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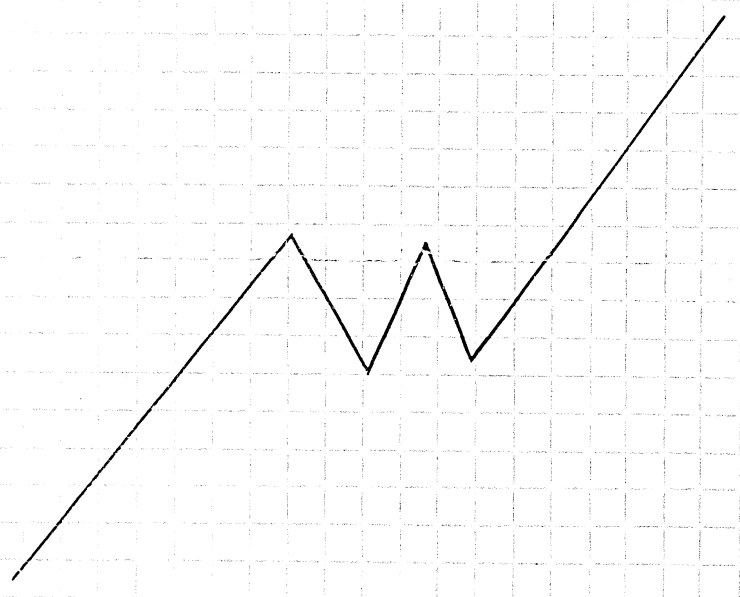

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REQUIREMENTS FOR CONTRIBUTIONS

Deserving articles in the field of agricultural economics, for publication in this journal, will be welcomed.

These articles should have a maximum length of 10 folio pages (including tables, graphs, etc.), typed in double spacing. All contributions should be submitted in triplicate (preferably in both languages) to the editors, c.o. Department of Agricultural Economics and Marketing, Pretoria, and should be received by the editors at least one month prior to publication date.

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Determination of an Economic Farming Unit

by
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Division of Economics and Markets

One of the most harassing problems of the supplier of credit to agriculture is undoubtedly the determination of the so-called "economic unit". Determiners of policy also wrestle with this problem, which comes to the fore especially in times of shrinking profit margins. Agricultural extension, both technical and economic, is also edeavouring to find a basis for defining the minimum economic size of farming units. And, in the last place, the farming community also is in urgent need of guidance with respect to economic farming units, since the future of many a farmer is closely bound up with this question.

Problems in determining an economic unit

The calculation of economic farming units is rendered difficult by the following problems:

(a) Climatic factors, which show great variations even within a small area.
(b) Variations in physical potential, for example, soil type, depth and quality, type and quality of veld grazing, water supply, distance from market, situation, etc.
(c) The relationship between resources, such as between cultivated land and pasture, between cultivated land under irrigation and dry land, between soil types on croplands, between veld types, etc., will have a determining influence on the "economic size" within a relatively small area.
(d) The personal ability of the farmer as manager of his business also to a large extent determines the size of the farming unit. In practice, countless examples are found, on the one hand, of farmers who do very well on small units and, on the other, of farmers who make a precarious living on larger farms in the same area. Frequently the individual is found to be responsible for this difference.
(e) The minimum requirements of the farmer and his family are another factor determining the size of the economic unit. The age of the farmer, his financial position, his standard of living, objectives, number of children, etc., are all factors dictating the net living requirements*. To these must be added amounts required for capital redemption, interest on loans

*Net living requirements are the amount of net income required by the farmer and his family before making any provision for farming expenses, capital redemption or interest costs.

ERRATA

Page 25: Example III - First line, has to read ... "Farm in Bethal, 490 morgen ..

Page 27: Example I, Farm size, morgen has to read ... 270 instead of 720.

Example III, Farm size, morgen has to read ... 490 instead of 500.

and the provision of capital for purposes of movable and working capital. It is therefore clear that the capital strength of the farmer will influence the size of the net income required; a farmer who has already paid for his land and met his requirements of movable capital, will, of course, be able to manage with a smaller amount every year.

