. Societj	No. branch creameries	Milk supply (m. gal.)	rumover (m.£)	Share-holders	Areas serviced
N.C.F.	100	17.5	11.3	9.000	Mayo. Sligo and parts of Donegal. N. 1 eitrim and V Roscommon.
Mid-western	3	9.0	3.5	4.500	Galway and parts of Roscommon, Offal) and Westmeath.
Kiltogherl	6	7.3	2.4	3.600	Most of Roscommon and parts of Lcitrim. E. Galwa) and Longford.
Iolal	109	33.8	17.2	17.100	
Killeshandra*	16	22.1	8.9	6.000	Longford and parts of Cavan, Leitrim, Meath Westmeath and Roscommon.

* Mainl) Co. C"a\an

Milk utilisation

The disposal of milk in the county involves delivery to the creamery and usage on the farm for animal and human feed. The distribution of farms according to method of milk disposal (30, 31) is shown in Table 49. The percentage of milk used on the farm has dropped very rapidly over the past few years, probably as a response to increasing price.

TABLE 49—Disposal of milk supplies (%)

	1967	1972	1973
Sold	62	79.2	88.3
Led on farm	38	14.5	9.1
Used in house		6.3	2.6
Creamery price per gal. (p)		18-20	20-22

Milk assembly

Almost all milk supplies are delivered by multican haulage systems, most of which are operated by private hauliers. The charge to the milk supplier ranges from lp-2p per gal. delivered. Some of the routes are long and because supplies are generally small, delivery at the creamery is often late in the day. A rationalised assembly system whereby milk is transported directly from the farm to the processing factory should reduce costs to suppliers.

Milk quality

The bacteriological quality of suppliers milk depends mainly on the level of contamination during milking and the extent of cooling during storage. Hence, an adequate supply of water (preferably a piped supply from a deep well) is necessary if the required standards in dairy hygiene and milk cooling are to be met. The absence of such a supply on the majority (89rf approx.) of farms in the county constitutes a serious problem in the production of quality milk.

The high percentage of milk supplies failing the 3-hour methylene blue test (Table 48) is an indication of a serious milk quality problem. In a study of milk quality in a multican haulage system (34), carried out in 1967. it was found that a serious drop in quality occurred throughout the warmer months (June to September). This deterioration in quality reflected the higher ambient temperature during this period of the year, the effects of which are to raise cooling water temperatures, reduce water output from many wells and cause some supplies to dry up completely for intervals, reduce the natural cooling effect of the air during milk storage and lead to rapid proliferation of bacteria on the surfaces of milking and milk cooling and storage equipment.

Most milk supplies are stored in cans on the farms and cooled by immersing the can with the milk in a trough or stream of water. This method is inconvenient and generally inefficient. However, it is often the only method available. A large percentage of milk supplies remain uncooled.

In the study of multican haulage (34) it was also found that while milk deteriorated in quality between farm pick-up and creamery delivery, this was small when compared to the difference in quality between supplies. It was concluded that the most important factor determining milk quality at delivery at the creamery was the quality at pick-up at the farm gate. Since quality at this point is determined by hygiene standards during production and extent of cooling during storage, the importance of rigorous equipment cleaning routines and the availability of an unfailing water supply is stressed. Where an adequate water supply cannot be secured at reasonable cost and within a reasonable time, then the use of mechanical cooling (possibly by ice-bank unit or immersion refrigeration cooler) is recommended. A comprehensive milk quality farm advisory system coupled to a milk quality differential payment scheme is basic to improving milk quality in the county.

Management targets and schedules for dairy/arming

The schedule outlined here has been developed and successfully used on the Cleendargan clay (Ballinamore soil series) where conditions are the most difficult. Most lowland soils in south Co. Leitrim are more easily and effectively drained and managed than the soil at Cleendargan and higher targets may be realistic. However, it must also be borne in mind that provision of farm and farmyard facilities takes time and the pace of farm development depends to a large extent on uncertainties imposed by economic, human and climatic factors. The targets : 40% farm area successfully-drained, a stocki-ng rate of one dairy cow on 0.6 ha (1.5 ac), a mean lactation yield of 2700 litres (600 gallons), 7 tonnes silage per cow equivalent for a 6-month winter with 75% of requirements harvested in the 1st cut, 2 kg (4 lb) meal per cow per day frorr calving time until cows go out to grass.

Schedule:

Mid-March:	1.12 quintal/ ha (1 cut ac) ot 26'[N and 0.10.20 fertiliser on all fields
Mid-April:	2.5 quintal/ ha (2¼ cwt ac) of 26% N fertiliser on silage fields, 1.12 quintal/ ha (1 cwt ac) of 26% N fertiliser on grazing fields, milking cows out to grass
1st week May:	all cows out to grass
1st week June:	1st cut silage, calves out to grass
2nd week June:	2.5 quintal/ ha (2¼ cwt ac) of 26% N fertiliser on silage fields closed off for 2nd cut
	1.12 quintal/ ha (I cwt ac) of 26% N fertiliser on grazing area
1st week August:	2nd cut silage
2nd week August:	1.12 quintal/ ha (1 cwt ac) of 26% N fertiliser on 2nd cut silage area
	2.8 quintal/ ha (2½ cwt ac) 0.7.30 compound fertiliser on silage area
1st week November:	all cows and cattle older than weanlings inwintered
1st December:	all weanlings inwintered

Suckling

It is. of course desirable that a system for the wet drumlin soils should rely on the grazing animal as opposed to systems of zero grazing or specialised winter feedlots. Because of the relatively poor quality of the herbage and of the problems of machinery use on these wet soils, the grazing animal must be able to utilise a certain amount of poor quality pastureland and not require an extra large proportion of conserved feed for winter.

Dairying has the advantage that it is a system based on keeping mature animals as opposed to younger animals. High quality feed would not be so important for mature cows during non-lactating periods. On the other hand, the single suckling cow rears a calf w hich requires a higher plane of nutrition. Here the cow performs the function of converting low quality herbage into milk which supplements the'diet of the calf. The efficiency of dairying, and to a lesser extent of suckling systems is dependent on milk yields and this is partly affected by the length of the grazing season. It has been shown already that the growing season in Leitrim is shorter than in many other parts of the country. Consequently, even though early grass production can be induced, it is still a month later than similarly treated grassland in the south of the country.

In autumn, the bearing capacity of the soil can be low due to increased rainfall.

The dairy cow, because it is a heavy animal, is particularly susceptible to poaching such land. This means that autumn grazing is terminated in unfavourable years, not due to lack of available herbage, but to excess treading damage, or poaching of the pasture.

Dairying is a suitable enterprise for the wet drumlin areas of Co. Leitrim with the limitation that the grazing season may be short due to lack of herbage production, and low bearing capacity of the soil. This means that milk yields per cow will tend to be lower than those on drier soils in other parts of the country. A straight system of dairy farming on its own, may leave land with considerable residual grass unutilised at the end of the grazing season. Single suckling may have an advantage here in that the calves could utilise this residual grass in autumn.

On the experimental farm at Ballinamore and at Drumboylan, 500 lb dry matter per acre has been left behind following a wet autumn with such a system. This represents over 10Cf of total annual production of grass off pastures receiving basal fertilisers only. In a dry autumn, dairy cows can graze late in the year utilising much more of the grass and leaving a residual of only 150 lb dry matter per acre, so that grass is only wasted during wet seasons.

More nitrogen fertiliser will be required in a wet year; the extra amount required depends on the wetness of the farm and on the amount and seasonal distribution of the rainfall.

Dairying and store cattle raising is the most rewarding system of farming in the county. Herd size is small and the trend towards larger herds is slow. Most small herds are Shorthorn and Shorthorn X cows while there is a tendency toward Friesian cows\ Average milk yields are low at 400-450 gal. per cow. It appears that dairying and store cattle (including dropped calves) offers the best prospect for agricultural expansion in the immediate future. Since the county is brucellosis free there would appear to be good prospects in the short and medium terms for raising in-calf heifers additional to replacements. The main requirements are expansion in cow numbers, improvements in the dairy merit of cows and a big expansion in silage making.

Housing

Weanling and store cattle can be housed in unroofed cubicles with adjoining silage pad and earthenwalled slurry pit. Experiments (Table 50) and experience at Ballinamore since 1968 show that all types of livestock do equally well in uncovered and covered cubicles. Growth was a little over 0.5 kg/day (1.1 lb/day) in both groups

TABLE 50—Growth of weanling Friesian calves in covered and uncovered cubicles

	Weight (lb)			
Group	Dec. 16	Jan.26	April 22	Gain lb/day
Covered	372	417	578	1.16
Uncovered	381	425	524	1.14

Fig. 31: Large numbers of cattle can be managed in unroofed cubicles with little labour.

identically fed. Large numbers of weanling and store cattle can be managed in unroofed cubicles with little labour (Fig. 31). Cows are best inwintered in covered cubicles with a front calf escape to accommodate management of the calves and in this case autumn calving may be desirable to cover the increased costs. Spring calving cows should be calved down by April to ensure a strong calf in autumn. Single suckling could give way to double suckling and this would appear to be encouraged under the proposed EEC scheme for "Disadvantaged Areas".

