Statistical and Social Inquiry Society of Ireland

Variability in Agricultural Statistics on Small and Medium-sized Farms in an Irish County

By R C. Geary

[*Read before the Society on November 2nd*, 1956]

PART I—THE DATA

Irish agricultural statistics, going back in an almost unbroken annual sequence for more than a hundred years, are amongst the country's most precious statistical possessions, and indications are that they will assume even enhanced value in future when they are integrated and collated with the results of the National Farm Survey

The traditional statistics have always been enumerated by the police and are tabulated in considerable detail as to area and type of statistic They are compiled from agricultural statistics books, usually one book to each D E D , of which there are about 3,000 in the rural areas of the country In the book is listed the name and address of each farmer in the district and opposite each name are entered the various agricultural statistics for the holding, acreages of the different crops, numbers of the different classes of livestock, numbers of different kinds of agricultural machinery, and a considerable number of supplementary particulars which, if of lesser importance, are asked only at intervals of several years In all, about 70 statistics for each farm are obtained each year. In the book, in turn, farms and parcels of land in each D E D are classified in broad size of farm groups. This arrangement means that, by simple aggregation of the figures in the book, there are available each year the totals of the various statistics in each D E D classified by size of holding These " size of holding " statistics are aggregated to larger areas (counties, provinces, the State) only at fairly long intervals of years—last in 1949 Even in the years in which particulars by farm size are required, it has not been necessary to have recourse to the punched card system of tabulation since the necessary data are preclassified in the books in a form convenient for tabulation by hand

This paper originated in an investigation started some years ago mainly with a view to appraising the advantages of using machine tabulation, i e. to find out what additional useful information could be obtained if the particulars for each holding were punched on cards. The experiment was confined to one of the smaller counties, so that the number of cards, which have to pass many times through the sorting and tabulating machines, should not be so unmanageably

large as to make the experiment a major task. The results are presented in this paper. In the county, in which agricultural standards generally are somewhat better than the national average (see Table 7), mixed farming is the prevailing type. The small area of the county and the relative homogeneity of type of husbandry are obviously advantageous from the viewpoint of finding significant relationships from a relatively small number of observations Also with a view to homogeneity, holdings of not more than one acre or more than 100 acres of agricultural land (area of crops and pasture) were excluded, so were holdings in more than one parcel of land Had time and resources been available, it would have been desirable to include holdings in two or more parcels, but on the other hand it might have been well to have eliminated holdings of not more than 10 acres and certainly holdings not exceeding 5 acres, for reasons which will be clear in the sequel. Holdings in more than one parcel should have been included because it is this feature of the compilation which, it is surmised, would lend itself to machine treatment I should explain that "parcelling" can arise, not only through separate parcels in the same neighbourhood (under single management), but also through holdings being divided by D E D boundaries Heretofore in Ireland parcels are brought together only in the assessment of *number* of holdings in the classification by size of holding Size classification in regard to other statistics is based, not on size of holding, but on size of parcel This is a disadvantage (if not a serious one) which will be rectified when the statistics are next compiled by holding size In the official statistics, the size classification has been based on total area of holding and not on the area of agricultural land (area under crops and pasture) The latter concept has been experimentally adopted for the present paper; furthermore the size analysis has been made in considerably greater detail than in the case of the official series. The analysis extends to about 2,000 holdings and relates to the year 1951

The Statistical Notion of Variability

Everyone is familiar with the concept of the mean but very few people except statisticians with any measure of variability or relationship This is singularly unfortunate in the Irish agricultural context, in which, as I shall show, the variability is very great in regard to particular agricultural entities and to output as a whole even on farms of the same size. I shall argue that to ignore variability is to leave out of account one of the most important elements in the Irish agricultural problem, i e. the problem of increasing agricultural output in the aggregate, which has heretofore proved so intractable, and of which we must be doubtful if we have yet found the solution

Relationship between Agricultural Statistics and Size of Holding

Table 1 shows the averages per holding on each size of holding in intervals of 5 acres of agricultural land up to 75 acres together with the averages for sizes 76–100 acres, in a single group because the numbers of farms in this group (see the second column) are small. The table is illustrated in Diagram 1 in which smooth curves of the second degree in farm size have been fitted to the data for farm sizes

1–75 acres, using orthogonal polynomials [1] It is obvious to the eye that the curves fit the observations in a satisfactory way The general characteristic of these curves is that (while the agricultural entities in most cases increase regularly with size of farm) they are slightly concave downwards, i e the respective averages do not increase proportionately with size of holding That this is the case with Other Cattle (i.e cattle other than milch cows and calves) will probably be found interesting and novel.

The formulae for the fitted curves in Diagram 1 are as follows :

Regression Formulae of Relationship between Agricultural Statistics per Farm and Size of Farm Farms 1—75 Acres

		Value of χ^2	
		Total (12 d f)	Excl term for farms 1-5 ac (11 d f)
Valuation	$=29\ 0747+3\ 485394A_1+0{\cdot}006188A_2$	n c	n c
Ploughed land and fruit	$=11\ 4220+1{\cdot}366893A_1-0\ 006685A_2$	43 63	20 27
Corn	$=\ 7\ 2787+0\ 930572A_1-0\ 004802A_2$	44 65	22 44
Root and green	$=\ 4\ 0986+0\ 433000A_1-0\ 001625A_2$	n c	n c
Potatoes	$=\ 1{\cdot}1833+0\ 073036A_1-0\ 002628A_2$	8 88	7 77
Other root and green	$=\ 2{\cdot}9153+0{\cdot}359964A_1+0{\cdot}001003A_2$	22 27	21 05
Cattle, total	$=15\ 2127+1{\cdot}753144A_1-0{\cdot}012811A_2$	n c	n c
Milch cows	$=\ 3\ 5247+0{\cdot}343286A_1-0\ 003257A_2$	34 27	10 74
Calves, under 1 year	$=\ 3\ 7027+0{\cdot}407536A_1-0{\cdot}004007A_2$	10 38	10 13
Other cattle	$=\ 7\ 9853+1\ 002322A_1-0\ 005547A_2$	7 76	7 29
Sheep	$=22\ 0187+2\ 407180A_1-0\ 033623A_2$	11 37	11 31
Pigs	$=\ 2\ 3787+0\ 194357A_1-0\ 005332A_2$	8 92	8 02
Poultry	$=76\ 77\ +5\ 137966A_1-0\ 115733A_2$	5 95	5 37
Persons on farms	$=\ 4{\cdot}2560+0\ 113929A_1+0\ 002665A_2$	n c	n c
Men working on farms	$=\ 1{\cdot}8240+0{\cdot}148500A_1-0{\cdot}002712A_2$	49 31	25 68
	Probability points of χ^2. 5%	21 03	19 68
	1%	26 22	24 73

n c =not calculated

To find the smoothed value for each farm size the following values for A_1 and A_2 are substituted in the formulae —

	Size of farm in acres (crops and pasture)														
	1–5	6–10	11–15	16–20	21–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60	61–65	66–70	71–75
A_1	−7	−6	−5	−4	−3	−2	−1	0	+1	+2	+3	+4	+5	+6	+7
A_2	+91	+52	+19	−8	−29	−44	−53	−56	−53	−44	−29	−8	+19	+52	+91

Diagram I

STATISTICS PER FARM ON FARMS OF DIFFERENT SIZES
SMOOTHED CURVES (1-75 ACRE FARM SIZES) & ACTUAL OBSERVATIONS

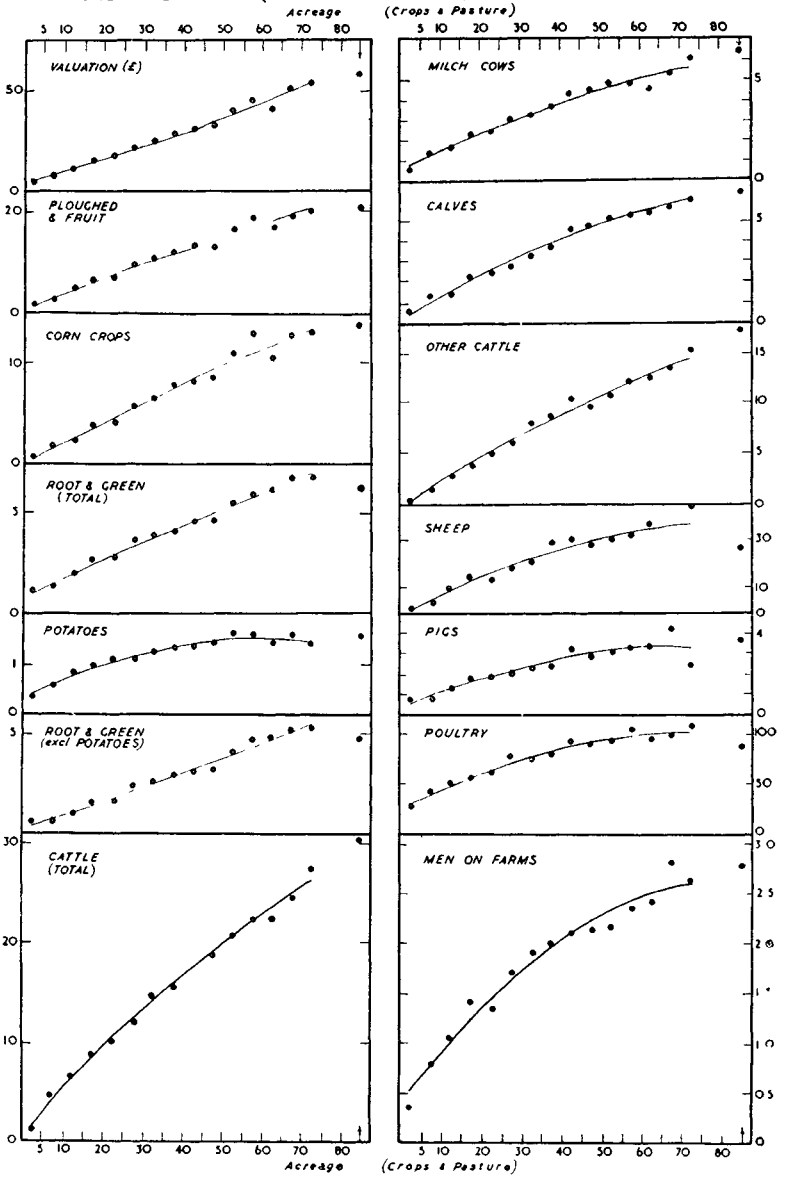

Diagram II

STATISTICS A PER 100 ACRES CROPS & PASTURE & B PER MAN ENGAGED ON FARMS 1-75 ACRES A —— B----- FARMS 76-100 ACRES A • B →