(f) Price relationships between products as well as price levels will also affect the economic unit. This is true especially of changes in price relationships between field and pastoral products.

What is an economic unit?

From the foregoing it is clear, therefore, that it is virtually impossible simply to lay down a certain size as an economic unit within a district or a particular area.

There is but one scientific way of determining an economic unit on a sound basis: it must be calculated for every individual case. A budget has, therefore, to be worked out in order to estimate the net income, allowing for limitations of climate, physical potential, the farmer as manager, living requirements, capital requirements and price relationships.

Thus, the size of an economic farming unit will vary according to both the potential of the farmer and the other factors mentioned.

From a national viewpoint, the limits of an economic unit should be determined in such a way that future operators will also be able to make a living on such a unit. The limit cannot be based on the level of the "best" farmer - if this farmer should die (or sell the farm), an average or incompetent farmer might take over. Neither can it be based on the "incompetent" farmer - the units would then have to be too large. On a national level the economic unit must therefore be determined on the basis of the "average" operator's ability as manager and on his living requirements. The incompetent manager who might take over, would then find the unit "uneconomic". True, but a rationally planned agriculture, with its great capital needs and vulnerable resources, cannot afford to have incompetent operators.

A reasonable "safety margin" should also be allowed for above the calculated economic limit - to serve as a shock absorber in the event of changes in price relationships, cost structure, marketing, etc. Technological developments may, to a large extent, provide this safety margin, although the application of such developments in practice (and particularly on small units) is a slow process. In view of the importance of decisions in this respect, a safety margin of about 10 per cent above the calculated unit will probably not appear unduly large.

An economic unit can then be defined as a unit (size) which will provide the operator of average managerial ability with a reasonable standard of living after provision has been made for -

(a) climatic and physical limitations;
(b) price and cost relationships;

(c) capital redemption, and interest costs;
(d) capital formation in respect of movable capital and working capital; and
(e) a safety margin to allow for future changes in cost structure, marketing, productivity, etc.

Determination of the net living requirements

In all sectors of the national economy a wide distribution of incomes is found. The level of income of a certain group of persons is necessarily such as to necessitate a comparatively low standard of living. Luxuries and university education for their children are beyond their means. They are nonetheless able to maintain a decent (though simple) standard of living, and their children have access to a variety of occupations offering good prospects.

In the sphere of agriculture the marginal units or smaller units (just above the economic limit) should be viewed in the same light. An economic unit is defined by some as a unit which will, for instance, enable the farmer to give his children a university education. If this definition were correct, agriculture would probably be one of the best-paid sectors of the country's economy; which would, however, also mean that intending farmers would require so much capital that it would be even more difficult than today to start farming.

Socio-economic research, with the sole aim of determining the minimum basic living requirements of an average farmer and his family, is the primary basic requirement for the correct determination of economic units. A survey to ascertain the number of children, household expenses, housing, medical expenses, transport costs, educational costs (children), clothing, insurance and other family expenses, will first have to be made. An average family of, say, three or four children may be used as a norm.

The net living requirements as determined should cover only family expenses and not farming expenditure. In calculating such net amount, provision should be made for transport costs (part of the vehicle costs will be borne by the farming enterprise). Persons in the city receiving a comparable income can make use of public transport. To the farmer some form of conveyance is absolutely necessary for his farming operations and for his private life.

For the purpose of this article, and to serve only as an example to illustrate the calculation of an economic unit, an arbitrary net income of R1,000 plus R200 for transport, i.e. R1,200, is assumed to be the minimum net living requirements.

Total net income

To the net living requirements still have to be added interest and redemption, capital formation (working capital and movable capital) and the so-called safety margin. A farmer who has his own capital (even if only in part) has, of course, the interest earnings on such capital for paying living expenses. Therefore, only the actual interest and redemption costs should be added to the net living requirements.

When calculating an economic unit in practice, the debt position of the farmer will be known or a debt ratio will have to be decided on. For the purposes of this article an arbitrary burden of debt of R8,000 is assumed, which has to be redeemed at the rate of 7% (including interest with redemption). This comes to R560 per annum.