Store cattle

Unlike dairying or sheep farming, which both involve breeding from mature animals, cattle grazing deals with immature animals only. As with dairying, poaching can be severe in a wet autumn and can result in a premature termination of the grazing season. The same is not true of the spring, for at this stage, animals are lighter and any poaching which does take place may be short-lived due to improved weather conditions and herbage growth with the approach of summer. Therefore, cattle fattening systems put less stress on the land during the spring and summer, but are more likely to cause stress during autumn. At intensive stocking rates, they also require more than 509r of the area to be conserved for winter feed. This can be difficult to achieve in a wet drumlin landscape. If cattle courd be grazed for the spring, summer and early autumn only, without provision being made for winter feed, then cattle production could efficiently utilise wet drumlin soils at minimum development cost.

The results of an experiment on cattle grazing on wet drumlin soils are summarised in Table 51. In this trial winter feed was provided taking two cuts of silage per year early in the season, and reducing the stocking rate in the second half of the grazing season. It was not intended to provide feed for the whole winter, but rather up to the middle of March, when cattle, if not finished, could be transferred to early grass on drier soils elsewhere in the country. This means that the cattle were supported at a reduced stocking rate for approximately 10-10'/: months per year. In Table 51. allowance has been made for this in calculating the annual stocking rate. The table gives production data for grazing cattle for (i) the summer; (ii) the autumn, and (iii) a potential annual stocking rate. Two basic types of pasture were investigated: (a) a pasture in good fertility, but not forced by nitrogen, and (b) a pasture receiving the maximum requirements of fertilisers. From this second treatment it was hoped to gain the ultimate potential physical performance in terms of cattle, irrespective of economics. A pasture surface seeded with perennial ryegrass and clover was also assessed in terms of livestock performance. The technique of surface seeding had previously proved promising as a means of getting a better establishment of clover in pastures where the natural clovers failed to make a worthwhile contribution. Botanical analyses showed that this technique was only moderately successful in this trial. Therefore, no conclusion can be drawn from this treatment although it is still worth noting that animal performance appeared to be slightly better from surface seeded pastures.

In all years, irrespective of the stocking rate, animals made a good liveweight gain in the first half of the summer. In 1972 and 1973, liveweight gains were made with all stocking rates up to the end of the first week in September. However, during 1974, liveweight gains were made only up to the begining of August, after which liveweight

TABLE 51 — Animal performance — Bullock Grazing Trial Ballinamore

TYPE OF PASTURE AND FERTILISER REGIME	YEAR	Average cattle liveweight (kg.)				*Stocking rate (bullocks acre		
		Early May	Early Aug.	Early Sept.	Early Nov.	May-Aug	Sept-Oct	Annua
Old pasture receiving basal fertilisers only								
i) Low stocking rate	1972	286		393	432	0.88	0.68	0.57
	1973	284	371	398	421	1.03	0.79	0.65
	1974	264	356	318	398**	1.03	0.79	—
ii) Medium stocking rate	1972	286		377	393	1.60	1.05	0.87
	1973	283	343	359	343	1.87	1.22	1.01
	1974	267	334	278		1.87	1.22	—
Surface seeded pasture receiving basal fertilisers only								
i) Low stocking rate	1972	286		410	440	0.88	0.68	0.57
	1973	283	392	416	429	1.03	0.79	0.65
	1974	264	370	307	401**	1.03	0.79	—
ii) Medium stocking rate	1972	286		372	410	1.60	1.05	0.87
	1973	283	356	375	345	1.87	1.22	1.01
	1974	266	346	295		1.87	1.22	—
Old pasture receiving basal fertilisers plus nitrogen								
i) Medium stocking rate	1972	286		403	430	1.59	1.04	0.86
	1973	288	382	411	377	1.87	1.22	1.01
	1974	265	368	315	358**	1.87	1.7[illegible]	
ii) High stocking rate	1972	275		342		3.07	1.38	1.15
	1973	281	337	349		3.46	1.77	1.47
	1974	270	323	280		3.46	1.77	

* i) During early part of grazing season silage is conserved while stocking rate is high; during the latter part of the grazing season silage fields were grazed, thus reducing the overall stocking rate.

ii) The amount of silage conserved was the same for all treatments and was short of requirements by about 1-2 months supply. An adjustment is made accordingly to estimate the annual stocking rate.

** Grazing season terminated and cattle weighed on October 24th, 1974.

losses were incurred. This was due to the pastures becoming badly poached as a result of a higher than average rainfall. On this basis, the pasture used had a summer grazing capacity of 3.46 bullocks per acre where nitrogen was applied, and 1.87 bullocks per acre where nitrogen was not applied, but fertility was otherwise high. This represents the upper limits of stocking rates where a slight reduction in individual animal performance is just begining to be encountered.

This trial shows that an acre of wet drumlin pasture is capable of producing 189 kilograms liveweight gain from early May to early August, where nitrogen'has been applied. Without nitrogen, a liveweight gain per acre of 138 kg. was achieved, while the best average animal performance irrespective of stocking rate was 107 kg for the three months. In some years, as in 1974, it may be necessary to reduce the stocking rates after early August. In other years, such as 1972 and 1973, it was possible to maintain a high stocking rate until early September, after which reduction was necessary.

During the autumn (i.e. September and October) when the stocking rate had been reduced: (a) in 1972 all cattle continued to either maintain their weight or make small liveweight gains for each month, (b) in 1973 cattle at the highest stocking rate lost weight for each month while those on the lower stocking rates lost weight for October only, (c) in 1974 no stocking rate gave a satisfactory performance in the autumn months due to unfavourable weather conditions.

During the winters, all cattle were fed ad libitum silage which had been harvested from paddocks subsequently grazed in the trial. The cattle were out-wintered in uncovered cubicles without shelter. Up to 4 lb beet pulp per head per day was fed for part of the winter, depending on its availability. Average liveweight gains varied from nothing to 1 lb per day per beast, depending on the year and the treatment.

Summarising the physical potential for cattle production from the wet drumlin grasslands then, it can be said that (i) a high stocking rate can be maintained with a good performance during mid-summer, from early May until early August, and in favourable years, this stocking rate can be maintained until early September while still getting a good liveweight gain. At a reduced stocking rate, liveweight gains can be made until the beginning of October, but only in a very favourable season can a liveweight gain continue to be made up to the beginning of November. Using nitrogen during mid-summer gave a 41% increase in production over pastures not receiving nitrogen. Liveweight performance during the winter was little better than maintenance in most cases, and in most treatments, little total liveweight gain was made between the beginning of September and the latter half of winter when the trial was ended for each year.

Calf rearing

So far. the theoretical advantages and disadvantages of various straight systems of farming have been discussed. Production targets in terms of liveweight gains and stocking rates have been estimated under experimental conditions. The Drumboylan farm, Co. Roscommon run by An Foras Taluntais has enabled systems to be tested on a farm scale with all the limitations of lack of capital, poor farm layout, poor facilities and variable soil conditions. The farm includes nearly all one small drumlin. and is typical of many of the more difficult wet drumlin farms of Co. Leitrim.

Originally, a dairy system was opted for because it gave the highest and most regular cash return. Over the years, dairying was intensified at the expense of other enterprises, and with increased use of nitrogenous fertilisers, until by 1970. a stocking rate of 1.9 acres per cow was reached using 29 cows and some heifer replacements (Table 52). At this stage, due to the high stocking rate with heavy animals, and an unfavourable autumn, poaching became a problem. This reduced the overall grazing season. Consequently, it was decided to change to a mixed farming system with less dairy cows to reduce the poaching hazards. A calf rearing enterprise was used to maintain the same overall stocking rate. For the years 1971, 1972 and 1973, calf rearing by different methods was tested (Table 53). Stocking rates remained high, and the performance of calves was good (Table 54) irrespective of the method used.

TABLE 52—Annual stocking rates (acres LU) Drumboylan 1966-1972

	Lb N per acre	Stocking rate ac cow	No. cows
1966	7	2.12	13
1967	17	1.73	22
1968	90	1.78	25
1969	94	1.82	28
1970	94	1.91	29
1971	17	1.92	24
1972	12	1.80	17

Suckling only gave a minor improvement on performance. A new problem arose—spring born calves, like bullocks, have a lower feed requirement at the beginning than at the end of the grazing season. Therefore, though they do less poaching damage than cows, and can graze on wet pasture for a longer period, they also involve higher stocking rates in the autumn when the farm is least suitable. Better quality winter feed is also more important for calves than for cows.