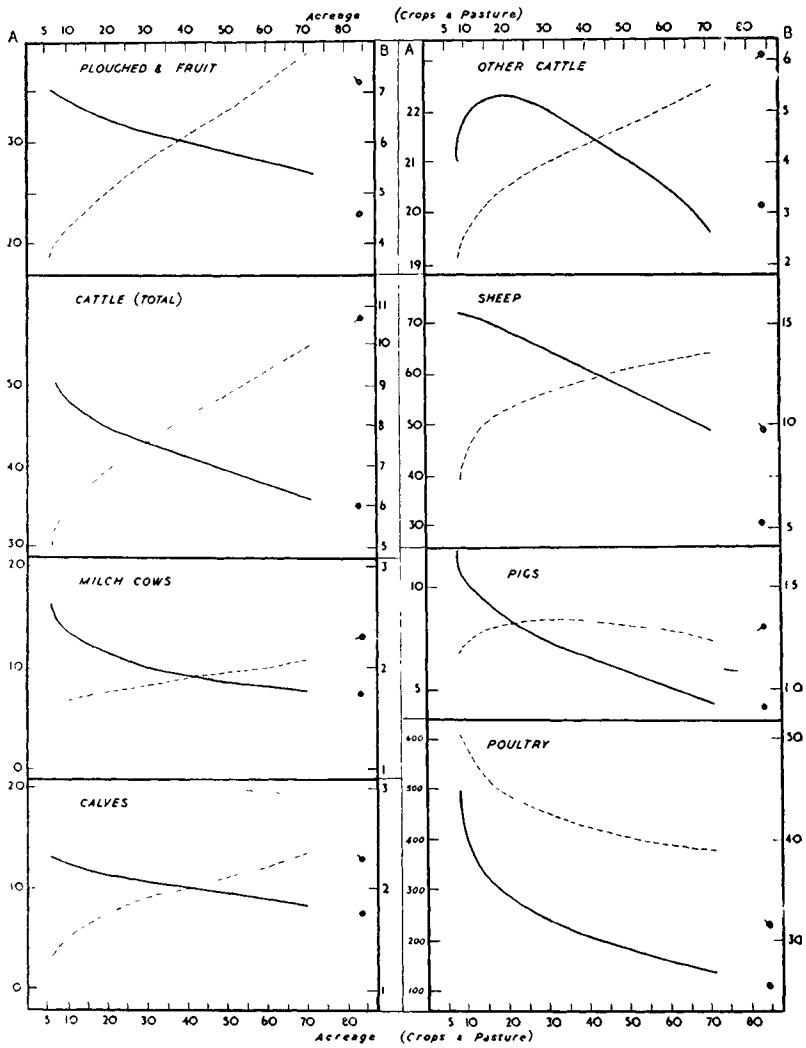

TABLE 1

Agricultural Statistics per Holding, classified by Size of Holding

Size of holding (acres, crops and pasture)	Number of holdings	Valuation (lands and buildings)	Area (acres)						Number of livestock							Number of persons	
			Crops and pasture	Ploughed and fruit	Corn crops	Root and green crops (total)	Potatoes	Other root and green crops	Cattle, total	Milch cows	Calves (under 1 year)	Other Cattle	Sheep	Pigs	Poultry	Total	Males working on farms
		£															
1–5	242	4 98	3 20	1 55	0 57	0 96	0 40	0 56	1 51	0 59	0 52	0 40	2 29	0 67	28 86	3 86	0 36
6–10	204	8 46	7 96	2 70	1 37	1 32	0 60	0 72	4 52	1 44	1 25	1 83	4 75	0 88	41 62	3 69	0 80
11–15	179	11 83	13 13	4 38	2 46	1 91	0 82	1 09	6 12	1 77	1 49	2 86	9 71	1 31	48 57	3 32	1 14
16–20	175	15 58	18 05	6 33	3 79	2 58	0 94	1 64	8 25	2 36	2 16	3 73	12 86	1 65	56 27	3 79	1 43
21–25	182	18 46	23 09	7 05	4 36	2 66	1 05	1 61	9 82	2 54	2 43	4 85	13 36	1 94	63 99	3 77	1 35
26–30	207	20 78	28 23	9 14	5 61	3 50	1 17	2 33	11 86	3 00	2 81	6 05	18 46	2 17	76 12	4 06	1 70
31–35	133	26 14	33 08	10 20	6 31	3 77	1 23	2 54	14 80	3 33	3 42	8 05	19 82	2 43	75 20	4 51	1 94
36–40	133	29 90	37 69	11 66	7 65	4 00	1 24	2 76	15 73	3 49	3 77	8 47	29 23	2 38	80 96	4 18	1 98
41–45	109	31 40	42 91	12 83	8 17	4 54	1 39	3 15	19 24	4 33	4 58	10 33	30 15	3 17	92 81	4 05	2 13
46–50	101	33 82	48 00	13 15	8 50	4 60	1 39	3 21	18 80	4 49	4 82	9 49	26 53	2 81	90 33	4 42	2 13
51–55	76	40 97	53 26	16 76	11 03	5 68	1 61	4 07	20 82	4 76	5 39	10 67	29 11	3 08	94 28	4 30	2 16
56–60	73	46 07	58 16	19 40	13 04	6 29	1 51	4 78	22 27	4 82	5 34	12 11	30 16	3 25	103 59	4 63	2 38
61–65	54	44 28	63 20	16 81	10 56	6 19	1 41	4 78	22 35	4 46	5 54	12 35	35 91	3 28	94 00	4 46	2 41
66–70	53	51 70	67 77	19 47	12 70	6 75	1 57	5 18	24 72	5 47	5 92	13 33	23 96	4 23	97 96	5 45	2 81
71–75	48	54 75	72 77	19 85	13 06	6 73	1 41	5 32	27 38	6 02	6 10	15 26	43 98	2 46	107 04	5 35	2 63
Total 1–75	1,969	22 25	28 28	8 74	5 46	3 25	1 04	2 21	11 76	2 85	2 89	6 02	17 26	1 99	66 82	4 05	1 53
76–100	86	58 38	84 99	20 13	13 95	6 12	1 49	4 63	30 07	6 50	6 41	17 16	26 58	3 66	88 33	4 71	2 79
Total 1–100	2,055	23 76	30 65	9 22	5 81	3 37	1 06	2 31	12 53	3 00	3 04	6 49	17 65	2 06	67 72	4 07	1 58

It will be seen from the formulae that in all cases except valuation, root and green crops other than potatoes and persons on farms the coefficient of A_2 is negative this is the mathematical expression of the concavity downwards with increasing farm size to which reference has already been made

The last points on each of the sub-diagrams of Diagram I represent the averages appropriate to farm sizes 76–100 in a single group graphed at average farm size for this group, namely 85 acres Even though this group was not taken into account in calculating the curves, generally the points seem to the eye to be in good accord with extrapolations of the curves. It will also be observed that as farm size increases the points tend to lie further away from the fitted curves This is, in general, a purely accidental phenomenon, due to the fewness of the observations for the larger farm sizes, as will appear from the next paragraph

It is not enough in statistics for a relationship to seem good to the eye The great statistician, Karl Pearson, has provided us with a rigorous objective test for deciding whether a curve adequately fits the observations, in simple terms to enable the researcher to decide whether the fitted curve represents the law of relationship This is the famous χ^2 test of goodness of fit In the present application its calculation involves the estimation of the variance (=standard deviation squared) for each entity in each farm size Machine tabulation with its high sorting and tabulator speeds is well adapted to the calculation of variances when, as in the present case, the entities are, in general, small whole numbers *

The values of χ^2 for most of the items are shown opposite the formulae in the foregoing series on two bases (i) including the contribution to the value of χ^2 of farms 1–5 acres and (ii) excluding this term. It may be taken that if a particular χ^2 is less than that appropriate to the 5 per cent probability point shown at the foot of the χ^2 columns then the fit is good, *sans phrases* It will be seen that 6 of the 11 calculated χ^2's satisfy this criterion even when the 1–5 acre class is included When this class is excluded the score becomes 7 and all the values except one are smaller than the 1 per cent χ^2 significance level. The great improvement in fit effected by omitting the 1–5 acre class indicates that for many entities this class does not conform to the general law of relationship for reasons which are obvious the great majority of these holdings are not operated as farms at all but are in the nature of gardens or afford merely spare-time employment for persons whose principal occupation is not that of "farmer" In general the second-degree curve fit is even better than the χ^2-test, as applied, indicates, principally for the technical reason that the orthogonal curve fitted was not that designed by the theory to minimise χ^2 The theoretical curve would, however, *appear* almost identical

It is truly remarkable that, as a fact by itself, the relationship

*Machine tabulation can equally well be used for the calculation of co-variances between each pair of entities also used in the present research, especially for the calculation of variance of EO (*see later*)

between agricultural entity per farm and farm size over such an extended range of sizes can be so simply represented as by a curve of the second degree It means that we can proceed with almost complete confidence to use the curves instead of the original observations for demonstrating the relationship between size of farm and the two efficiency factors for each entity, namely (i) per 100 acres and (ii) per male worker, omitting farms 1–5 acres. These are illustrated in relation to the principal items in Diagram II† (derived from Table 2).

TABLE 2

Statistics (A) per 100 Acres Crops and Pasture and (B) per Man engaged in Agriculture on Different Sizes of Farm Smoothed Data on Sizes 1-75 acres, Actual Data on Sizes 76-100 acres

	Farm size in acres crops and pasture									
	6–10	11–15	16–20	21–25	31–35	41–45	51–55	61–65	71–75	76–100
	Smoothed data									Actual data
Ploughed land and fruit										
A—per 100 acres	35 9	34 3	33 4	32 7	31 5	30 6	29 7	28 8	27 9	23 7
B—per man	3 63	4 33	4 80	5 16	5 72	6 21	6 69	7 21	7 79	7 21
Total cattle										
A	50 3	47 7	46 1	44 9	42 8	41 0	39 3	37 7	36 1	35 4
B	5 08	6 02	6 63	7 09	7 77	8 34	8 88	9 44	10 06	10 78
Milch cows										
A	16 2	13 4	12 1	11 3	10 2	9 4	8 8	8 2	7 7	7 7
B	1 63	1 69	1 74	1 78	1 84	1 91	1 98	2 06	2 15	2 33
Calves under 1 year										
A	13 1	12 2	11 7	11 3	10 6	10 1	9 5	9 0	8 5	7 5
B	1 32	1 54	1 68	1 78	1 93	2 04	2 15	2 25	2 37	2 30
Other cattle										
A	21 0	22 1	22 3	22 3	22 1	21 6	21 0	20 5	19 9	20 2
B	2 12	2 78	3 21	3 53	4 00	4 39	4 75	5 13	5 54	6 15
Sheep										
A	72 9	71 9	70 3	68 6	64 8	61 0	57 0	53 0	49 1	31 3
B	7 36	9 07	10 11	10 82	11 76	12 38	12 87	13 29	13 68	9 53
Pigs										
A	11 7	10 0	9 1	8 5	7 5	6 6	5 9	5 2	4 5	4 3
B	1 18	1 27	1 31	1 34	1 36	1 35	1 33	1 29	1 24	1 31
Poultry										
A	499	376	318	281	236	205	180	159	140	104
B	50 4	47 5	45 7	44 4	42 7	41 6	40 7	39 9	39 1	31 7

In the case of all the entities shown, density declines with increasing farm size By far the most important of this series of curves is that for Other Cattle after size about 20 acres, this typically " large farm product " decreases with farm size This phenomenon is commented on later Except for pigs and poultry the figures per man increase regularly with farm size

†Attention is directed to the fact that in several of the sub-diagrams the base is not zero, so that the curves exaggerate the effects illustrated

TABLE 3

Coefficients of Variation for Certain Agricultural Statistics on Certain Sizes of Farm Smoothed Data