Most smaller farms experience a shortage of movable and working capital. The agricultural financier must realise that this capital has to be accumulated from profits, just as fixed capital (land and improvements) grows from profits. For this reason a small, conservative amount of R200 per annum is taken for movable and working capital formation. Because working capital depreciates, a farmer cannot accumulate more than R4,000-R5,000, with a gratification of R200 per annum, over a period of 40 years.

The total net income per annum should therefore be:

Net living requirements	R1,200
Interest and redemption	R 560
Capital formation	R 200
Total	R1,960
Plus safety margin (10%)	R 196
Total	R2,156

The net income of R2,156 may seem high, but in practice it ensures no more than a precarious living to the receiver of such income. It is true that the farmer concerned will, after 40 years, have an accumulated capital of about R18,000, but it should be realised that he cannot live on this, or utilise it, during his lifetime. And with an average family of three children (farmers on smaller farms usually have more), the capital is reduced at death to R6,000 per heir.

Standards necessary for calculating an economic unit

Before it is possible to start with the calculation of an economic unit, agricultural economic research must first provide a series of standards. Similarly, technical research must be able to give an indication of the potential of various soil and veld types.

The following technical information is required:

(a) The potential of various veld types (in other words, the carrying capacity) at different stages of division into camps, rotational grazing and management.

(b) The potential of various soil types according to rainfall, age of soil (years cultivated), condition of soil and, of course, the physical factors, such as soil type, depth, structure, slope, acidity, etc.

The results of the technical research referred to in the foregoing are basic, not only for the determination of economic units but also for any purposeful planning in agriculture.

Economic research must furnish the following information:

(a) The relative profitability of various farming enterprises at different yield levels. These yield levels, of course, depend on the soil potential, management, production practices, etc.
(b) The production requirements in terms of working capital, mechanisation, labour, credit, etc., at the various yield levels.
(c) The expected price and cost structure will, as far as is practicable, have to be estimated for the future, in order to make adjustments for this by means of estimates.

Both technical and, in particular, economic research fall far short of the minimum requirements set by the needs of the present time. The necessity for formulating a basis, on which economic units can be determined, cannot be overemphasised. Research, it is hoped, will be able to make up the leeway in the more distant future. For the immediate future available information, however meagre, may, if sound judgment is applied, nevertheless be used to advantage.

Calculation of an economic unit

The standards used in the calculations below are not absolute standards but computed or estimated standards based on the limited information available. The standards relate to the lighter soils of the Transvaal Highveld, and only one crop (maize) together with a number of intensive and extensive livestock enterprises are used for illustration. (See standards in Annexure).

The method of calculation is as follows:

(a) A crop-rotation system which includes some soil-building crop or other, sich as a legume or ley crop, is, of course, considered essential. These soil-building crops are usually fodder crops. The better the soil, the smaller the percentage of soil-building crops, and vice versa. There is, however, a group of scientists who assert that on average and good soils the incorporation of plant residues and inorganic fertilisers suffices for the maintenance of soil fertility.
(b) After the choice of a crop-rotation system has been made, the morgenage of potential fodder crops (soil-building crops) is now known, say x morgen. Usually silage, hay and root crops have to be added to this so as to be able to provide a balanced roughage ration. Then add 25 per cent to the "x" morgen, in order to obtain the total available morgenage of fodder crops*.

*If animal husbandry efficiently utilises the soil-building crops, it is complementary to field husbandry. But with this 25% of additional fodder crops, animal husbandry already enters the competitive phase in respect of field husbandry. However, the silage and root crops are essential and usually give a high marginal productivity above the soil-building crops, which normally are hay or grazing crops.

(c) Now calculate the number of the large-stock units (L.S.U.) that can be kept on the veld. Divide the morgen of fodder crops by the number of L.S.U. to get the morgen of fodder crops available per L.S.U. Next read from Table 2 (Annexure) which type of livestock will be best adapted in this locality. Naturally, intensive stock require more fodder crops per unit than extensive stock. Similarly high-producing dairy cattle, for example, need more fodder than poor producers.