TABLE 53—Calf rearing by different methods (Drumboylan) 1970-1973

		Cows	Heifers	Calves	Bull
1970	Dairy cows and heifer replacements	29	7	5	0
1971	Dairy cows, calves, and heifer replacements	23	5	20	• 0
1972	Multiple suckling	17	3	42	0
1973	Multiple suckling	16	3	53	1

TABLE 54—Calf liveweight gains (Drumboylan) 1971 -1973

	No. of calves	Date of birth	Liveweight (lb) mid-October
1971	20	Early February	426
1972	42	Early February	443
1973	53	Early February	388

These experiments at Drumboylan show that dairying at a high stocking rate on wet, undrained, or partially drained drumlin soils, is liable to poaching problems. Mixed farming with a high proportion of calves produces problems of a high autumn stocking rate, and inadequate supplies of good quality winter feed. A mixed farming system of dairying JDIUS rearing all calves born, seems to be the best compromise between these two extremes. In this case, the stocking rate of cows is not at a maximum; therefore, better milk yields can be expected, and poaching may be less of a problem in a wet season. The calf performance will also be good, as a low density of calves can be successfully forward grazed ahead of the dairy herd. Milk yields, stocking rates, fertiliser and concentrate use in this system are shown in Table 55.

TABLE 5 5 ^ Average yield, fertiliser and concentrates used in darying and calf rearing system (Drumboylan 1969-1971)

	1969	1970	1971
Number ol cows		29	23
Average yield (gal)	467	521	54.1
Stock acres per cow	1.82	1.91	1.92
lb. \ per acre pasture	94	94	17
Concentrates per cow	EJ.2	14.2	15.7

In the autumn, a small number of calves do not cause a large increase in the stocking rate, and can also perform a useful function by grazing pastures which cows would poach. It is also usually possible to provide at least a small amount of good quality silage for the calves. A stocking rate of 1.75 acres LU can be achieved using one mid-summer cut of silage. On marginal land such as the wet drumlins. the production potential varies considerably from season to season, depending on the weather. It is, therefore, not possible to achieve a steady maximum stocking rate lor all years, and a system of farming must have some flexibility built in to accomodate this. A small call-rearing enterprise achieves this, as calves can be sold either in the autumn, or in the following spring, depending on the availability of feed. They can also gra/e aftergrass which dairy cows would damage in a wet season. Meanwhile, the dairy herd can be kept at full capacity, irrespective of the season.

Store Lambs

As already indicated, one of the major inefficiencies in any form of cattle farming on wet drumlin soils is the poor utilisation of grass during autumn and winter. On drier soils with higher stocking rates, a four-month rest period during winter is adequate to allow recovery of pasture for spring. On wet drumlin soils, the experimental sheep farming system proved to be the only one to achieve maximum utilisation of grass, and still have a long grazing'season with a short winter rest period. With dairying or beef production, there is a minimum of five months winter, and often much more. There is often considerable residual grass left over at the end of the grazing season, but by the following spring when grazing recommences, there is no extra grass available despite the five months period of rest. Thus, during winter, any growth that has taken place has been counteracted by decay of the existing herbage.

On a pilot scale, store lambs have been successfully grazed at a very low stocking rate over the winter on cow pastures at Ballinamore. Such lambs were sold fat (having had some supplemental meal feeding) on a favourable market in the early spring, having utilised this winter growth. There was still time for adequate recovery of the pastures before the cows commenced grazing later in the year. This is another example of where a "mixed" farming system can make more efficient use of the grass.

Pig **Production**

As pointed out by Scully (30) for farms with limited land resources increasing incomes depend mainly on the development of pig production. Yet 82.2% of farms in Leiirim do not produce pigs. In addition, the proportion engaged in pig production decreases with decreasing farm size, e.g. 36.2% of farms over 50 acres produce pigs whereas only 18.6% of farms of less than 30 acres do so.

Where pig production is practiced the scale of the enterprise is usually very small. Almost three quarters of breeding farms have two sows or less and 50% of fattening farms have less than 10 pigs at one time. The total number of pig fattening farms in the county in 1970 was only 44. In 1970 only 10% of pig breeding houses and 18.2% of fattening houses were classified as good (30).

Conclusion on Systems for Wet Drum/in Soils

1) *The use of nitrogen to achieve high intensity farming is not justified, as the combination of high stocking rate and low bearing capacity, following fertilising, is liable to cause considerable nrr)hleni*
2) *Intensive farming at stocking rates greater than 1 ½ acres per livestock unit have to rely on a two-cut system of silage-making, to provide enough winter feed. In unfavourable seasons, it can be difficult to harvest the second cut of silage. Therefore, high intensity farming cannot be guaranteed because of this.*
3) *To achieve a high efficiency of grassland utilisation, a farming system with some built-in flexibility is desirable.*
4) *The efficiency of dairying can be improved by running it in conjunction with a calf-rearing enterprise, or overwintering store lambs.*
5) *There is a good performance from summer grazing beef cattle, and a poor performance from autumn grazing. Overwintering on a large scale is not desirable, due to the difficulties of making enough good quality silage.*
6) *A pilot trial on sheep production is promising, and it is achieving a high efficiency of grass utilisation.*
7) *Pig production does not significantly contribute to farm incomes at present.*

Hill and Mountain Farming.*

Farming of hill and mountain land is carried on on the lower slopes of Slieve Anierin and on the hill and mountain land of North Co. Leitrim. The chief problems are poor soils, steep gradients and inaccesibility. Hill and mountain land in Co. Leitrim can be classified into three categories on the basis of suitability for hill land farming (Fig. 32).

(i) Dry hill and mountain land associated with the Carboniferous limestones of North-West Leitrim. This includes the hill and mountain land adjoining the Glencar. Glenade and Lough Melvin Valleys with the exception of Benbo mountain. Soils are mainly Aughty series with Ballinamore and Drumkeeran series in the valleys.

(ii) Predominantly dry hill-land on the steep slopes of south-west and west Slieve Anierin facing Lough Allen. Soils are Drumkeeran and Aughty series,

(iii) Wet hill and mountain land associated with Carboniferous shales. This includes Arigna. Slieve Anierin. the Lacagh Hills and Thur mountain. Also