	Size of holding (acres, crops and pasture)								
	6–10	11–15	16–20	21–25	31–35	41–45	51–55	61–65	71–75
Ploughed land and fruit	0 65	0 58	0 54	0 52	0 49	0 48	0 46	0 45	0 44
Corn crops	0 93	0 72	0 63	0 59	0 54	0 52	0 50	0 49	0 48
Potatoes	0 84	0 75	0 69	0 65	0 60	0 57	0 55	0 53	0 51
Other root and green crops	1 20	1 04	0 95	0 88	0 79	0 72	0 67	0 62	0 58
Cattle, total	1 04	0 82	0 71	0 65	0 58	0 55	0 53	0 52	0 52
Milch cows	0 93	0 79	0 71	0 66	0 59	0 54	0 51	0 48	0 46
Calves	1 23	1 01	0 90	0 84	0 76	0 71	0 68	0 65	0 62
Other cattle	1 71	1 22	1 03	0 92	0 82	0 77	0 74	0 73	0 73
Sheep	2 83	2 29	2 04	1 89	1 70	1 56	1 45	1 34	1 22
Pigs	2 19	1 91	1 75	1 65	1 52	1 43	1 35	1 28	1 19
Poultry	0 89	0 81	0 76	0 72	0 67	0 63	0 60	0 57	0 55
Men working on farms	0 86	0 71	0 62	0 56	0 49	0 45	0 43	0 42	0 42

So far I have dealt with means only In Table 3 I reach my subject proper. This table shows the coefficient of variation (or the ratio of the standard deviation to the mean) for certain statistics and for certain farm sizes It will be remarked that the calculations have been based on smoothed data, in fact the means used were those from the curves of which the formulae have already been given and the standard deviations have also been derived from two-term orthogonal polynomials fitted to the raw data. As remarked at the outset, the general idea underlying the table is to describe in highly condensed form the variability of each entity. For instance in the group of 133 farms of 31–35 acres there were 16 farms with none or 1 cow , 35 with 2 cows , 32 with 3 cows , 16 with 4 cows , 16 with 5 cows , 9 with 6 cows ; and 9 with 7 or more cows This is an example to show that the (smoothed) ratio of 0 59 can imply a very large measure of variability There is much to be said for giving frequency distributions of this kind for each agricultural statistic on each farm size and I had to obtain such distributions for the purposes of this paper ; in fact, as will appear later, it is almost as logical to classify farms by number of cows as by acreage of farm or, for that matter, by certain other kinds of statistics. Table 3, however, suffices for my present purpose.

The table shows that, despite the remarkable regularity of the relationship between *means* and farm size displayed in the earlier tables and diagrams, there is an almost chaotic degree of variation at the individual farm level For all classes of statistics, the rule holds that the smaller the farm the greater the relative variability, i e the coefficient of variation This is almost the reverse of what one would expect For all size classes, sheep and pigs are the most variable and men working on farms the least variable In fact, there is a great measure of consistency in the relative order by reference

to the various statistics on each farm size for instance (excluding ploughed land and total cattle which are composites of other items), in descending values of the coefficient of variation, the order for the first five items is sheep, pigs, cattle other than cows and calves, calves, root and green crops except potatoes, on both the smallest and largest farm sizes shown An outstanding feature of this research is the consistency of the results despite the great variation between individual farms

As a preamble to the presentation of Table 4, which is perhaps the most important of the series, I should remark that the large variability of individual items would be consistent with relatively small variability of all items taken together (e g in the form of total output) on farms of given size We might expect that if, on a farm of given size, acreage of ploughed land was high, then cattle should be few since the pasture area would be low , if sheep were numerous, dry cattle should be few On the other hand if ploughed acreage is high we would expect pigs and poultry to be numerous If, therefore, coefficients of correlation between the measures of each pair of items for fixed farm size be calculated, we would expect to find a mixture of + signs and — signs qualifying the magnitudes of the coefficients. This is not what happens The table shows that all the coefficients without exception are positive and, except in one or two cases, all are highly significantly different from zero The sampling standard deviation of the correlation coefficient (with universal value of the coefficient zero) for number of farms 1,969 is approximately 0225 Every coefficient in excess of twice this value, i e 0 045 may be regarded as significant

Table 4 shows three correlation coefficients between each pair of items (*a*) the complete correlation coefficient, and the two partial correlation coefficients (*b*) with farm area constant and (*c*) with valuation constant The figures at (*a*) have no special interest they are displayed because they are required for the computation of the figures at (*b*) and (*c*) and to place anyone who is interested in the position of calculating partial coefficients on other assumptions, for example between sheep and other cattle with cows and farm area constant Coefficients (*a*) owe part of their significantly high value to the fact that most items tend to increase with increasing farm size as Diagram I shows It is only when we eliminate the effect of farm size (whether measured by acreage or valuation) that the figures assume significance. This is what is done in the series (*b*) and (*c*) In the simplest terms they may be regarded as showing what the coefficients would have been if all farms were exactly 28 acres in area and £22 in valuation respectively, the average for all farms in the group 1–75 acres of crops and pasture

Apart from the fact, already noted, of all the (*b*) and (*c*) coefficients being positive, which is the outstanding showing of the table, it will be seen that the (*c*) series are never less than the (*b*) series which, statistically speaking, is reassuring since it is reasonable Though the valuation is a measure more than 100 years old, it is probably a better gauge of the quantum of land than the crops and pasture acreage It should be noted that the valuation figures used in this paper include buildings as well as lands ; if the contribution of

buildings could be eliminated the (*c*) series coefficients would probably be higher

I must allow Table 4 largely to speak for itself None of the (*b*) or (*c*) series are very large for the reason, shown in Table 3, that the variabilities of the items are very large One may even infer that, as between each pair of items, given farm acreage or valuation, there is a large measure of quite random association, i e , a sizeable proportion of farms which do not conform to the general pattern in the relationship between entities The general pattern is, however, quite unmistakeable and can be summarised as follows on small and medium-sized farms the rule is high in one entity, high in all and low in one, low in all

TABLE 4

Complete and Partial Correlation Coefficients, Farms 1—75 acres

(*a*) Complete correlation coefficients
(*b*) Partial correlation coefficients, farm area (crops and pasture) fixed
(*c*) Partial correlation coefficients, valuation (lands and buildings) fixed
n c =not calculated
n s =not significant, as correlation between part and whole
Value of standard deviation of correlation coefficient on nul hypothesis = 0225 approximately

		1	2	3	4	5	6	7	8	9	10	11	12	13
1 Ploughed	(*a*)		n s	n s	n s	62	56	55	51	31	33	51	26	64
land and	(*b*)		,,	,,	,,	24	21	25	16	14	23	33	20	37
fruit	(*c*)		,,	,,	,,	39	38	36	27	28	29	41	20	, 49
2 Corn crops,	(*a*)			72	52	59	53	52	50	n c	30	48	24	61
total	(*b*)			50	33	20	15	19	14	,,	18	27	18	31
3 Root and	(*a*)				n s	55	51	51	44	n c	31	46	25	59
green crops,	(*b*)				,,	22	21	25	14	,,	20	28	18	35
total														
4 Potatoes	(*a*)					41	45	39	30	n c	33	46	22	46
	(*b*)					18	25	19	07	,,	25	34	17	28
5 Cattle, total	(*a*)						n s	n s	n s	35	34	50	21	60
	(*b*)						,,	,,	,,	21	24	33	14	34
	(*c*)						,,	,,	,,	33	30	39	14	44
6 Milch cows	(*a*)							75	53	26	36	53	29	58
	(*b*)							62	28	11	27	38	24	33
	(*c*)							67	37	22	32	44	24	45
7 Calves	(*a*)								51	25	30	51	24	55
	(*b*)								28	10	20	36	16	32
	(*c*)								34	20	25	42	18	41
8 Other cattle	(*a*)									33	26	37	13	48
	(*b*)									23	15	17	04	21
	(*c*)									30	20	29	05	30
9 Sheep	(*a*)										15	26	12	30
	(*b*)										08	15	07	16
	(*c*)										13	22	10	26
10 Pigs	(*a*)											33	26	33
	(*b*)											26	23	23
	(*c*)											29	24	29
11 Poultry	(*a*)												34	46
	(*b*)												30	29
	(*c*)												30	36
12 Persons on farms														n s
13 Men working on farms														

To synthesise Table 4 one may ask the question · by reference to the principal items, which item is most closely related to all the rest ? To answer, we take hiuristically the group of seven items (1, 6, 8, 9, 10, 11, 13) and find the simple average of the figures for each item in relation to the remaining six items The results for the (*b*) and (*c*) series are as follows

	Average		Rank (descending order)	
	(*b*)	(*c*)	(*b*)	(*c*)
(1 , 6, 8, 9, 10, 11, 13)	240	353	4	3
(6 , 1, 8, 9, 10, 11, 13)	263	363	2	1
(8 , 1, 6, 9, 10, 11, 13)	200	288	6	5
(9 , 1, 6, 8, 10, 11, 13)	145	235	7	7
(10 , 1, 6, 8, 9, 11, 13)	203	253	5	6
(11 , 1, 6, 8, 9, 10, 13)	263	335	2	4
(13 , 1, 6, 8, 9, 10, 11)	265	358	1	2

It will be seen that items 6 and 13, namely milch cows and men working on farms, have, on average, the strongest relationship to all other principal items It seems to be a fact of the first importance from the demographic point of view that men on farms are hereby accorded so outstanding a role

Since Table 4 seemed so significant it appeared worthwhile to press home its significance in a more elementary manner which at the same time would give a clearer idea of the inter-action of the items on one another This is done in Table 5 where the farms are classified in two ways (i) broad acreage groups and (ii) percentage of land ploughed All the figures shown in the table (except those in the last column) are expressed per 100 acres of crops and pasture. Apart from size, percentage ploughed was selected for analysis Table 4 shows that we could equally well have selected almost any other item (e g , men working per 100 acres, milch cows per 100 acres) as the basis of classification The percentage ploughed was selected because this standard has traditional validity " the good farmer is the tillage farmer " of which the present research amply confirms the truth. The percentage ploughed classes used were derived from a table showing the totals for each farm with 0–9 per cent., 10–19 per cent., etc , the grouping used in Table 5 being such that a reasonable number of farms fell into each class, thereby mitigating in some degree the accidental effects due to small numbers in a highly variegated system

What Table 5 does is to spell out the lesson of the first row of figures at (*b*) in Table 4. The regularity of the tendency of each item in each size group to increase with percentage ploughed is very striking, except in the case of valuation (column (4)) which is irregular in the first size group Within each size group there are no breaks in regularity for sheep (column (10)) and men working (column (14)) Most of the breaks in sequence seem due to fewness of farms the breaks are accidental. Between the first two tillage groups in the size group 1–15 acres there are irregularities for all three cognate items cows, calves and Other Cattle, which at least argues the consistency of the basic data But the most interesting phenomenon is that the density of Other Cattle and sheep increases with percentage ploughed

TABLE 5

Agricultural Statistics per 100 Acres Crops and Pasture on Farms Classified by Size and Percentage Ploughed and Fruit