As a result of the existing price relationships between field husbandry and animal husbandry, the highest profits are obtained when animal husbandry is included up to the level where it will fully and optimally utilise the pasture and the crop-rotation products. If the correct type of livestock (for example, extensive on a particular farm) is therefore included, animal husbandry and field husbandry will be complementary to each other. If the wrong type of livestock (dairy cattle instead of sheep) is included, livestock will now become competitive with field husbandry, because more morgen of fodder crops will be required. And with current price relationships, animal husbandry cannot compete with field husbandry on an equal footing (i.e. of efficiency). When the level (efficiency) of animal husbandry is higher than that of field husbandry, the position changes, of course.

(d) The crops to be cultivated, as well as the livestock enterprises, are not known. With the aid of Table 1 (Annexure) the expected net income can now be calculated. Note that the cultivation costs of fodder crops have been included in the costs of pastoral production. Therefore take only the morgen of cash crops and the number of L.S.U. and multiply these by the expected profit. Be careful in choosing a profit margin - the quality of soil and animal must be seen in relation to the average farmer taken as a basis for the calculations. (See tables in Annexure).

The calculated net income may then be compared with the minimum net income required, so as to be able to decide whether or not the farm is an economic unit.

EXAMPLES OF CALCULATION

EXAMPLE 1

Farm in Bethal, 270 morgen in extent, with 120 morgen of lands of average quality and 150 morgen of pasture. With average management the lands can yield 20 bags per morgen. The carrying capacity of the veld is $1\frac{1}{2}$ morgen per L.S.U.

Step 1: Calculate morgenage of potential fodder crops

On average soil, for example, 20% soil-building crops will have to be planted, i.e. 24 morgen on this farm; add 25% for silage and root crops - a total of 30 morgen of fodder crops is, therefore available. There will thus be 90 (120-30) morgen of cash crops.

Step 2: Decide on type of livestock

With 150 morgen of veld and a carrying capacity of $1\frac{1}{2}$ morgen per head of cattle, 100 L.S.U. can be kept. Therefore, there is $\frac{30 \text{ morgen}}{100 \text{ L.S.U.}} = 0.3$ morgen of fodder crops available per L.S.U. According to Table 2(b) in the Annexure, this indicates the nutritional requirements of extensive livestock (at the second highest production level). Sheep are more profitable than beef cattle, but a sheep/cattle ration of, say, 1 cattle L.S.U. to 1 sheep L.S.U. (= 6 sheep) is known to be essential for good veld control. Consequently 50 L.S.U. of sheep and 50 L.S.U. of beef cattle are decided on.

Step 3: Decide on expected profit levels and calculate net income:

90 morgen of maize @ R15/morgen profit	=	R1,350
50 sheep L.S.U. @ R8/L.S.U. profit	=	R 400
50 cattle L.S.U. @ R6/L.S.U. profit	=	R 300
TOTAL	=	R2,050

According to a calculation earlier in this article, a net living requirement of R2,156 is the limit of an economic unit. This farm, therefore, has a shortfall of R106 when average production levels are assumed. An above-average manager can easily make this an economic unit, but from a policy viewpoint the limits of economic units should be based on the average farmer. In practice this farm will therefore have to be treated as a marginal case.

EXAMPLE II

Farm in Bethal, 160 morgen in extent, with 100 morgen of high-quality lands (25 bags per morgen with average farmer) and 60 morgen of veld with a carrying capacity of $1\frac{1}{2}$ morgen per L.S.U.

Step 1: Very good soil requires a lower percentage, say 15% of soil-building crops - i.e. 15 morgen in all. Now add to this 25% root and silage crops. Therefore, there are 19 morgen of fodder crops and 81 morgen of cash crops available.

Step 2: 40 L.S.U. may be kept. (60 morgen of veld at $1\frac{1}{2}$ morgen/L.S.U.) Thus there is $\frac{19 \text{ morgen}}{40 \text{ L.S.U.}} = 0.5$ morgen of fodder crops available per L.S.U. According to Table 2(a) (good soil) this is sufficient fodder for intensive livestock of the highest production level (0.5 morgen of fodder crops per L.S.U.) Since the calculations are based on an average farmer, the second highest production level is however accepted, and fresh-milk production is planned.