•Contributed b> M. OToole. An r-orasTalunlais. Maam

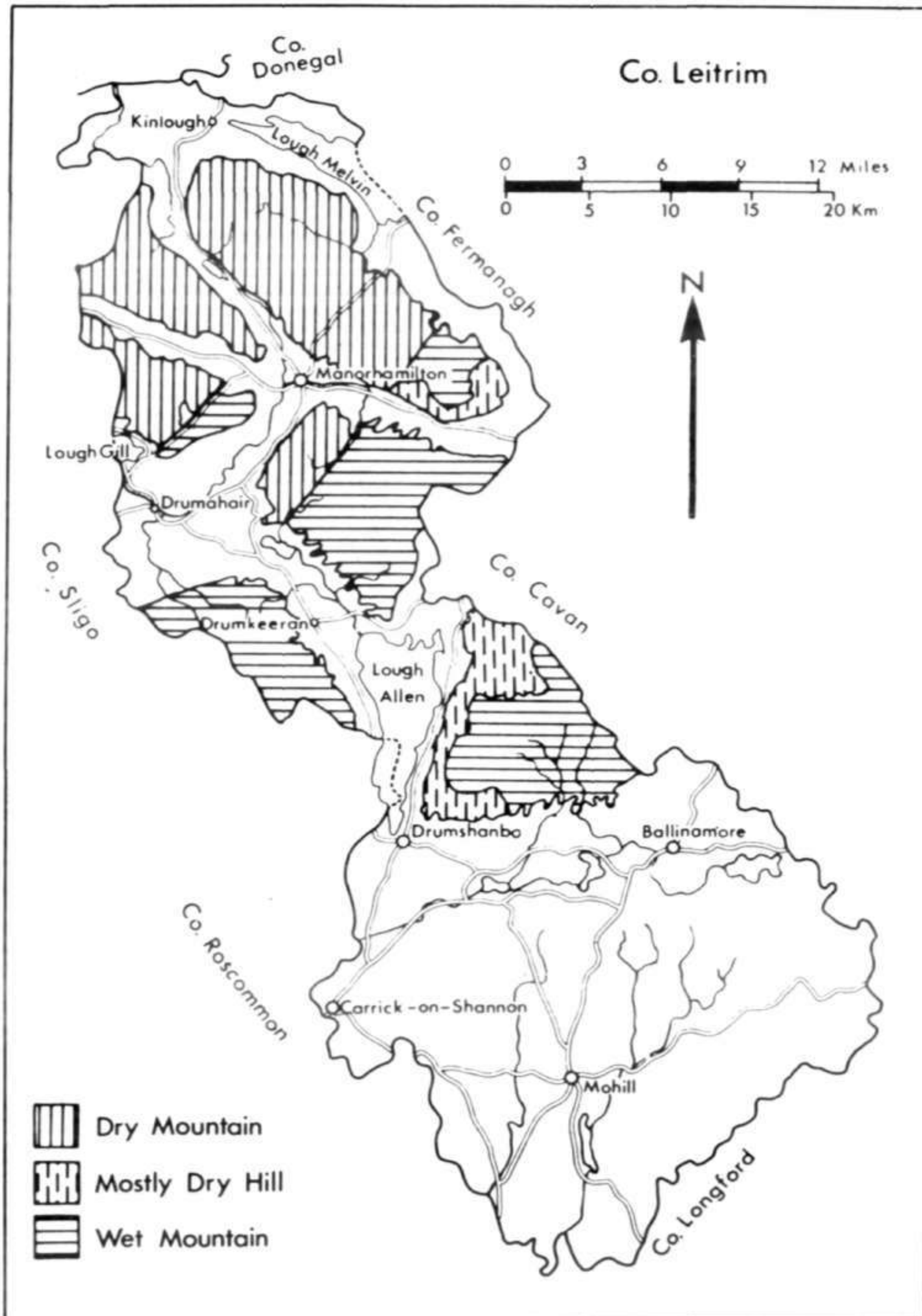


Fig. 32: Suitability of hill and mountain land for farming in Leitrim.

included in this category is Benbo mountain where bad drainage and wet peaty soils are associated with iron pan formation on micaschist debris.

The classification of wetness outlined has implications for future as well as present land use. If wet hills are fertilised they tend to become dominated by rushes. Rush control on the inaccessible areas could only be achieved by hand or aerial spraying and on the machinable land by tractor sprayer. Hand and aerial spraying would be expensive on large tracts. Deep wet peats growing sedges, mosses and heathers would not yield an economic response to aerial fertilising. There would also be a high risk of severe fluke infestation in sheep and cattle after fertilisation of wet hill land. In the framework of average agricultural prosperity big investments in hill farming on wet slow draining hill and mountain soils cannot be recommended.

The density of mountain sheep follows closely on the quality of the hill and mountain (Table 56). Dry grassy hills carry most of the sheep while wet hills carry few sheep. At the Tullybawn inspection centre which covers virtually all the wet gently sloping southern slope of Slieve Anierin only 342 lambs and 167 hogget ewes were presented for inspection (1973). Dry grassy hills have the most potential for the improvement of mountain sheep farming.

TABLE 56 Sheep presented forsubsidv at selected centres (1973)

Mountain	Quality	Lambs	Hogget ewes
I ruskmorc-l.eean*	Dry	5520	2356
Leean	Dry	6184	3050
Anierin	Dry	3675	1763
Anierin**	Wet	681	351
Arigna	Wet	543	379
Lackagh	Wet	733	280

Source Ollicials ot (he Dept of Agriculture Hill Sheep Suhsid> Scheme

•Approximate Injure
••Includes figures lor centre bounding wet and dry mountain

TABLE 57—Sheep presented for subsidy in Co. Leitrim 1968-1974.

Year	lambs	Hogget owes
1968	14.440	
1969	18.260	6.892
1970	20.301	8.667
1971	20.729	10,170
1972	22.215	10.274
1973	24.223	10.747

Present position of hill sheep.

Hill farming in Co. Leitrim follows the same general pattern as other western hill areas. Sheep are confined mainly to rough hill grazing and allowed only limited use of improved lowland with the reverse holding for cattle. Cattle farming on the hills is not practiced but on some farms cattle have access to rough grazing particularly during the summer months.

Since the introduction of the Mountain Lamb and Hogget Ewe Subsidy Schemes sheep numbers have increased dramatically with a 33fV increase in lamb numbers from 1969 to 1973 (Table 57). All farmers may not have presented their lambs in 1968. the first year of the scheme. Assuming a weaned lambing percentage of 70 there are approximately 35.000 breeding ewes on Co. Leitrim hills.

The ewes are practically all Cheviot and Scottish Blackface types or crosses between these. They are usually crossed with Cheviot rams. There is some movement of Scottish Blackface ewes into the county from Donegal. The lambs are sold as stores.

TABLE 58—Sheep flock size in Co. Leitrim in 1968 (from Mountain Lamb Subsidy Scheme)

Numbersof lambs presented for subsidy	1-25	26-50	51-75	76-100	100+
Number of farmers in each si/e group	*328*	*95*	*41.*	12	26.

Sheep flock size in Co. Leitrim is small. The data presented in Table 58 show that in 1968. 65% of farmers presented less than 25 lambs for subsidy with only 5% presenting more than 100 lambs. As already stated, numbers have increased dramatically since 1968 but it could still be assumed that two-thirds of all farmers keeping sheep have flocks of less than 50 ewes.

There are approximately 36,000 ha (90,000 ac) of land above the 137 m (500 ft) contour in Co. Leitrim and sheep are confined mainly to this. This gives an overall stocking rate of one breeding ewe plus followers per hectare. Hill stocking rates vary enormously in situations such as this where there are distinct geological and corresponding soil and vegetational differences. The limestone hills west of a line running roughly from Kiltyclogher to Killarga comprise half of the total land above 137 m and 759c of the hill lambs are produced there. This would indicate a stocking rate of 1.5 ewes per ha on the limestone hills and 0.5 ewes per hectare on the remainder. The stocking question is complicated further by substantial areas of hill land being devoted to forestry.

Hill land use limitations and proposals for development

There are many limitations to hill land use and development. The most important of these are problems associated with drainage, fertility status, accessibility, fencing, land ownership and ability of the farming population. In afforestation programmes, care has to be taken not to isolate good sheep hills by planting the lowlands. Afforestation and hill sheep farming can be complementary since generally the two activities need not be competitive.

Drainage

This has a two-fold effect on stocking rate. Wet hills carry fewer animals and have a very limited potential for improvement. The drier limestone hills support the majority of sheep and these have definite possibilities for increased production.

Surface drains strategically placed on the lower slopes would collect seepage and surface waters and help to dry these hills further. More intensive drainage would be justified on adjoining lowland only to facilitate production of winter feed and better sheep management.

Fertility status and accessibility

Prolonged leaching, accumulation of organic matter under conditions of poor drainage and mineral extraction by grazing sheep all contribute to the low fertility status of hill soils. Fertilising should be confined to areas where the greatest response is anticipated i.e. on dry grassy slopes and on adjoining lowland. Improvement of wetter areas would be very limited and might accentuate parasite problems.

Hill soils are usually acid even when derived from limestone parent material and severely deficient in phosphorus. Substantial increases in production would arise from lime and phosphorus application. Quantities and type to apply are largely determined by accessibility. The lowland on the hill farm should be limed and fertilised in the usual manner to give winter feed and grazing at critical periods in sheep management e.g. lambing, post-weaning, lamb fattening and mating. Using "Land-drive" machinery such development can be extended on many farms as far as 18° slopes. Over 18°, land reclamation is not feasible and aerial fertilising is the only alternative. This would exclude ground limestone and necessitate the use of more concentrated forms of fertiliser. Relatively light dressings of basic slag or mineral phosphate can *he* economically applied from the air. It is proposed that dry mountains be aerially fertilised by the Co. Council or the Department of Agriculture and Fisheries; such a proposal can be justified by an argument similar to that used for arterial drainage.

Fencing and sheep management

The first and very essential requirement in sheep management is that of fencing off and developing a section of good grassland - at least one acre for each 10 ewes in the flock. This would have several uses - providing spring grass at lambing time, grass for conservation in summer, and autumn grass for weaned and fattening lambs and flushing of ewes at mating. A fenced section of hill adjacent to handling pens is also needed.

The labour requirements of sheep farming under traditional systems of management are far too high. Because of inadequate fencing and handling facilities, particularly at lambing, walking the hill becomes a full time occupation for one man with a small flock of less than 50 ewes. If properly organised one man should handle at least 500 ewes. Perimeter fencing of the holding or co-operative fencing of commonage would also save valuable time.

A large proportion of hill land is still farmed as common grazing. In this situation it is usual to find a variety of people involved, many of whom have no interest in development. Progressive farmers interested in developing their share are not in a position to do so. Improvement will take place only when such land is either sub-divided or re-allocated to farmers interested in co-operative farming of hill land. The latter situation would be the most desirable as in many cases topography and position in relation to the holdings would only allow subdivision at very high fencing costs.