Size of farm and percentage ploughed and fruit	Number of farms	Average size of farm (c and p)	Valuation	Ploughed and fruit	Total Cattle	Milch cows	Calves	Other cattle	Sheep	Pigs	Poultry	Persons on farms	Men working	Expected Output (EO)	
			(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	Per man working (16)
(1)	(2)	(3)	Per 100 acres crops and pasture												
		ac	£	ac	No	No	No	No	No	No	No	No	No	£	£
Size 1—15 *acres*	*625*														
Under 20%	139	8 6	119 6	8 1	48 7	15 6	12 7	20 4	42·2	6 7	420	38 5	7 3	1,811	248
20—39%	249	7 3	99 3	31 5	45 2	14 9	12 5	17 8	51 6	10 5	485	50 2	9 5	2,399	252
40—59%	154	6 6	106 5	53 1	51 0	16 2	14 7	20 1	65 5	17 5	580	57 3	11 2	3,231	288
60% or over	83	8 4	101 6	70 3	64 7	18 1	16 3	30 3	162 9	17 7	620	45 3	11 6	4,173	360
Size 16—30 *acres*	*564*														
Under 20%	138	23 2	70 9	10 9	30 3	8 4	6 3	15 6	27 4	4 3	167	13 4	4 6	1,147	249
20—39%	237	23 7	78 4	29 9	39 5	10 8	10 0	18 7	51 8	7 6	277	16 5	6 3	1,938	308
40—59%	152	23 5	84 4	47 6	53 7	13 5	13 4	26 8	101 3	10 4	377	19 0	7 6	2,854	376
60% or over	37	21 8	86 0	69 0	71 5	17 3	19 6	34 6	136 1	19 1	357	19 6	9 2	3,840	417
Size 31—50 *acres*	*476*														
Under 20%	103	40 8	70 9	11 4	34 1	8 1	7 7	18 2	50 8	4 0	143	9 2	4 0	1,236	309
20—39%	249	39 7	74 6	28 7	39 9	9 3	10 0	20 6	59 7	6 7	205	10 7	4 9	1,820	372
40% or over	124	39 1	81 2	47 7	55 3	11 8	13 0	30 5	91 9	9 1	282	12 4	6 6	2,699	409
Size 51—75 *acres*	*304*														
Under 20%	64	62 8	62·7	11 2	32 7	6 8	6 8	19 1	58 6	1 7	110	5 2	2 7	1,070	396
20—39%	164	62 6	75 9	29 3	36 1	8 3	9 1	18 7	52 8	6 5	167	8 1	4 1	1,695	413
40% or over	76	59 2	83 4	47 1	44 8	9 1	11 1	24 6	61 3	5 7	189	9 1	4 8	2,206	460
Size 76—100 *acres*	*86*														
Under 20%	35	84 8	55 7	12 5	32 4	7 8	6 5	18 1	11 8	3 0	86	4 9	2 7	1,028	381
20% or over	51	85 1	77 6	31 3	37 4	7 6	8 3	21 5	44 6	5 2	116	6 0	3 7	1,643	444
Total number of farms	2,055														

Heretofore we have dealt exclusively with separate items. We must now try to combine them into a composite whole. The most natural way to effect this is to compute a statistic z which is a weighted average of the measures of the principal items, so that

$$z = \sum_{i=1}^{k} a_i \; x_i$$

where k is the number of selected items, x_i is the measure of item i and a_i is the weight An obvious way to derive the weights a is to relate the agricultural statistics of acreage ploughed, number of milch cows, etc , to the appropriate values in the table for the estimated gross output Thus in 1953 when the number of milch cows on 1 June was 1·17 million, the estimated value of the output of dairy produce was £37·3 million so that to each cow is attributable an output value of £31·9, which is the weight a appropriate to number of cows Actually the items selected and the weights used were as follows —

Ploughed land and fruit	£19 5	per acre
Milch cows	£31·9	per unit
Cattle other than cows and calves	£17·8	,, ,,
Sheep	£3·21	,, ,,
Pigs	£24·7	,, ,,
Poultry	£1·17	,, ,,

Somewhat optimistically I term the statistic z the " Expected Output" (EO) We must await the detailed results of the National Farm Survey before we can hope to establish regression or functional relationship between output, labour income, etc , on the one hand and the traditional agricultural statistics on the other As I indicated at the outset, great hopes are reposed in this linking up of the old with the new The traditional statistics, indeed, derived a large part of their value from their giving a rough indication of output I am aware that in a few other countries, researches have so far yielded disappointing results in the way of establishing relations between these two series of statistics, which must be due in part to the necessarily small sample, insufficient classification of the data, by farm size, by zones of the country, type of husbandry, efficiency in the use of capital,* etc I remain optimistic about the possibilities of this approach in Ireland if only because of the exceptional regularity and consistency which the traditional statistics, on analysis, display, as in this paper I therefore recognise that EO is an unsophisticated formula of relationship between output and individual items I plead that I use it because I must, for want of better , that I use it only for the purposes of comparison between one group and another and generally only to give the widest indications of the relative magnitudes involved I will be well content if you accept the formula as merely a device for bringing the separate items into a single figure

*J O Jones [2] states that his survey material shows 'complete confusion" in the relationship between capital on the one hand and net product and labour input on the other See also same author in reference [3]

Conceptually this figure covers £164 4 million of the estimated gross agricultural output in 1953 of £167·3, excluding turf EO at the individual farm level must be taken as the value of output sold, together with consumption of own produce consumed in farm household, less purchases of cattle and other stock and produce from other farmers, in the year 1953 The figures in column (15) of Table 5 show EO per 100 acres derived from the foregoing formula for z and the figures in columns (5), (7), (9), (10), (11) and (12) The figures in column (16) are the quotients of columns (15) and (14)

It will be noted that under each farm size the precession shown in columns (15) and (16) is completely regular For example on 16–30 acre farms an increase from 11 to 69 per cent (column (15)) in area ploughed, with concomitant increases in other agricultural items, raises EO from about £1,100 to £3,800 per 100 acres, and EO per man from £249 to £417 The number of farms in the higher tillage classes, with all that this entails for all other entities, i e , the number of good farmers, is a small proportion of the total but, as will be stressed in the second part of this paper, that they are there at all is the most encouraging showing of this whole research

The regularity of the figures in the table seemed to justify the exercise of expressing each entity as a linear function of (1) percentage ploughed and (2) farm size The formulae* are as follows —

Regression of Certain Agricultural Statistics per 100 Acres of Crops and Pasture and EO per man on Percentage Ploughed (x_1) and Acreage of Farm (x_2)

(NOTE —Figures in brackets under coefficients indicate estimated standard deviation)

Per 100 acres crops and pasture		R^2
Milch cows*	$=12\ 5754+0{\cdot}0794x_1-0{\cdot}1126x_2$ (023) (017)	0 8085
Cattle other than cows and calves*	$=13\ 3116+0\ 2110x_1+0{\cdot}0328x_2$ (046) (035)	0 5709
Sheep*	$=16\ 6406+1\ 5068x_1-0\ 0948x_2$ (25) (19)	0 7170
Pigs*	$=\ 5\ 1802+0\ 1888x_1-0{\cdot}0900x_2$ (023) (017)	0 8831
Poultry	$=\ 360\ 34+3\ 5117x_1-5\ 3554x_2$ (1 02) (78)	0 8190
Men working on farms*	$=\ 6\ 8227+0\ 0739x_1-0\ 0845x_2$ (0097) (·0074)	0 9384
Expected Output (EO)*	$=1241\ 07+39\ 40x_1\ -11\ 80x_2$ (2 48) (1 90)	0 9561
Per man working on farm		
Expected Output (EO) per man working on farm*	$=177\ 21+2\ 2987x_1+2\ 7482x_2$ .. (31) (24)	0 9072

*Purists who like dimensionality in structural relations may cavil at the form of these equations My object is merely to give a smoothed version of Table 5 in which the fact, and largely the nature, of relationship is obvious.

It will be seen that, as regards individual items, given percentage ploughed, densities decrease with increasing farm size except in the case of Other Cattle and given farm size the densities uniformly increase with percentage ploughed The standard deviations show that all the coefficients are highly significantly different from zero except in the cases of the coefficients of x_2 for Other Cattle and sheep which, for all we know to the contrary, may be taken as zero We may go further and state that, on average, a 10 per cent increase in percentage ploughed on a farm of given size entails an increase of densities of 0 8 in the case of cows, 2·1 for Other Cattle, 15·1 for sheep, 1·9 for pigs, 35·1 for poultry, 0·7 for men working on farms.

As regards the EO aspect, given percentage ploughed, a 10-acre increase in farm size deducts £118 from EO per 100 acres and, given farm size, each 10 per cent increase in area ploughed adds £394 to the density EO per man increases both with percentage ploughed and farm size given percentage ploughed, each 10 acres increase in farm size increases the figure by £27 and, given size, each 10 per cent ploughed adds £23 to EO per man

Opposite each formula is shown the value of R^2, where R is the multiple correlation coefficient which may be regarded as the degree in which the formula fits the observations the nearer to unity the better Except for Other Cattle and sheep the fit of the formulae to the observations may be regarded as adequate It is particularly satisfactory that the fit for men working and EO per 100 acres as well as EO per man is so good, since we are thereby emboldened to make firm inferences from the formulae

It is of some interest to compare Table 5 with somewhat analogous data relating to the whole province of Leinster (in which the county under investigation is situated) which happen to be available for the year 1917 [4]

TABLE 5A

Agricultural Statistics per 100 *Acres Crops and Pasture, Province of Leinster,* 1 *June,* 1917

Size of holdings and percentage of ploughed and fruit	Ploughed land and fruit	Total cattle	Milch cows	Cattle under 2 years old	Other cattle	Sheep	Pigs	Poultry
30–50 *acres*								
Less than $\frac{1}{5}$	10 7	35·0	7 2	16 9	10 9	24 7	4 1	93 2
$\frac{1}{5}$ to $\frac{1}{3}$	25 2	33 5	9 5	19 0	5 0	24 1	9 6	148 0
Over $\frac{1}{3}$	46 0	31 0	9 0	18 1	3 9	27 3	16 3	187 4
50–100 *acres*								
Less than $\frac{1}{5}$	10 3	34 0	6 0	14 8	13 1	30·0	3 1	61 1
$\frac{1}{5}$ to $\frac{1}{3}$	25 3	31 9	8 2	17 8	6 0	30 1	8 0	105 2
Over $\frac{1}{3}$	43 4	29 3	7 6	16 7	5 0	33 6	12 6	138 3

Comparisons can be made between the densities for the items total cattle, cows, sheep, pigs and poultry for the two classes of farm size. The contrasts are striking Consider the first and third lines for

the size group 30–50 acres in the two tables The percentages ploughed are about the same for each line Yet as percentage ploughed increases total cattle declines in 1917 whereas it rises sharply in 1951 , while milch cow density rises in both cases the rise is steeper in 1951 , sheep density, about the same in 1917, rises with percentage ploughed in 1951 , on the other hand, the density of pigs rises more sharply with percentage ploughed in 1917 than in 1951 , and for poultry the rises are relatively much the same in the two years

We now come to the variability of EO as a whole For seven farm sizes the arithmetic mean and standard deviation were calculated from the data The standard deviation was calculated in such a way as to eliminate the effect of different farm sizes within each size group , this effect should in theory be appreciable in the smaller size group in fact it is not These values of mean and standard deviation were smoothed using orthogonal polynomials to the second degree as in the case of the individual items dealt with earlier The results are shown in columns (2) and (3) of Table 6 It will be been that the variability on all farm sizes is very large and increasing but that, in relation to the mean, it diminishes with increasing farm size, as shown in column (6) which is, in fact the coefficient of variation (x 100) of EO

TABLE 6

Expected Output (EO) per Farm Means, Standard Deviations and Lower and Upper Deciles on Farms of different sizes Smoothed data

Size of Farm (1)	Mean (2)	Standard Deviation (3)	Decile		Percentage of Mean		
			Lower (4)	Upper (5)	Standard Deviation (6)	Lower Decile (7)	Upper Decile (8)
acres	£	£	£	£			
11–15	306	204	90	579	67	30	189
21–25	494	274	190	861	56	39	174
31–35	662	331	289	1,107	50	44	167
41–45	812	376	383	1,316	46	47	162
51–55	943	408	473	1,489	43	50	158
61–65	1,056	427	558	1,626	40	53	154
71–75	1,149	433	640	1,727	38	56	150

It is essential, however, to form a more concrete idea of the variability than as shown merely by the mean and the standard deviation. To do this I have in effect computed a theoretical frequency distribution from these two known statistics, using a Pearson Type V which had the advantage that the Incomplete Gamma Function Tables[5] could be used for the computation of frequency points.