Step 3: Calculate profit levels:

81 morgen of maize @ R22/morgen profit	=	R1,782
40 L.S.U. of dairy cattle @ R11/L.S.U. profit	=	R 440
TOTAL	=	R2,222

According to the accepted net living requirement of R2,156, this farm is an economic unit by a very narrow margin.

It may now be argued that if intensive stock were included in the case quoted in Example 1, it could easily be an economic unit. If 100 L.S.U. of dairy cattle (for cream) of the second highest production level are kept, 50 (100 x 0.5) morgen of fodder crops are required. Therefore:

70 morgen of maize @ R15/morgen profit	=	R1,050
100 L.S.U. of dairy cattle (cream) @ R8/L.S.U. profit	=	R 800
TOTAL	=	R1,850

The inclusion of more intensive dairy stock (for cream production) therefore yielded R200 less, which means that the inclusion of more intensive stock, which require additional morgen of fodder crops, cannot compete with cash crops.

As has already been mentioned, animal husbandry can compete with field husbandry, provided stock of a very high productivity is kept. If it is proposed to produce fresh milk instead of cream, the profit per L.S.U. will rise from R8 to R11, and the calculation will then be as follows:

70 morgen of maize @ R15/morgen profit	=	R1,050
100 L.S.U. of dairy cattle (fresh milk) @ R11/L.S.U. profit	=	R1,100
TOTAL	=	R2,150

Fresh-milk production gives R100 more profit than the original planning with extensive stock. Animal husbandry can, therefore, be competitive with field husbandry, provided intensive stock of high productivity is kept. It is evident that with dairy stock of poor quality, animal husbandry would not be able to compete with field husbandry.

EXAMPLE III

Farm in Bethal, 500 morgen in extent, with 160 morgen of indifferent land (average potential 15 bags of maize per morgen) and 330 morgen of veld with a carrying capacity of $1\frac{1}{2}$ morgen per L.S.U.

Step 1: The indifferent-quality land will have to carry, say, $33\frac{1}{3}$% soil-building crops per annum, i.e. 53 morgen. Add 25% for root and silage crops to get 66 morgen of fodder crops and 94 morgen of cash crops.

Step 2: On the available pasture 220 L.S.U. can be kept. Thus there is $\frac{66 \text{ morgen}}{220 \text{ L.S.U.}} = 0.30$ morgen of fodder crops per L.S.U. available. According to Table 2(c) this indicates extensive stock of the second lowest production level. A sheep/cattle ratio of 1:1 L.S.U. is assumed.

Step 3: Calculate profit levels

94 morgen of maize at R8 profit/morgen	=	R 752
110 L.S.U. of sheep @ R4 profit/L.S.U.	=	R 440
110 L.S.U. of beef cattle @ R3 profit/L.S.U.	=	R 330
TOTAL	=	R1,522

This farm, therefore, is not an economic unit.

However, it has already been mentioned that when the level of animal husbandry is higher than that of field husbandry, animal husbandry can under present price relationships be competitive with field husbandry. Suppose the farmer in Example III decides to keep stock of the second highest quality, since his lands are very poor for cash crops. What will happen then? According to Table 2(c) extensive stock of that quality will require 0.4 morgen of fodder crops per L.S.U.

Thus 220 L.S.U. x 0.4 morgen = 88 morgen of fodder crops will be required, leaving 72 morgen for cash crops.

Calculated profit levels

72 morgen of maize @ R8 profit/morgen	=	R 576
110 L.S.U. of sheep at R8 profit/L.S.U.	=	R 880
110 L.S.U. of beef cattle at R6 profit/L.S.U.	=	R 660
TOTAL	=	R2,116

With an accepted R2,156 necessary for an economic unit, this farm can now be regarded as an economic unit.

Note that when croplands are poor, stock of higher quality and intensity can raise the unit's profit margin. With good soils (see example of dairy cattle in Example I) more intensive stock is not likely to give a greater profitability than field husbandry.