Finally the hill sheep industry needs young active farmers who at present are in the minority among hill sheep and hill land owners. Re-allocation of land is therefore inevitable if the industry is to survive and develop.

CHAPTER VI

ANIMAL HEALTH PROBLEMS

Diseases, Parasitism, Metabolic Disorders

*D. B. R. Poole**

The main purpose of a section on animal health in a survey report is to attempt to anticipate on the basis of present knowledge, major disease or nutritional problems which would be likely to occur in any programme of livestock development or intensification. The factors therefore which have to be taken into account, in addition to the knowledge of existing animal health problems in the area, are the soil characteristics, both chemical and physical, climate and the type of production enterprise recommended.

As pointed out earlier, Co. Leitrim is almost exclusively a pasture area, involving a considerable cattle enterprise and dairying and to a lesser extent a sheep population. Many of the dairy farms are grouped in the area north-east of Carrick-on-Shannon; the sheep are predominantly on the mountain farms in the northern part of thecounn.

The present knowledge of animal disease incidence in the county is based mainly on the experience and findings of the Regional Veterinary Laboratory at Sligo (which services the area), the Divisional Veterinary Office in Sligo, the Field Investigations Department of An Foras Taluntais and other individual veterinary surgeons with specific interests in the area.

Animal diseases

Cattle

In cattle the predominating disease syndromes are those associated with parasitism and malnutrition. This is particularly the case during the winter months, when the use of poor fodder with a high fibre content leads to various digestive and nutritional problems. These findings concur with those of Drennan (see Chapter IV) who pointed out an overall shortfall of winter feed in excess of 22% of requirement. Although specific nutritional disorders are not frequently reported, there have been a number of cases of ill-health and ill-thrift in cattle, associated with abnormally high levels of molybdenum in the herbage. In one such case, a full investigation confirmed copper deficiency and a response to copper therapy was recorded. It would appear that the incidence of poisoning by lead, basic slag and arsenic, is rather high in the county, as are cases of plant poisoning, e.g. by bracken, ragworth or malefern. This incidence could be in some degree, a reflection of malnutrition.

On some of the heavy gley soils, foot abnormalities (abscesses, foul in the foot, etc.) occur, in what would appear to be an abnormally high incidence.

•**Field Investigations Department. An** Koras laluntais. Dunsinea. Castlcknock. Co Dublin

Sheep

While the pattern in sheep is very similar to that in cattle, the low level of animal performance in the hill or mountain areas is an alleviating factor. Nonetheless, "twin-lamb disease" and other metabolic disorders of pregnancy and early lactation, are known to occur and poor birth weights in lambs (resulting from maternal malnutrition) are prevalent and must affect subsequent performance. Very little supplementary feeding is provided to hill or mountain flocks.

A survey of neo-natal losses, undertaken by the Regional Veterinary Laboratory, showed that the main causes of mortality were exposure and failure to get milk during the first few hours of the lamb's life. In many cases this occurred in twins, where the weaker lamb was abandoned. In other cases the ewe had no milk, or the weak lamb was killed by predatory birds. Other conditions which were identified were: miliary abscesses, traumatic rupture of the liver and an unidentified haemorrhagic enteritis. The incidence of clostridial diseases such as pulpy kidney is low, despite the fact that many owners did not use vaccines or antisera.

In some areas of the county, louping-ill can be a problem, the course of the disease varying from the usual nervous symptoms to cases of sudden death.

Pigs

A number of conditions occur with some regularity in pigs. These include E. coli gastro-enteritis in baby pigs, oedema disease (mainly at or near weaning), swine dysentry at 10-12 weeks of age. Mulberry heart disease and an haemorrhagic syndrome (both occurring mainly between 12 and 16 weeks of age).

Much of the material received at the Regional Laboratory comes from home-built piggeries with from two to five sows. In general, inadequate hygiene, faulty housing and poor husbandry are involved in many of the disease outbreaks. An improvement in these conditions, with increased veterinary consultation for treatment, should reduce losses considerably.

Poultry (mainly reared on a free-range system)

The diseases encountered are.' avian tuberculosis, parasitism, coccidiosis and blackhead (in turkeys).

State Eradication Schemes

Bovine Tuberculosis

Full-scale eradication began in the county in 1958, and the area was declared attested in February 1961.

There are approximately 6,560 herds in the county; in 1973 there were 26 restricted herds and the incidence of tuberculosis was 0.07%. The county is on a 50% check testing system.

Brucellosis

Full-scale eradication began in 1966 and Co. Leitrim, together with several other neighbouring counties, was declared brucellosis-free in 1970. As a result of this, Sligo port was approved for the export of certified brucellosis-free cattle in 1971, approximately 34,000 cattle being shipped (mostly store heifers). This status also initiated the export of pedigree Hereford cattle from Leitrim to Sweden and Denmark.

The total number of eligible herds in the county amounted to 6,164. There are 54 restricted herds and the disease incidence is 0.51^ Infection is mainly confined to the southern part of the county.

Warble-fly

A total of 114.885 cattle were dressed during the 1973-74 campaign.

Sheep scab

No positive identification of sheep scab from Co. Leitrim was recorded by the District Divisional Qffice during 1973.

Parasitism

Parasitic gastro-enteritis and hoose, affecting both cattle and sheep, occur throughout the county. It is probable that due to the low stocking rates on most farms these conditions may not be as severe as one would anticipate, although it can be assumed that the prevalence is similar to that in other counties. However, in view of the malnutrition which is often present, these diseases pose a constant threat to animal health and performance.

Liver fluke

Liver fluke disease is an important condition, not only at its present level of incidence, but also as a disease which could become much more serious under conditions of pasture or animal intensification. At present up to threequarters of the livers of animals going to slaughter from the area ranged from slightly to heavily infected.

Faecal egg counts from the Ballinamore Research Station[1] showed that all the animals had acquired an infection, which proved difficult to eliminate completely despite therapy with proprietary drugs. Calves also acquired infection with serious liver damage in some cases.

The impermeable nature and weak structure of most of the soils in Leitrim result in impeded drainage and liability to poaching by animals. This creates a favourable snail habitat, often throughout an entire field. General farm drainage can be used to dry out bad areas of the farm. Some patches *ai'* very wet land may have to be fenced off during danger periods.

However, the limited efficiency of normal drainage techniques in reducing surface water on the most impeded soils has suggested the need for research on molluscicides as a fluke control measure, coupled with the use of light animals in an effort to reduce damage by poaching.

Preliminary results of molluscicide trials using spring applications show that they can reduce the damage from liver fluke *(Fasciola hepatica)* by approximately 70%. They still need to stand the challenge of some really wet years. Studies elsewhere show that use of molluscicides need to be supplemented with worm dosing. Adequate control, achieved by these methods, does not of course mean eradication and continued efforts will be required to avoid serious fascioliasis. In addition, other

'The mulls on liver nuke research are ihose reported by Dr. M.J Hope-Cawdery. An Foras laluniais. Ballinamore.

molluscicide application programmes might be tried, for instance an application in mid-Jiily has been found of value elsewhere.

The grazing of sheep at Ballinamore has reduced poaching. Sheep pastures are in better condition than those grazed by cattle. This improvement is shown both by increased dry matter production and also by increased stock-carrying capacitv.

Wintering off pasture is desirable and the use of covered sheep kennels or slatted units enables the land to be kept free of stock during the winter, thus avoiding poaching and encouraging spring pasture growth.

However, despite these research findings, the problems of liver fluke disease remains as a serious hazard in Co. Leitrim. The implementation of farm plans based on intensive animal husbandry must not reduce the opportunities for the planned resting of wet areas during danger periods.

Metabolic disorders

The occurrence of metabolic disorders in grazing animals arising from deficiencies or imblances of trace elements is referred to in detail in Appendix I. The results of trace element analyses are also given (Table 59) together with further explanation and interpretation. The known incidence of clinical disorders does not appear to be high, but experience from elsewhere suggests that intensification of animal production tends to precipitate such problems, and also that many farmers fail to observe, or recognise such conditions as a cause of ill-thrift in their animals.

Cobalt

Deficiency of cobalt can affect both cattle and sheep, although sheep appear to be considerably more sensitive, being frequently affected on farms where cattle appear to be normal. Cobalt deficiency occurs on soils where cobalt status is low, and is further exacerbated by drainage and by lime application.

At present, the major sheep flocks in Leitrim are in the hill areas, and appear to be predominantly grazing on peat soils. Heather grazing, even on a cobalt deficient peat, does not usually result in severe cobalt deficiency, but efforts either to upgrade animal performance or to reclaim and reseed the pasture, would almost certainly necessitate the provision of supplementary cobalt.