I should emphasise that I have no means of knowing whether this form of function affords an adequate representation of the actual frequency ; here again we must await the results of the National Farm Survey. The lower and upper deciles of EO are shown in columns (4) and (5)

These figures mean that if, in each size group, the farms were ordered according to the magnitude of EO it would be found that one-tenth

would have smaller EO's than the figure shown for the lower decile and one-tenth would have larger values than the upper decile The deciles may therefore be regarded as the *effective* limits of range At this point I should remark that whatever one feels about the calculation of output or the effective limits of range for each farm size, there can be little doubt that the calculated ranges (e g , for the 31–35 acre class from £289 to £1,107 or by £818) are understatements In fact if the true value of output were Z on the individual farm, we may write $Z = z + u$, where z is the EO and u the aberration from the formula on the given farm For all farms in a size group we then have, under general conditions —

$$\text{Var } (Z) = \text{Var } (z) + \text{Var } (u)$$

We have no right to assume that the last term is small Accordingly the variance of z, on which the frequency distribution so largely depends, may be sizeably larger than the variance of z from which the deciles of EO in Table 6 have been computed.

PART II—COMMENTARY

In the second part of the paper I propose to discuss some of the implications of the statistics presented in the first part, supplemented by other data. The facts on which I propose to comment are the following —

(i) The density of manpower and of each agricultural statistic, even of dry cattle, declines with increasing farm size (Table 2, Diagram II) ; the decline is marked for agricultural output as a whole, as estimated by EO (Table 6).

(ii) On each farm size the variation of each agricultural statistic (Table 3) and of EO (Table 6) is very marked

(iii) There is an emphatic tendency for farms which are high in one agricultural item to be high in all and vice versa (Tables 4, 5, 6)

(iv) The higher the EO per acre, given farm size, not only the higher the number of men at work (as is to be expected) but EO per man is higher (Table 5 and formulae following).

In this summary of what has gone before the emphasis is strongly on per acreage (or per farm of given size) rather than per man, as a measure of agricultural efficiency, though the figures per man have been dealt with incidentally—see Diagram II, Table 5 and formulae following There can be no question that, as a guide to policy, our ideas should be dominated by the per acreage concept Meeting under the shadow of the 1956 Census figures, we do not need to be reminded that the task transcending all others is to increase (or at least to prevent a further decline in) the numbers of persons working on the land This should be the dominating criterion by which we should judge whether agricultural policies and practices are successful or not I assume that the right of the individual to sell his labour where he wills is inviolable. If the individual chooses to work on a farm rather than migrate he does so therefore of his free will. That he elects to do so must mean that income per person in agriculture is increasing ; and if income

per head and workers on farm is increasing, total output must increase. In Irish circumstances the criterion of output per man is misleading as applied to the State as a whole Over the past century we have quadrupled output per man but mostly at the price of a reduction of the rural population to one-third of what it once was We could (theoretically) achieve the highest productivity per man in the world by confining our agricultural activities to the rearing of store cattle looked after by a few thousand herdsmen · we have gone too far in that direction already. I write in the conviction that, not only on grounds of national sentiment but for the soundest economic reasons we must aspire, and direct policy towards, an increasing total population ; and the latest Census figures have grimly reminded us that the capacity of non-agriculture to absorb the rural surplus population is strictly limited. It is also my conviction that agriculture is so important from the demographic and economic points of view that it is scarcely an exaggeration to say that nothing else matters

With regard to (1), the nation cannot afford to tolerate any longer the average standard of farming on the larger farms Admittedly the proportion of bad farming on small farms is at least as great as on large but bad farming on a unit of 200 acres is ten times as serious as bad farming on 20 acres The analysis in Part I extended only to farms not exceeding 100 acres in a particular county in which, I would remind you, the standards are higher than the national average. The picture for the county can be extended to the larger farms, if in a very general way, by the statistics from the 1949 enumeration. The total acreage of agricultural land in 1949 on farms of 100–200 acres was 2,274,000, and on farms over 200 acres 1,369,000, representing 20 per cent and 12 per cent respectively of the total area of agricultural land on farms of all sizes. The problem of increasing output on large farms is accordingly of considerable importance. In Table 7 the densities of the principal items are displayed

I should point out that in this table the farm-size classification is based on total area of farm, not on area of agricultural land as elsewhere in the paper The traditional justification for large farms has been that they were an essential part of the system of production of dry cattle, to the benefit of farmers, small and large for, so the doctrine ran, small farms could not economically carry aged stores The table questions the validity of this assumption Compare farm sizes 30–50 acres with 200 acres and over in the county (series A). On the former class, manpower density is two-thirds higher , and all other densities except dry cattle 3 years and over are higher on the smaller farm class It may appear that a good reason in itself for improving the general efficiency of larger farms is that these farms encourage the retention of aged stores. For all we know to the contrary some of these stores are over 4 years of age Surely it is in the best interests of the country that cattle should be brought to maturity (for slaughter or export) at the earliest possible age, that we should achieve a more rapid turnover of cattle stocks , in agriculture as in other economic sectors sales in relation to stocks should be as large as possible The practice on large farms encourages exactly the contrary The trend has been for the worse since prewar. Between 1937–39 and 1953–55

TABLE 7

Area of Ploughed Land and Fruit, Cattle, Sheep, Pigs, Poultry and Men on Farms per 100 *acres of Crops and Pasture, classified by size of Farm in* 1949, *County* (*A*) *and State* (*B*)

Description	Size of Farm						
	1 to 15 acres	15 to 30 acres	30 to 50 acres	50 to 100 acres	100 to 200 acres	200 acres and over	Total 1 acre and over
Ploughed Land and Fruit (ac)							
A County	26 8	26 1	27 1	25 1	22 1	21 0	24 0
B State	18 6	16 7	16 5	16 7	16 2	13 5	16 3
Total Cattle (No)							
A County	34 5	29 2	33 8	31 5	30 8	25 9	30 6
B State	42 4	37 0	36 1	36 2	34 3	30 2	35 6
Milch Cows							
A County	10 7	8 2	8 0	7·0	5 6	4 0	6 5
B State	15 6	11 7	11 2	10 8	8 3	4 7	10 1
Other Cattle							
Under 1 year							
A County	8 6	7·3	7 9	7·0	5 6	3 8	6 2
B State	11·9	9 9	9 3	8 6	6 7	3 8	8 3
1–2 years							
A County	8 8	7 1	8 3	6 9	5 9	5·0	6 6
B State	8 9	8 4	7 5	6 9	6 1	4 5	7 0
2–3 years							
A County	4 6	4 2	6 2	6 5	7 3	5 6	6 3
B State	4 4	5 2	5 5	5 9	6 8	6 8	5 9
3 years and over							
A County	1 2	1 7	1 9	2 7	4 7	5 9	3·5
B State	1 1	1 2	1 6	2 5	4 7	8 9	3 2
Cattle other than Cows and Calves (No)							
A County	15 2	13 7	17 9	17 5	19 6	18 1	17 8
B. State	14 9	15 4	15 6	16 8	19 3	21 7	17 3
Sheep (No)							
A County	28 2	32·0	45 5	36 9	34 6	32 0	35 8
B State	19 2	16 9	18 7	17 2	18 1	25 4	18 7
Pigs (No)							
A County	10 1	7·2	7 5	5 8	4 2	3·4	5 5
B State	7·0	6 4	6 4	6 3	4 7	2 7	5 6
Poultry (No) .							
A. County	419 6	221 6	212 3	158 0	107 7	61·0	150 9
B State	416·0	276 4	206 9	148 8	94 9	49 2	176 2
Men on Farms (No)							
A County	6 3	4 9	4 5	3·5	2·8	2·7	3·5
B State	9 4	5 8	4 5	3 4	2 6	2 2	4 1
EO (£) ·							
A County	1965 4	1554 2	1682 0	1470 8	1299 3	1117 4	1419 5
B State	1846 8	1508 7	1416 9	1354 1	1209 4	1005 2	1352·5

dry cattle 3 years or over have more than doubled (from averages of 168,000 prewar to 350,000) while cattle under 3 years (excluding cows, bulls and heifers in calf) increased by one-fifth (from averages of 2,311,000 prewar to 2,787,000) Have farmers become like other stock-gamblers in "holding for a rise"? If so, this is a hazardous practice, as farmers have learned to their cost in the past twelve months during which period the price of store cattle 2–3 years per head fell by £10 and store cattle 3 years or over by £12 With a small income from other sources the risk of carrying large cattle stocks is considerable In 1953–55, on average, cattle output (at an estimated 940,000 head per year) formed 21·1 per cent of average cattle numbers on 1 June

Table 7 shows that if all the land was parcelled out in small holdings we could carry all the dry cattle over 1 year we require on existing farming standards, and Table 6 shows that if farming techniques were all as good as the present best we could carry many more Perhaps the most remarkable showing of the 1949 agricultural statistics classified by farm size was that the percentage increases in dry cattle aged 2 years and over was far greater on small holdings than on large between 1931 and 1949 numbers per 100 acres increased by 55 per cent on farms of 30–50 acres compared with 8 per cent on farms above 200 acres, the general increase being 26 per cent All Irish farmers are "ranchers" now so that the contumelious term has vanished from the vocabulary

Variability.

As to (ii), Table 6 merely gives some precision to the well-known fact that output and income varies greatly on farms even of given size situated in the same neighbourhood and practising the same type of husbandry Professor M Murphy[6] has shown that on West Cork creamery farms in 1941–42 family income per week on 40–50 acre farms varied from under 30 shillings to over 100 shillings and on Dr R O'Connor's mid-Roscommon farms[7] over 50 acres "Surplus" (family income less family labour remunerated at same rate as hired labour) ranged from under 100 shillings to over 300 shillings per week in 1945–46. With regard to the variability of individual items and of EO in this paper, I begin with the truism that the farmer brings to his activities such ability, knowledge, energy and capital (including land value) as he possesses Now we have seen that even with farm size fixed there is a fantastic variation in pattern of exploitation in a small county with no great variation in land value, the same climatic condition, same proximity to markets and generally the same environmental conditions We are entitled to assume that even if the attributes of ability, energy and capital were fixed, we would also find considerable variability which can only be due to individual idiocyncracy This does not make sense. Given the pricing system (of products, labour and materials) soil type, situation of farm, etc., there is an optimal pattern to which farmers should be expected to conform, i e , a distribution of activities between different classes of livestock, different crops, etc., which will yield the maximum profit per acre. This points to the urgent need of developing Farm Management in Ireland. It is at present practically unknown, even

to good farmers, who should realise that management is as highly developed a science as farm technology and scarcely less important. I have no doubt that the publication of the results of the National Farm Survey will give a great impetus to this aspect of farm efficiency. Ideally the only variability in pattern of activities should be due to quality of soil on individual farms which points to the need for a systematic Soil Survey One of the casualties from Table 6 is the time-honoured notion of the Land Acts, namely that of "economic holding" deemed to be of not less than £20 valuation Now, in fairness to the Land Commission, it is clear that a certain amount of variability, generally in the downward direction, is imputed to the concept (see for example [8]) Nevertheless the notion that a living cannot be made on a holding of less than 25 acres of average land is very widely held Table 6 makes nonsense of this notion in showing that a reasonable income is being made on farms of 15 acres and a poor living on farms of 75 acres in existing conditions farm size is largely irrelevant to level of output ! The fallacy about 25 acres as a minimum might be regarded as a prime example of the statistical principle announced at the outset, namely that an average derives meaning for administrative use only from the fact that the associated variability is small.