The mineral soils assessed as having above average stock potential (i.e. grazing capacity classes B and C) appear to have normal cobalt levels, although in the Mortarstown-Kinvarra Complex high levels of exchangeable manganese might interfere with cobalt uptake. The Ballyhaise-Corriga Complex has a marginal cobalt level. However, on all the mineral gley soils, which account for about 46% of the total area of the county, soil cobalt levels are suspect, and in the case of the Ballinamore Series and the Garvagh Series/which have a potential use for pasture farming (see Part I), cobalt levels are low (especially in the case of the Ballinamore Series). Upgraded stocking, more particularly the use of sheep, with lime applications and some drainage, could well result in widespread cobalt deficiency, unless suitable prophylactic measures are taken. Even in the case of cattle, particularly w ith calves, the possibility of clinical cobalt deficiency must be considered.

TABLE 59 — Trace element analyses of Leitrim soils.

Great Soil Group	ri Total area	Series	Co.	E.R Mn	Zn	Cu	Mo	B	9c Loss on Ign.
Brown Earths	0.14	Loughmurrin	7.4	77	10.0	11.0	0.14	1.3	20.6
			9.5	82	13.8	8.75	0.18	2.1	22.2
Grey Brown Podzolics	0.20	Clooncareen	5.6	135	21.6	15.8	0.47	1.6	15.8
Brown Podzolics	1.78	Corriga(<l%)	4.3	37	4.0	12.3	0.29	1.2	15.8
		Kilnageer(<l%)	7.0	48	7.7	13.8	0.36	1.4	15.6
		Wardhouse (<1%)	6.0	128	6.5	9.5	0.29	1.8	15.0
Podzols	0.45	Stonepark							
Gleys	46.82	Ballinamore(IO%)	0.8	22	15.0	6.0	0.07	1.0	11.2
			1.6	80	7.3	1.75	0.32	1.2	17.4
		Drumkeeran (I0%)	12.1	66	12.7	8.0	2.16	1.9	26.4
		Drumkeeran (peaty) (2%)	1.2	115				2.5	53.6
		Garvagh (17%)	3.3	33	51.2	32.5	0.43	31	55.2
			4.8	55	10.0	22.0	1.08	1.2	16.8
		Howardstown(2%)	3.0	120	23.0	13.0	0.40	1.9	12.8
			6.0	120	9.7	11.0	0.29	1.5	23.8
		K.iltyclogher(2%)	2.1	72	16.8	6.75	0.45	1.9	27.4
		Rinnagowna (4%)	1.6	44	10.8	17.75	0.11	0.7	15.0
Rendzinas	0.90	Burren							
l.ithosols	0.45	Crumpaun	4.8	98	12.5	12.3	0.65	1.7	25.2
			3.8	36	12.5	11.0	0.25	1.3	16.0
Complexes	7.31	Ballyhaise-Corriga(3%)	3.3	80	15.0	11.0	0.22	4.0	14.4
		Mortarstown-Kinvara(4%)	7.9	300	21.6	7.5	1.29	1.2	21.4
			5.6	150	13.0	12.3	0.40	2.1	22.4
			4.8	212	9.7	8.0	0.85	1.2	14.6
Association		Ardrum(IO%)	4.8	9.8	9.25	18.5	0.51	1.5	19.2

Copper- Molybdenum

Occasional cases of suspected molybdenum-induced hypocuprosis have been observed in cattle, especially in the southern part of the county. Serum caeruloplasmin estimations, undertaken on a number of farms as an indicator of the copper status, showed some depletion of copper reserves in those herds.

Soil sample analyses undertaken as part of a survey by Mr. J. C. Brogan, Johnstown Castle, have shown high molybdenum levels.

Table 59 shows high levels of available soil molybdenum for the gley soils of the Drumkeeran, Garvagh and Kiltyclogher Series. Moderately high values were also present in the Mortarstown-Kinvarra Complex and in the Crumpaun Series (l.ithosol). Of these, only the Mortarstown-Kinvarra Complex has a useful stock-carrying capacity, but on all of them the possibility of elevated pasture molybdenum levels must be anticipated. High pasture molybdenum uptake is usually associated with impeded drainage and with lime application, as well as with clover-rich swards. Since all these factors will be present in these areas in any intensive pasture system for calves, the likelihood of induced hypocuprosis must be considerable.

Summary

There are three important points, from the animal health point of view, in assessing future livestock developments in Co. Leitrim. The first, and possibly the most difficult, is the problem of fascioliasis or liver fluke disease, which is inseparably connected with the gley soils of the drumlin area. While continuing research may offer various prophylactic and therapeutic possibilities, this is a problem which will remain for the forseeable future.

The other two problems are cobalt deficiency and molybdenum-induced copper deficiency for which adequate prophylactic means are available.

Adequate animal management and feeding, the provision of winter housing, and good summer pasture management should alleviate most of the other animal health problems associated with the area.

CHAPTER VII

ANGLING RESOURCES

*S. C. McMorrow**

Co. Leitrim is well endowed with lakes and rivers ranging from the River Shannon and Lough Allen to the more general small lake of 20-30 acres. For years these waters lay virtually derelict. Indeed, many of them looked unpromising and uninviting, being surrounded with weed growth and obstructions which certainly did not offer a welcome to the angler or boating enthusiast. Yet, over the past 10 or 15 years, many of these waters have attracted thousands of visitors from many countries and have become the cornerstone'of tourism in a county hitherto largely outside the realms of that valuable business.

The story of the successful promotion and development of coarse fishing waters for angling visitors at comparatively little cost in Co. Leitrim, is clear evidence of the progress that can be made by energetic local voluntary organisations combining with professional agencies in the highly profitable use of a natural asset. Indeed it can also be said that much of the overall progress that has been made in the county in recent years stems from the enthusiasm and ability of persons who found their first outlet for promotional activity in the small coarse fishing clubs set up in the late 1950's.

Estimated returns for 1970 show that about 4,000 angling visitors spent over £100,000 in the county. This valuable injection of capital was spread right through the local economy with particular benefit to the farming community who supplied much of the requirements of the 12 hotels, 30 guest-houses and about 100 farm and private houses catering for visitors. The employment of local staff required for these establishments was a further bonus to the local economy as well as employment on building work in extending accommodation. Another valuable outcome of this angling business has been the creation of, and the impetus given to the demand for, other water-based sports. Carrick-on-Shannon is a good example of the development of pleasure boat and cruiser-based holidays over an extended season.

Angling waters — Development and Promotion

The main fishing available in Co. Leitrim is for the well-known coarse fish species of pike, perch, rudd. bream and tench. Game fishing for salmon and trout is largely confined to some waters in North Leitrim, e.g. Lough Melvin, the Rivers Bonnet, Glenade, Glencar. Fig. 33 and Table 60 show the waters currently in use by anglers.Most of these waters are in the River Shannon catchment, the fishing rights of which are vested in the Electricty Supply Board who are co-operating fully in their use for angling purposes. Local farmers whose lands adjoin the waters have been most helpful in every way.

•General Manager. Inland Fisheries Trust.

Fig. 33: Angling waters etc., Co. Leitrim.

TABLE 60 — Angling Waters in County Leitrim

Centre	Waters	Area (Acres)	Productivity	Species	Bank Angling Space	Access (Nearest Road)
Ballinamorc	Garadice L.	1200	Moderate	Pk. Ph. Rd. Br.*	100's	50 yards
	St. John's 1	105	Moderate	Pk. Ph. Rd. Br.	100's	30 yards
	Fenagh L	75	Good	Pk. Ph. Br.	15	SO yards
	Donogher L.	25	Moderate	Pk. Ph.	5	150 yards
	Drumann} I .	70	Good	Pk. Ph.	15	100 yards
	Corduffl.	8	Very good	Pk Br	15	30 yards
	Camagh L.	50	Good	Pk. Ph. Rd.	20	30 yards
	Reane L.	25	Good	Pk. Ph. Rd.	5	30 yards
	Drumcoura L.	50	Moderate	Pk. Ph. Rd. Br.	5	30 yards
	Drumloun L.	4	Moderate	Ph. Rd.	5	30 yards
	Drumlonan L.	40	Very good	Pk. Ph. Rd.	10	40 yards
	Corgar 1	35	Very good	Pk. Ph Rd. Teh.	10	150 yards
	Bolganard L.	30	Very good	Pk. Ph. Rd.Tch.	10	50 yards
	Willowfield L.	3	Very good	Pk Ph. Rd.	5	200 yards
	Dromore L.	18	Good	Pk. Ph. Rd.	5	50 yards
Carrick-on-Shannon	R. Shannon		Good	Pk.Ph. Rd.	100's	50 yards
	Lough Tap	90	Moderate	Rd. Br. Teh.	20	VA mile
	Drumharlou L.	250	Very good	Pk. Ph. Rd. Br. Teh.	20	30 yards
	L Aduff	13	Good	Pk. Ph. Rd. Br. Hyb.	15	300 yards
	Head ford L.	5	Good	Pk. Ph. Rd. Br. Hyb.	5	70 yards
	L. Bran	50	Very good	Pk. Ph. Br.	25	!A mile
	Rinacurreen L.	7	Moderate	Pk. Ph. Br.	20	20 yards
	Albert Lock (Drumsna)	25	Good	Rd. Br. Teh.	45	100 yards
	Gortinty 1.	125	Good	Pk. Ph. Rd. Br. Teh.	30	50 yards
Carrigallen	Gangin L.	II	Moderate	Pk. Ph. Br.	8	V* mile
	Cloncorrick 1	35	Moderate	Pk. Ph. Br. Teh	15	V* mile
	Mosey L.	II	Moderate	Pk. Ph. Rd. Br. Teh.	7	V* mile
	Town L.	45	Moderate	Pk. Ph. Rd. Br. Teh.	30	20 yards
	Gulladoo(t'pr)l	100+	Moderate	Pk. Ph Rd. Br. Teh Hyb	100's	50 yards
	Beaghmore I	25	Moderate	Pk Ph Rd. Br Teh Hyb	10	J/: mile
	Cullies L.	15	Moderate	Pk. Ph. Rd. Br.	5	x/i mile
	Tully 1	40	Moderate	Pk. Ph. Rd. Br. Roach	20	30 yards
	1 Nabehy	45	Moderate	Pk. Ph. Br.	22	100 yards
	Doogary L.	50	Moderate	Pk Ph. Br.	25	200 yards
	Glasshouse L.	100	Moderate	Pk. Ph. Rd. Br. Hy. Rh.	35	100 yards
	Drumhart L.	8	Moderate	Pk. Ph. Rd. Br. Rch.	5	150 yards
	Rockfield L.	80	Moderate	Pk. Ph. Rd. Br. Rh. Hy	35	100 yards
	Calloughs L.	100	Moderate	Pike, Perch.	40	300 yards
Rooskey	R. Shannon		Good	Pk. Ph. Rd. Br.	10	50 yards
	Rinn R.		Good	Pk. Ph Rd. Br.	100's	100 yards

TABLE 60 — Angling Waters in County Leitrim

Centre	Waters	Area (Acres)	Productivity	Species	Bank Angling Space	Access (Nearest Road)
Mohill	1 Rinn	500	Good	Pk. Ph. Rd. Br. Hy	100's	100 yards
	Drumbad 1	90	Good	Pk. Ph Br Hy.	30	250 yards
	1 McHugh	100	Good	Pk Ph. Rd Br Hy Ich.	20	[1]: mile
	Creenagh L.	40	\ er\ (iood	Pk. Ph. Rd. Br. Ich.	15	100 yards
	Sallagh L	50	Ciood	Pk. Ph. Rd. Br	10	150 yards
	Errew 1	**100**	Good	Pk. Ph. Rd Br Hy	20	200 yards
	Clonbone) I	25	Good	Pk. Ph. Rd. Br. Tch.	15	20 yards
	Errill L.	60	Good	Pk. Ph. Rd. Br. Tch.	10	150 yards
	Keeldra 1 .	90	Good	Pk. Ph.	10	**150** yards
Drumshanbo	L Allen	8500	Good	Pk. Ph. Rd. Br. Hy	I00's	**100** yards
	R. Shannon					
	(Ballintra)		(iood	Pk. Ph. Rd. Trout	50	100 yards
	("arnckport L.	120	Moderate	Pk. Ph. Br. Hy Rd.	60	50 yards
	Lustia I.	7	Good	Pk Ph. Rd. Br. Hy.	10	V* mile
	Price's L.	10	Good	Pk. Ph. Br.	10	**100** yards
	1 . Scur	200	Moderate	Pk. Ph. Rd. Br. Hy	35	**150** yards
	Keshcarrigan I .	70	Good	Pk Ph. Rd. Br. Hy.	20	150 yards
	Acres 1	15	Good	Pk. Ph. Rd. Br. Hy	15	100 yards
	Black rock Pond	3	Moderate	Perch. Tench.	10	150 yards
	Drumgorman L	30	Moderate	Pk. Rd. Br. Tch.	20	150 yards
	Roscunnish L.	22	Moderate	Pk. Ph. Rd. Br. Hy	10	'/: mile
	Drumkeelan L.	18	Moderate	Pk. Ph. Rd. Br. Hy.	5	V* mile
Dromahairc	Belhavel L.	300	Moderate	Pk. Ph. Tch. Rd. Br.	80	'/i mile
	Corrigeencor L.	130	Moderate	Pk. Ph. Tch.	50	50 yards
Kiltyclogher	I.ough McNean	2600	Good	Pk. Ph. Rd. Br.	I00's	100 yards
	Toom R.	**1**	Good	Pk. Ph. Rd. Trout	25	150 yards
Manorhamilton	I.ough Melvin	5300	Good	Salmon and Trout	lOO's	**100** yards
	Glenade L.	350	Moderate	Pike, Perch, Trout	20	150 yards
	Glencar R.		Moderate	Salmon, Trout	35	50 yards
	R. Bonnett		Moderate	Salmon, Trout	45	**100** yards

• - Pk. = pike: ph. = perch: rd. = nidd: br. = bream: ich. = tench; hy. = rudd x bream hybrid*

The Inland Fisheries Trust is carrying out a continuing long-term programme of surveys of new waters to assess their capacity for development and usage. This is followed up by essential development work aimed at making it possible for anglers to get to and fish the water from the nearest roadway. This involves construction of footsticks and stiles over drains and fences encountered en route to the fishery, as well as removal of obstructions on the lake shore or river bank and erection, where necessary, of fishing stands or platforms from which the angler may fish in comfort. The Trust also compiles and supplies maps with information required by anglers on the fishing available at each centre.

An Bord Failte and the Regional Tourism Organisation help to promote and publicise the angling available and give assistance in many ways to the local voluntary bodies and interests who are directly engaged in selling the fishing to visitors. These bodies also combine with the local authority in providing improved access roads, car-parks, signposting and such essential facilities. The high standard of the fishing, accommodation and facilities being provided is evidenced by the fact that many visitors return to the same centre repeatedly with their families and friends. This has been the key to success in angling tourism where the satisfied angler is the best advertisement for an area. The future is very promising for angling in the county. More waters are being opened up for visitors and more accommodation and facilities are becoming available. When tourist business returns to normal it should only be a few years until Leitrim's angling waters are earning upwards of *V/i* million per annum.

With a few exceptions, the threat from pollution is not serious at present but this must not give rise to complacency. The local authority is alive to the need for protecting fisheries from pollution. For instance, it is understood that the County Engineer is engaged in an appraisal of the adequacy of sewage disposal plant in each town and also that the Planning Authority is extremely careful in the siting of new developments which might prove hazardous to the fishing interest. The agricultural authority is active on preventive and remedial action in respect of agricultural developments such as silage and intensive pig production.

An unusual threat to the long-term fishery interest arises from the demands from certain tourist interests who are pressing for the reopening of the Ballyconnell Ballinamore Canal, to provide a direct link for boats from the Shannon to the Erne System. It is regrettable that this laudable project could prove very damaging to the fishery interests because it would allow roach which are now infesting the Erne System to invade the Shannon System (see Fig. 34). In time, this could mean that these highly prolific fish would seriously injure the present excellent game and coarse fishing in the entire Shannon System. It is to be hoped that this matter will be resolved satisfactorily with that co-operation at all levels which has marked the growth of angling tourism in the county over the past 15 years.