We have seen from Table 6 that variability is greater on small than on large farms. Otherwise expressed, there are proportionately more inefficient farmers on small farms than on large In the discussion at the previous meeting of this Society, General Costello made the interesting suggestion that this was partly due to the number of small farmers and members of their families who take jobs on roads and other non-agricultural employment There must be very few small farms whose income is derived solely from agriculture Apart from earned income from road work, etc , small farmers and members of their families have large receipts from social security and emigrants' remittances. Since a large part of the income of small farms is sub-sistence, i e., non-cash, small farmers tend to attach undue value to what townsmen would regard as quite small cash payments Though the difficulties are formidable, one would wish that a better way could be found for subsidising agriculture than by paying Unemployment Assistance to small farmers and members of their families, which must be conducive towards weaning them from work on the land In 1951 there were 87,000 agricultural holdings in the size group 1–15 acres while the Census showed that the number of persons whose principal occupation was "farmer" was only 43,000 ; and, in the size group 15–30 acres, holdings numbered 86,000 and farmers 65,000 In the province of Connacht in 1951, of the 76,000 persons with jobs other than farmer or relative assisting, no fewer than 32,000 or 42 per cent of the total lived on holdings over 1 acre From certain information I would be inclined to add to General Costello's thesis that people who work partly on farms and partly on non-agricultural jobs are generally not every efficient at either Of course, most holders cannot make a living from very small holdings and policy should be directed towards accelerating the welcome trend over the past quarter-century of the decline in their numbers by consolidation into larger holdings. No population need be lost thereby if such larger holdings are properly

farmed This, I repeat, is the essential condition for increasing rural population, diminishing emigration and inducing a rising trend in the total population

Variability in Efficiency

With regard to point (iii), I do not think that the showing of Tables 4, 5, 6 can be rationally interpreted on any other hypothesis than that the great variation in EO and the tendency for farms to be high in all items or low in all items is due in the main to the inherent ability of the individual farmer By ability I mean the qualities of intelligence, knowledge, energy and initiative applied to the job That this research has shown that around a low average there is a great variability means that the number of inefficient farmers is very large The good farmer must be something of a manager, an agronomist, an engineer and a veterinarian, and work hard at his job He must be aware of the gaps in his knowledge and know where he can turn for help Good farming, therefore, requires far superior attributes than does the average town employee's job and the average townsman's begrudging attitude towards the good farmer's earnings has no basis in reason or equity We should be less surprised at there being so many bad farmers than that good farmers are reasonably numerous, as Table 6 shows The prestige of farming among farmers themselves is low It is so low that if boys or girls on farms show signs of being " good at their books " they are marked for migration Almost any town job is regarded as superior to a job on a farm Even as regards graduates in agriculture, they seem reluctant to work as farmers though, with their college-acquired knowledge as farmers or farm managers they should earn twice or three times what they earn as employees of public authorities The result must have been a steady exodus from farms of the more intelligent family members Primogeniture does not necessarily operate in the inheritance of farms

While in Ireland the efficiency standards in economic sectors other than agriculture leave much to be desired, the public have the safeguard that efficiency in these sectors cannot fall below a certain level without driving the person or firm involved out of business This kind of economic sanction, this weeding-out of the unfit, is operating all the time in business—some of us consumers in Ireland even wish that the process would operate more ruthlessly It does not necessarily happen in agriculture because (1) the living standard to which the majority of farmers aspire is low, and (2) what they deem to be their essential requirements can be supplied with little effort from their farms The large subsistence element in Irish agriculture—in 1955 farm produce and turf consumed in the households of the farms on which they were produced formed one-fifth of output, a proportion which, of course, was higher on small farms—is at once the strength and the weakness of Irish agriculture. The strength, because whatever the economic vicissitudes the farmers can never starve, their weakness because for this reason sacrifices can be forced on them, as the years of depression showed, and because a frugal sufficiency easily obtained makes them disinclined to make the greater effort involved in attaining a higher standard These are the main reasons for the far greater variability in output in agriculture than in non-agriculture

Variations in return can be due to causes other than variations in the ability of farmers. They may be due to bad agricultural policy, unsatisfactory prices, ill-luck or inability to work through age or infirmity. I must dismiss the first two of these causes out of hand because in a given locality they affect all farmers nearly equally, apart from variation due to differences in soil which may condition the pattern of farming I assume such variation to be relatively small in the same locality and that, up to a point, poor soils can be made better by proper treatment I have no statistics about incapacity through illness As regards age, the average age of men farmers in Ireland (1951) is 55 and 28 per cent are over 65 years of age. The percentage of men farmers unmarried is 28. It therefore seemed not unlikely that one of the reasons for the great variability in EO was to be sought in differences in the age-conjugal condition pattern of farmers There is a saying to the effect that " the best incentive to hard work is small children tugging at father's trouserleg", though only 27 per cent of rural families are of the type man-wife-all children under 15 years [9] Accordingly I judged it expedient to effect a concordance between the farms included in the present study derived from the annual agricultural statistics with the returns for the same farm households from the Census of Population of 1951 This proved an exceedingly onerous undertaking, the object of which specifically was to identify young farmers (*a*) single and (*b*) married The results are shown in Table 8.

While all items except poultry are somewhat higher for young farmers than the general average we cannot regard the differences as significant . EO per acre is only 4 0 per cent and 7·1 per cent higher than the general average in the case of single and married young farmers respectively Age or conjugal condition of farmers therefore has little effect on agricultural output The justification for juvenation of agriculture, beyond question a good in itself, has to be sought in sociology, in particular for the increasing of the rural marriage rate.

TABLE 8

Agricultural Statistics per 100 *Acres of Crops and Pasture, distinguishing Single and Married Young Farmers*

NOTE All figures have been standardised to the 1949 acreages of crops and pasture classified by size groups

Category	Number of Farmers	Ploughed land and fruit	Total Cattle	Milch Cows	Calves	Other Cattle	Pigs	Poultry	EO (except sheep)
	Per 100 acres crops and pasture								
	No	Ac	No	No	No	No	No	No	£
Men farmers under 45 years of age									
Single	115	30 6	46 1	10 1	10 6	25 4	6 0	174	1,722
Married	129	32 4	41 9	10 2	10 1	21 6	7 5	208	1,772
All farms	2,055	29 7	40 1	9 5	9 7	21 0	6 4	207	1,655

Effect of Good Farming on Population.

With regard to point (iv), the most hopeful showing of this inquiry has been that good farming, as indicated in Table 5 by the propensity of workers to increase with increasing area ploughed (and taking into account the concomitant increases in other items) results in increased employment on the land, according to the rule that, given farm size, employment of men increases by 0·74 per 100 acres for 10 per cent increase in tillage. One of the most puzzling statistical results in the past has been that there is no discernable relationship between the decline in rural population on the one hand and the decline in tillage area on the other in each of the periods 1881–1911 and 1911–1926.[10] These results were based on the State as a whole using the Poor Law Union as the unit of analysis It has also been noted in the past that the statistic agricultural workers per 100 acres of crops and pasture does not differ much between counties of relatively high and low tillage. It is quite possible that the lack of relationship was due to mixing of areas, different type of husbandry and farm sizes. The present inquiry shows the importance of analysis of smallregions of the country, lest we be misled by negative results through failure to control local and other environmental conditions which may act in opposite directions and so confound the experiment. Good farming in Ireland clearly does not involve the complete substitution of machines for men though no doubt the National Farm Survey will show that the ratio of machines in use to manpower, increases with increased efficiency as measured by output.

Given percentage tilled, manpower per 100 acres declines with increasing farm size. As a personal opinion and unmindful of the difficulties, this and other results presented in this paper point to policy being directed simultaneously towards the objectives of (1) improving the efficiency of all farms and (2) dividing up large farms which are not efficiently exploited and consolidating very small farms into larger units In as far as the Land Commission has powers or can acquire powers in the matter, the firmest guarantee should be given that farms created or expanded should be properly worked.

The Agricultural Mind.

Before concluding the paper with some reflections on its policy implications I would like to say something further about mental attitudes in rural Ireland. As far as I know, nothing authoritative has been written on this subject and the speaker is no authority. I propose nevertheless to speculate briefly and with various degrees of uncertainty on certain aspects of the psychological problem recognising that, if it could be measured, the degree of variability in mental attitudes is probably as great as the variability in the statistics. My main point is that it is high time that attention should be given to this matter

Is the Irish farmer an " economic man ", in other words how does he respond to price and other economic stimuli In 1951[11] I very tentatively suggested that on the whole the answer is in the negative. Price rises tend to accompany falls in aggregate volume output and vice versa, though the amplitude of volume movements is much smaller than that of prices. At about the same time Dr. C. H. Blagburn[12] from an analysis of large farms in the South and South Midlands of

England wrote : " A 10 per cent reduction (in price), however, without having such a disastrous effect, would greatly increase the incentive to expand production " Later in FAO, I learned that this inverse relationship between prices and aggregate volume of production was well-known as applying to primary producers in many countries I was told, by way of illustration, of a rubber-producing district early in the war years in which a halving of price resulted in a doubling of output. To the extent to which this thesis is true it would have far-reaching consequences. In the case of those farmers who work to a more or less fixed income there is no certainty that increased investment, improved technology (especially if this is more or less imposed from outside, i e , is not autonomous) will result in increased output or, at the best, the return will be less than it should be Failure of the majority of farmers to take advantage, in increasing output of the services which have already been placed at their disposal, at considerable cost to the nation, is evidence of this nil effect It is true of course, that the standard of living of the average agriculturist has about doubled since prewar but this was from a preposterously low level and was the accidental resultant of a greater rise in farm prices than in retail prices of household goods and a fall in the agricultural population Agricultural demand for consumption goods and services is not nearly high enough A curious exception to this rule is motor cars In 1954 there were 40,000 cars on Irish farms, equivalent to about one car per farm of over £40 valuation, which is not to be taken to mean that all farms in this valuation class have cars—and reminds one that in 1946 the number of such holdings with a pipe water supply on to dwellings was about 15 per cent and the number with a fixed bath about 10 per cent of the total. I am informed that, including depreciation, it costs £150 a year to run a car which means that the 40,000 cars entail an annual expenditure of £6 million which, one feels, could be much better spent. Farmers are not exceptional in going in for motor cars in a big way. I calculate that, by reference to the number of incomes of £750 or over in Britain and Ireland, we have something like 50 per cent more cars than our neighbour

The conviction that the only hope for agriculture lies in high prices for products and low prices for materials and services prevails widely amongst Irish farmers Granting that a large part of farm income is derived from permanent pasture, the product of which, if the land is not improved, must be constant from year to year, this attitude is understandable enough . in such a system and sector no increase in output can be expected. It is fatal, however, to any hopes we may entertain of substantially increasing our agricultural exports. It must be realised that except for wheat and maize-substitute the home market for home agricultural produce is near saturation point. All increased output must be exported, at any rate unless and until we substitute home wheat and feeding barley at economic cost for imported wheat and maize which is one of the most obvious ways of improving the balance of payments position * Irish ingenuity should prove equal

*External trade is a very large part of the Irish economy In the ten years 1946-55 external assets decreased or external investment in the State increased to the extent of £188 million. Our imports of wheat and maize in the ten years amounted to £102 million which came from countries which purchased only £21 million of our goods

to the task of baking an edible all-Irish loaf (I have been eating Dublin bread for 60 years without realising its ambrosial quality). We must clearly understand that we cannot break into export markets without a substantial reduction in prices. If we are sincere, we must abandon all notions of prices based on average costs or anything else but those which enable us to sell our goods competitively in Britain and elsewhere. To improve incomes under such conditions, quantum output must be greater to more than compensate for the inevitable fall in prices. Recently there was an authorative statement in Dublin that all European countries are now working towards agricultural surpluses for export—an eloquent commentary on the flesh-creeping of the Malthusians to which we have been so subjected in recent years We may even be driven out of the few markets we have unless we improve our efficiency. The task facing us is therefore a grim one Frankly in the existing climate of opinion there is not much prospect of any substantial increase in agricultural exports from this country

In 1930[13] I wrote " It can, I think, safely be asserted that from the Famine to the present day there was no prolonged period during which the level of rural prosperity was so high and increasing at so rapid a rate as during those seventeen years before the outbreak of the European war". I see no reason to revise this opinion Pre-World War I the outlook of farmers was far healthier than it is today Then the fact that prices of materials and products were world prices within which one had to work was fully accepted. It followed as a corollary that prosperity could be attained only by efficiency, organisation and hard work The autarchic trend—during the past quarter century agricultural exports as a proportion of total output has decreased from one-half to one-third—has also made its contribution to the price-obsession of farmers.