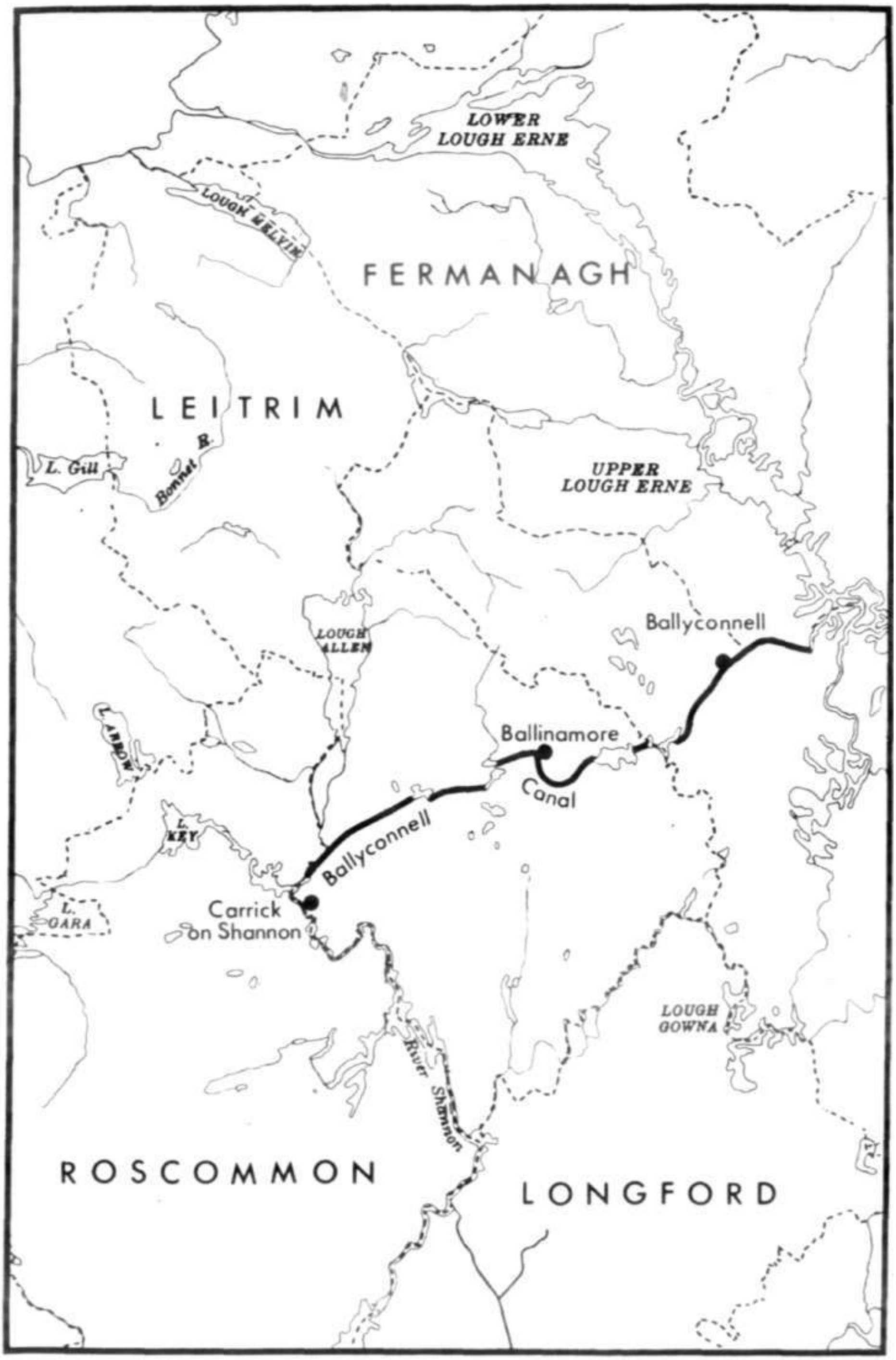


Fig. 34: Reopening of the Ballyconnell I Ballinamore Canal would link the Shannon and the Erne.

APPENDIX I

TRACE ELEMENTS IN LEITRIM SOILS

*G. A. Fleming**

Some trace elements are essential for plants and animals. Deficiency or toxicity levels in soils can be detrimental to livestock. The geology, drainage conditions and soils of Co. Leitrim indicate that trace element problems might arise especially if agricultural production were intensified. It is for these reasons that samples from the principal soils throughout the county were analysed for trace element content. The results and their implications for agriculture are discussed in this section.

Surface samples from several soil series within the county were analysed for cobalt, manganese, zinc, copper, molybdenum and boron. As 46% of the soils of the county are poorly drained gleys, the main emphasis in these analyses was placed on these soils. The values shown (Table 59) are not totals, but extractable values indicating availability. pH and loss on ignition figures are also given. The former indicates the degree of acidity of the soil while the latter gives a measure of organic matter. The higher the loss on ignition figure the higher the organic matter content.

Gleys

Thirteen soils from six different series were analysed. All soils from the Ballinamore series showed extremely low cobalt levels and cobalt deficiency especially after liming would appear to be unavoidable unless cobalt is applied to the land or given to grazing stock. Soils should receive 2 lb cobalt sulphate per acre on selected areas to which stock will have ready access. Full details of the different methods of supplying cobalt to stock are given in an An Foras Taluntais Research Bulletin (35): Other soils showing low levels of cobalt, occured in Aghoo East (Garvagh series) in Drumod Beg (Howardstown Series) and in Brockagh Lower (Kiltyclogher series). Two soils showed high levels of available molybdenum, the Lisgavneen soil (Drumkeeran series) and the Brockagh soil (Kiltyclogher series) while a third the Drumod Beg soil (Howardstown series) could well be borderline. The Lisgavneen soil in particular is extremely high in molybdenum and while no data are available for the two other soils of this series (Drumduffy and Tully) the possibility of high molybdenum here should not be ruled out. The Tully soil is quite organic and the parent material from which it is formed (Namurian shale) is known to be frequently rich in such elements as molybdenum and selenium(36). The peaty nature of this soil would also predispose it to copper and manganese deficiency, for instance, in cereals. The Beihy soil (Rinnagowna series) has a very low level of cobalt and a relatively low level of boron. The boron content is the lowest encountered in the soils examined and is quite possibly a reflection of the light texture of this soil (15% clay in the A horizon). Susceptible crops such as swedes should not be sown on this soil unless boronated fertiliser is used. Alternatively borax may be mixed in with the basal fertiliser in sufficient quantity to give an application rate of 35 to 40 lb per acre.

•Plant Nutrition and Biochemistry Department. An Foras Taluntais. Johnstown Castle. Wexford.

Lithosols

Two soils from the Crumpaun Series were analysed. Results were normal for most elements with the possible exception of cobalt. With liming, which would be recommended at the prevailing pH values, cobalt in herbage might drop below levels desirable from the point of view of grazing stock.

Brown Earths

Two soils from the Loughmuirran Series were analysed. Trace element levels appear adequate but again the pH levels are low and liming would normally be recommended. It is noticable that the cobalt levels here are higher than in the Crumpaun series. This is probably a reflection of the shaly parent material in the Loughmuirran soil as distinct from the limestone of the Crumpaun. Following liming, herbage cobalt levels should be checked to ensure that remedial measures can be taken if required.

Rendzina

One series (Burren) was analysed. Herbage cobalt and molybdenum levels should be watched if lime is applied. The molybdenum figures indicate that following liming, availability might increase sufficiently to give rise to trouble in stock. Liming would also tend to increase the clover content of the pasture resulting in possible undesirable molybdenum levels.

Grey Brown Podzolic

Within this group of soils, the Clooncarreen series was analysed. Similar remarks apply to this soil as to the previous one i.e. there is a possibility of cobalt deficient and molybdenum toxic herbage after liming.

Brown Podzolics

Soils from three series, (Corriga, Kilnageer and Wardhouse) were analysed. Here the bouldery phase of the Corriga series is the soil most likely to give rise to trace element problems if limed. The prevailing pH is quite low (4.7) and while the extractable cobalt is high, liming might depress herbage values below threshold levels. Such threshold values vary depending on the susceptibility of different animals but for lambs, a figure of not less than 0.1 ppm Co in the dry matter of herbage would appear to be necessary (37). The main problem likely to be encountered when improving this soil could well arise from molybdenum. The extractable value of 0.82 when viewed against the low pH and relatively high organic matter content (30% loss on ignition) must be viewed with caution. The other series appear reasonably well supplied with trace elements but cobalt might become borderline if the soils were limed.

Soil Complexes

Low cobalt levels were encountered in the Beihy and Gortermore soils (Ballyhaise series) and in the Drumduffyand Killanummerry soils (Mortarstown-Kinvara series). High molybdenum values occurred in phases and components of the Mortarstown-Kinvara series: the Castlerogy and Glebe soils were particularly high and as organic matter is also high, these soils must be regarded as potentially dangerous for stock particularly if lime is applied.

Summary

As only 4% or so of the soils of Co. Leitrim are suitable for tillage, emphasis must necessarily fall on those trace elements which are frequently of importance in good pasture management. Here, cobalt and molybdenum are involved, the former from the deficiency point of view, the latter from the toxicity aspect. When lime is applied, pasture levels of cobalt and molybdenum must be closely watched. The possibility of selenium toxicity in localised areas where the soil parent material is formed from Namurian shale (Kiltyclogher and Drumkeeran series) should not be ruled out.

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