One could write a whole chapter on the deleterious effect of the bullock on Irish rural mentality. There is no product anywhere in the production of which the contribution of nature is greater and of man less. The prestige of the bullock was never so high as it has been in recent years, and indeed deservedly so. I am authoritatively informed that a holding of 100 acres of average land, stocked with dry cattle, with a cow, a few hens and an acre of potatoes for household supply during a régime of stable prices will yield the holder a net income of £700. If the farmer deems this sum sufficient for his needs, there is little use in telling him that, with proper husbandry, he could treble his income.

Another characteristic of probably the majority of Irish farmers is a reluctance to invest capital or to increase current costs. There are traditional elements in this attitude, possibly even a hang-over from rack-renting days , and stores cost so little to produce that in a degree they " spoil " farmers for anything else I am well aware that the cost-output ratio is a much discussed topic about which I intend to remain silent until we have all had an opportunity of examining the Survey results. Table 4 strongly suggests that Irish expenditure is in the phase of increasing returns which means that increased capital and costs will yield handsomely in income. At the same time, there is much to be said at whatever point on the scale of returns an enterprise is, for reducing costs to a minimum, for example,

by producing as large a quantity of animal feed as possible on one's own farm. One cannot, of course, be dogmatic on the latter point, though in general it seems to be a safe rule. Decision to buy feeding stuffs or to produce them on own farm in any particular year can be determined only by study of prices and costs.

There is a great deal of unreality in public discussion on Irish agricultural problems except as regards technology which affects comparatively few farmers. There seems to be very little recognition in such discussions of the vast range of variability in farming skills throughout the country, in particular that indifferent farmers are very numerous In private, people who are knowledgeable and interested will argue about the bad farming aspect of the problem but when they write—and agriculturists often write extremely well—or speak in public a " united front " is presented. The farmer is this, and the farmer is that, as if they were all the same. Most of the ills, they say that farming suffers from, are due to Government malpractice and the universal panacea is higher prices for their products. Of course, farmers are not themselves entirely to blame for the poor state of Irish agriculture. They have inherited a poor system They would do well to recognise, however, that public authority has tried always to do its best for them (though, no doubt, mistakes were made) and that, within the very limited means of the country, its best is considerable, as Mr. Whitaker has shown in the previous paper read before this Society.[14] It would be a far healthier attitude on the part of farmers to shoulder responsibility for the state of agriculture and cease reviling everybody else. An exceptional ferocity seems to inform all general discussions on agriculture and a stranger reading the recent controversy on the proposed Agricultural Institute could not but think that the dearest wish of nearly all the protagonists was to kill the proposal, which is the exact opposite of the truth. Acrimony is a force which does damage far outside the target area. Closer attention to the data—and statistics in particular—on all sides will make discussion more harmonious, will narrow the margin of difference and bring agreement closer.

As to the other end of the scale of variability, it is probably true that every parish in Ireland has its good farmers. As far as my observation goes, in general these men are not held in special esteem by their less efficient, more numerous, neighbours. If this is true, it is to be deplored. Their less efficient neighbours should pay them the sincerest form of flattery ; and efficient farmers would be different from the more efficient in every other walk of life if they were not prepared to help and to advise all who ask them, often, be it confessed, to the point of tiresomely overdoing it.

I have expatiated at length on the mental outlook of agriculturists. This in turn is conditioned by the attitudes of townsmen, which, in the group are characterised by great plans for other people to work more or for the spending of other people's money. There is much talk about rights and entitlements and no talk at all about responsibility, personal or group. What contribution are we townsmen prepared to make to the attainment of desired ends ? Farmers find it hard to understand our " entitlement " to an increasing standard of living when in 1954 the average income per head of agriculturists (actually

gross domestic product), exposed to the blast of competition in external markets, was about £300 and of non-agriculturists about £400. They do not understand (and neither do I) that postwar invention, the simultaneous round of pay increases affecting all industries alike and all employers whether they are prosperous or not ; or the lack of interest of industrialists, sitting pretty behind high tariff barriers, in seeking external markets —" We have discovered no inclination amongst Irish (industrial) producers to take any kind of risk "—U S Consultants to Coras Tráchtála Teo.[15] They do not understand how town workers so easily forget one leg of the Marxian precept " from each according to his abilities to each according to his needs ". One test of the sincerity of important non-agricultural groups is that employers and employees should be prepared to work harder and for longer hours to reduce for agriculturists the cost of things they have to buy. This would give a fillip to agricultural demand for consumer goods and thereby favour increased agricultural output. It would tend to price us into external markets for non-agricultural as well as agricultural products.

Farm taxers will derive small comfort from the figures in this paper The largest EO in Table 6, namely £1,727, for the upper decile of the 71–75 acre class, is equivalent to a family income of about half this figure, say £850, which, divided between the working family members would give an income per family worker of perhaps £400, which is less than the income of a Dublin artisan (1953) The average income per family worker in the 71–75 acre class was probably about £300

Policy Implications

There is universal agreement—if with varying degrees of enthusiasm and emphasis—that advance in agriculture involves (i) improved technology, (ii) increased advisory services and (iii) increased investment in agriculture. To these might be added (iv) reconsideration of tenure, an aspect of the problem which has hitherto received insufficient attention. These are not, of course, exclusive categories. Let us briefly examine the implications of these approaches in the light of the facts.

There can be no two views about (i). Investment in technology (including farm management as well as the better-known agricultural sciences) must yield larger dividends than any other form of investment, and the expenditure involved is small in relation to even the present level of agricultural income and investment. Both (ii) and (iii) raise a fundamental question · is the existing corps of agriculturists able and willing to take advantage of increased knowledge and intensification of activity ? The best test surely is that of the genuine autonomous demand on the part of the farmers themselves, apart from that aspired for them by their mentors By this test, I have the impression (and I may be wrong) that existing advisory services are nearly sufficient and farmers in the mass have no difficulty about raising such little capital as they feel they require * I will be proved wrong when 15,000 farmers march on Dublin to demand more capital

*Dr R O'Connor[16] states that in Irish agriculture lack of demand for capital is far commoner as a deterrent to investment than ability to obtain credit at reasonable interest rates

and advice. The impression which the present research has left on my mind (and again I may be wrong) is that a sizeable proportion of Irish farmers are incapable of acquiring the considerable knowledge needed for good farming. This is a special problem in agriculture in which the economic process does not necessarily weed out the unfit. There remains undoubtedly a large proportion of farmers who could profit from advisory and educational services, but do they feel themselves the need in excess of what is already available ? The demand must come from the inside. The age distribution of farmers is scarcely conducive to avidity for knowledge . only 7 per cent are under 45 years of age As regards farmers' sons the age-structure is, of course, better but the quarter century on average which they have to wait from teenage to inheritance is a dampener to enthusiasm when, in the meantime, there is little assurance that their fathers will take their advice

As already observed, there are very good farmers in every neighbourhood in Ireland. Could a means not be found for integrating them into the advisory service so that each locality has its model farm or farms ?

Very large sums have been mentioned as required for investment in agriculture to raise the level of Irish agriculture to Western European levels The raising of capital obtained by farmers themselves by ploughing in of profits or by loans should, of course, get the strongest encouragement and loans should be granted under the most favourable conditions Free or too-cheap loans are to be deprecated principally for the reason already mentioned that such loans are unlikely to yield a proportionate return in output. We must be very chary about grandiose plans for expenditure in advisory services or too low interest loans to agriculture from the public purse until at least the conditions precedent to such expenditures (the principal of which is the willingness and the ability of farmers as individuals to co-operate in ensuring commensurate increase in output) have been created.

With regard to (iv), tenure and cognate matters, the Population Commission[17] recommended that in case of intestacy (which is so common) the farm should become the property of the eldest son subject to reasonable claims of the widow and children ; that old-age pensions should be granted to the small farmer (and his wife) on reaching the age of 65 on condition that he transfers his farm to one of his children ; and, more tentatively, that the possibility of providing farms on rental should be considered. I understand that in one or two counties migrant farmers have placed themselves entirely under the guidance of Agricultural Instructors for the management of their farms Surely this is a welcome development which, if extended, might appreciably reduce the number of inefficiently run farms. One might even envisage a new profession of Farm Managers, alumni of the universities and agricultural schools, who would get clay on their boots but would have more money in their pockets. We must have regard to inefficient farming as a specific problem. Otherwise we may as well write off at the start a fair proportion of our 11½ million acres of agricultural land as unimprovable. Expropriation of the unfit is however a solution which we cannot contemplate. In Fouché's immortal words this would be worse than a crime · it would be a blunder.

Conclusion.

The situation is not one of unrelieved gloom During recent years there are, at long last, fairly definite signs that Irish agriculture is on the move Between 1951 (when output was at about the 1938–39 level) and 1955 the official gross volume output index had increased by 9 4 per cent or by 10·6 per cent when year to year changes in numbers of livestock are taken into account Admittedly these increases are small, considering the low level of output per acre from which they started The demographic aspect of the situation (characterised, for example, by 49 per cent of men in agricultural occupations aged 25 or over unmarried, the great decline in the agricultural population even in recent years and the low ratio of women to men in the young adult age group in the rural population) is a more serious cause for concern than even the economic position The demographic and economic aspects of the rural problems are indivisible and both are dominated by the mental outlook of agriculturists.

Inheriting a low density of population on naturally fertile land, group for group we, agriculturists and non-agriculturists alike, appear to have to work less hard to attain a modest sufficiency than any other country in Europe Aspiration and realisation are probably more nearly equated here than anywhere else While there are philosophical elements in this attitude we must come to realise that we will be happier with more of the things which money can buy Weakness in agricultural demand for consumption goods and services and the means to obtain them is almost our main economic problem

We must not beguile ourselves by what I may call the " institutional fallacy", namely that, by creating the necessary physical conditions, development will follow almost of its own accord I think this fallacy is a dangerous one. It may lead to wasteful expenditure from our very limited resources In the Irish context the proverb about the horse and the water may have to be qualified to the extent that you may not be able even to lead the horse to the drinking trough Institutions are necessary but by no means sufficient for advance commensurate with level of investment Some means must be found for getting at the minds and hearts of the Irish people as individuals This is quite the dominant note in the Reports and Addenda of the Population Commission It is involved in what at least one signatory meant by the reference to "leadership" in paragraph 441 of the Majority Report. In my opinion change in outlook is much more important than the provision of institutions in the sense that given the former the latter will be sure to follow. If a change does not take place in the mental attitude of individuals then we must, however ruefully, conclude that the present poor showing is the way the people want it and that there is nothing government or anybody else can do about it

I have, I hope, made it fairly clear that, though the expression of views has been forthright, my main object in the second part of this paper has been merely to raise the questions which seem to require answer. Such expertise as I possess extends only to statistics ; and the statistician is, on the whole, better at asking questions than at answering them. It will be well if these happen to be some of the right questions and if they are propounded in the right terms For the well-posed question, we are told, implies the right answer.

It will be evident that the foregoing was written before the Interim Report of the National Farm Survey became available It is pleasing to note that at the few points of contact of the Survey and this research the results are in good accord For instance when allowance is made for different coverage and time of reference there is no discrepancy between mean EO (column (2) of Table 6) and medium output as shown by the Survey This fact encourages our hopes, to which reference was made at the outset, of being able to integrate the Survey with the national agricultural statistics and thereby greatly extend the scope of both Also as anticipated, the variance of output on given farm size is greater than that shown in this paper, lending added force to its main argument

DISCUSSION

Dr J. Greene : I regard it a great privilege to be invited to propose this vote of thanks, and to have the opportunity to listen to Dr. Geary's paper this evening I was present when Dr. Geary first invited and met farmers' representatives to discuss the project of the National Farm Survey. Though this is not the subject of this evening's paper, I would like to say that at that time Dr. Geary did not receive immediately unanimous approval I am glad to say that he very quickly managed to win over confidence for this project, the fruits of which will soon be to hand

The only criticism I would make about the recent Surveys is that they should have happened many years ago Knowledge and reliable information can never be too great on such matters and in the end much good must come from it Even if it only helped to reduce the amount of irresponsible chatter and hot air that is associated with agriculture as a subject, it would save much time which could be devoted to better purposes. Dr. Geary's function this evening is to break down farmers into figures. My job is to use figures to build up farmers into a united front and though Dr. Geary says in his paper that farmers too often speak with a united front I do not think they have ever really achieved this desirable end.

It is worthy of note that the rural population has fallen to one-third of what it once was, which has had the effect of increasing agricultural output per man by four times what it once was. Mechanisation no doubt has assisted greatly in helping fewer people to produce as much. I think this figure provides the answer to those who believe that our present ills are due to the fact that in rural areas people do not work. It is obvious that they are working even though they may not yet be working as efficiently as they might. Dr. Geary suggests that it is his conviction that agriculture is so important from the demographic and economic point of view that it is scarcely an exaggeration to say that nothing else matters. I can agree with him from the economic point of view, but I have my doubts about the validity of this statement from the demographic standpoint. We must ask ourselves what are the requirements of agriculture on the assumption that we have 12 million acres of agricultural land in the country. On the present pattern of crop and animal husbandry ; on the more efficient farms it would appear that the labour content per hundred statute acres

would amount to only three persons, so that speaking for the country as a whole, one would expect that 400,000 people would provide sufficient labour force, and we have already got this number Increased efficiency, possibly resulting in increased mechanisation, and a certain degree of automaton would tend to reduce rather than increase this figure If we are not to progress along these lines, how are we to become competitive The degree of efficiency that would require three men to the hundred acres would, in effect, mean that we would probably double our gross agricultural output. This, no doubt, would increase our ancillary services directly associated with agriculture in rural areas, which could absorb a considerable number of people more, but I do not think it would ever be sufficient to say that it would provide a solution to our demographic problem. In most countries, agriculture are employing less and less people on the farms, and yet it is true to say that they are maintaining to some degree their labour force, in so far as a large force is required to produce machines and services which are compensating for the drift from the land In this country too, agriculture is employing labour in another form, but unfortunately, because of the fact that we are unable to re-employ them to make machines in our own country, they must move overseas To prevent the substitution of machines for labour would only mean that everybody would have to work harder and for less reward, and I do not think our people are prepared to do this Reference has been made to the standard of farming, both large and small This, in my opinion, is entirely a matter of balance between individual farm economics and national economics, and linked to some extent with ambition. Tenure of land today undoubtedly carries with it very serious obligations. Security of tenure on the larger farms is by no means gilt edged, and in addition, low utilisation carries with it considerable risks. This should provide incentives to better farming on these farms. On the smaller farms, security of tenure is absolute and other incentives to better utilisation are necessary All farms would improve a great deal if they could look into the future with confidence and reasonable stability. Education, or lack of it, is the greatest single deterrent to the achievement of optimum utilisation and productivity, and in that rests the solution of many of our recurring problems, I need not go further than to ask, what are the qualities we regard necessary in deciding on the vocations of our sons and daughters.

It may be difficult to find the actual reasons which explain the differences, both demographic and economic, found statistically, between large and small farms In Dr. Geary's own words there is no typical farm, small or large, and so the fallacy in his argument here is that he creates a typical small farm and compares it with a typical large farm I cannot accept his conclusions as sufficient pointer with regard to future policy on the matter At this stage it is too early to speak of manpower density, which if enforced and carried to extremes might mean little more than the creation of rural slums.

On the question of cattle there is much with which I would agree with him. Unnecessarily carrying older stock is wasteful I think small farms tend to over-stock, which results in maintaining our cattle for too long a period An attempt should be made to finish as many of these cattle as possible on the farms on which they were

born, by holding less and selling the surplus earlier The comparison of the numbers of cattle on smaller and larger farms probably has its origin in the fact that the smaller farms carry stores and the larger farms are attempting to fatten, and so can carry less to the acre

Much has been said about variability, family incomes show a tremendous variation, and so does the type of farming practised, and the degree of utilisation It is a big problem to tackle, and I believe the solution is to be found in a better understanding and knowledge of farm management and expected return on investment Each farmer must know what he is entitled to, what is the immediate return for his capital and labour It is up to our advisory officers to see that farmers know what this figure is, and to explain to them how it can be achieved on any existing pattern of prices He must then demonstrate how greater efficiency can give even better return. This is where they are likely to clash with Dr. Geary, as it will inevitably mean greater output per man, and this will upset the demographic picture Nothing that can be said about management can be overstressed and in this the farmer himself must be the specialist He can go elsewhere for other specialist advice, but unless he himself is a specialist in management, optimum returns could not be achieved I agree also that the account book is the principle instrument in efficient farm management, and unfortunately most of our farmers have a horror for book-keeping of any sort. The rising generation will require sound schooling in accounts, because even advice unsupported by figures can be very unconvincing

I will go a long way with General Costello's view on the problem of small farmers having other forms of employment This raises a social as well as an agricultural problem, which requires attention

The interdependence between rural and urban dwellers requires to be brought forcibly to mind from time to time The subsistence level of agriculture, the basic industry of the country, needs to be understood by all. Rumours of prosperity among the farmers should be a matter of rejoicing in urban areas, because it is the pulse by which the economic health of the nation can best be judged.

Dr. Geary doubts if the rural community are very responsive to stimuli, but the most constant stimulus they have ever known is depression For generations they have been made feel superfluous to the national programme and socially inferior—"the bloke with mud on his boots" Given a policy, given a change of attitude and the means with which to meet an imperfect situation that actually exists, I believe they will respond to get us over our immediate difficulties. Our ultimate objective of course, must be in our ability to face competition where it is fair competition. The majority of the competition we have to meet at the present day is subsidised competition in one form or another.

I do not think we have anything to fear from a "united front" It has been sadly lacking in the past with the result that the tendency is to blame the other fellow. Public authority has failed to do the most obvious thing over past years, and that is to encourage and educate the farmers to the point of active responsibility for agricultural progress. In other words where you have rights you also have responsibilities.

I do not know if I have helped Dr. Geary very much in answering any questions, but his paper has been a long one, and it is difficult, to cover all his points in a short time, nor do I think there is any easy answer to all of them He has stimulated us to grapple with these problems, and the answers of course must be found some day

I have much pleasure again in proposing a vote of thanks and hope that my colleagues who will follow me will have something more helpful perhaps, by way of comment, to offer him

Senator Professor Joseph Johnston The elaborate statistical technique (to which I do humble obeisance) has given chapter and verse for what we already knew—that there are very wide variations in the output per person and per acre on farms of similar size and quality

If the less efficient farms could be graded up to the level of the average we would probably double the real national income and if they could all be graded up to the level of the most efficient we would have here a real Utopia and the millennium would be at hand.

The problem of doing so is mainly a human one

With much of the commentary I agree especially with the statement that the incidence of inefficiency is higher in the smaller farms Inefficient large farms carrying aged stores are themselves the result of inefficient small farms starving their calves and young cattle in the first two critical winter periods

I know of large inefficient grazing farms of unimproved land whose owners have regularly made money out of aged badly reared stores Another farmer who was highly efficient and (foolishly) bought this same herd of cattle (run of the mill stores) poured good food down their aged throats and never made more money than an agricultural labourer.

He got out of farming in good time and is now better off as a "rentier"—at 5 per cent interest

Irish farming has been twice ruined in our life time and cattle played a major part in both In the Economic War they were the chief victims In the period since 1939 the long continued upward trend in dry cattle prices till 1955 made cattle owning a speciality in which all sizes of farms could make money too easily.

When I was a politician I got into trouble for suggesting that this upward trend of cattle prices should be resisted by an export tax on cattle, and the money used to subsidise feed barley growing for expanded pig production Every size of farmer wanted my head on a lamp post!

Of course it was not practical politics but if it could have been done the recent precipitous fall in cattle prices could have been evened out by removing the export tax—and a great many farmers, big and small, would be on better terms with their bankers today.

References

[1] R A Fisher and F Yates *Statistical Tables*, 1953, pp 27, 80

[2] J O Jones "The Productivity of Major Factors in British Farming," *The Farm Economist*, Vol VIII, No 4, 1955, p 11

[3] J O Jones *Op cit* [2] No 5, 1956, pp 11-12

[4] *Agricultural Statistics 1847-1926*, Report and Tables, p 144

[5] *Tables of the Incomplete Γ- Function* Edited by Karl Pearson, F R S Office of *Biometrika* Re-issue, 1951

[6] M Murphy: "Financial Results of Sixty-one West Cork Farms in 1940-41," *Journal of the Statistical and Social Inquiry Society of Ireland*, April, 1942, p 11

[7] R O'Connor "Financial Results on Twenty Farms in mid-Roscommon in 1945-46," *Journal*, October 1948, p 15

[8] Kevin O'Sheil: *Public Administration in Ireland*, Vol III, Civics Institute of Ireland, p 295

[9] R C Geary "The Family in Irish Census of Population Statistics," *Journal*, October, 1954, p 9

[10] *Op cit* [4], p lxi

[11] R C Geary. "Irish Economic Development since the Treaty," *Studies*, December, 1951, p 410

[12] C H Blagburn "Some Economic Aspects of Increasing Farm Output," *University of Reading, Department of Agriculture*

[13] R. C Geary "The Mortality from Tuberculosis in Saorstát Eireann: A Statistical Study," *Journal*, June 1930, p 75

[14] T K Whitaker: "Capital Formation, Saving and Economic Progress," *Journal*, May, 1956, p 7

[15] *Dollar Exports—Report of U S Consultants* Published by Córas Tráchtála Teo, p 3

[16] R O'Connor "A Living from the Land," *Studies*, Winter, 1955, p 403

[17] *Commission on Emigration and Other Population Problems—Majority Report*, pp 86-87