SUMMARY OF EXAMPLES

The three examples of Bethal farms may be summarised as follows:

Example	Farm size morgen	Land morgen	Veld morgen	Quality of land	Quality of veld	Estimated profit
						R
I	720	120	150	Average	Average	2,050
II	160	100	60	High	Average	2,222
III	500	160	330	Indifferent	Average	2,116

With correct planning (for optimum profit), three Bethal farms of varying extent, ratios between veld and lands as well as quality of soil, and with average management, barely succeeded in attaining the limit of an economic unit (R2,156). In practice a still greater variation in soil and veld quality is found than that indicated above. For this reason it is not possible in practice to determine summarily the limits for economic units, except in the case of exceptionally homogeneous regions. The limits will have to be calculated.

SUMMARY

Climatic factors, relationship between resources, variations in physical potential, the managerial ability of the farmer, his living requirements and those of his family, and price relationships are the determining factors in calculating an economic unit. There is but one scientific way of determining an economic unit on a sound basis: it should be calculated for every particular case. Economic units should be determined on the basis of the managerial ability of the average farmer and his living requirements. A safety margin will also have to be introduced, in order to absorb changes in price relationships, cost structure, etc. Technological advancement may, however, serve as a shock absorber.

An economic unit is defined as a unit (size) which will provide the operator of average managerial ability with a reasonable standard of living, after making allowance for climatic and other physical limitations, price and cost relationships, capital redemption, interest costs, capital formation in respect of movable capital and a safety margin.

Socio-economic research will have to determine the minimum net living requirements of farm families. It will be the task of economic research to ascertain the maximum permissible debt ratio.

A complete set of technical and economic standards is required for the calculation of economic units. Therefore technical and, in particular, economic research will have to give high priority to the formulation of practical standards if economic units are to be determined.

By employing the principles and methodology of farm-enterprise planning, the potential income of various farming units can be calculated. With correct planning of three Bethal farms of various extent, all three barely attained the accepted level of an economic unit. In practice still greater variations in soil and veld quality are found.

For this reason it is not possible in practice to determine summarily fixed limits for economic units, except in the case of exceptionally homogeneous regions. The limits will have to be calculated.

ANNEXURE

CALCULATED STANDARDS*

Table 1. Profit margins of field husbandry and animal husbandry enterprises with average managerial ability and varying potential

1.	MAIZE:	SOIL POTENTIAL (BAGS OF MAIZE PER MORGEN)				
	Bags per morgen	30 bags	25 bags	20 bags	15 bags	10 bags	6 bags
	Profit per morgen	R30	R22	R15	R8	0	-R8
2.	FRESH MILK:	FRESH MILK (POTENTIAL)				
	Gross income per L.S.U.	R100		R75	R50		R30
	Profit per L.S.U.	R 20		R11	R 5		-R10
3.	FACTORY MILK:	FACTORY MILK (POTENTIAL)				
	Gross income per L.S.U.	R 80		R60	R40		R20
	Profit per L.S.U.	R 16		R 9	R 4		-R 8
4.	CREAM:	CREAM (POTENTIAL)				
	Gross income per L.S.U.	R 70		R50	R35		R20
	Profit per L.S.U.	R 14		R 8	R 4		-R 8
5.	SHEEP:	SHEEP (POTENTIAL)				
	Gross income per L.S.U.	R 40		R30	R20		R10
	Profit per L.S.U.	R 12		R 8	R 4		R 0
6.	BEEF CATTLE:	BEEF CATTLE (POTENTIAL)				
	Gross income per L.S.U.	R 25		R20	R15		R10
	Profit per L.S.U.	R 10		R 6	R 3		R 0

* Notes:

1) These standards are for the lighter soils in the Transvaal Highveld, estimates being given where data are lacking. The standards are not to be regarded as absolute, but are merely given by way of illustration.

2) Interest has not bee included in the costs.

3) Only one crop is given for purposes of illustration.

Table 2. Morgen of fodder crops required per L.S.U. in the case of three soil types*

(a) GOOD SOIL	Production level of livestock			
	1	2	3	4
Fresh milk	0.5	0.4	0.3	0.2
Factory milk	0.5	0.4	0.3	0.2
Cream	0.5	0.4	0.3	0.2
Sheep	0.5	0.4	0.1	0.05
Beef cattle	0.5	0.4	0.1	0.05
(b) AVERAGE SOIL	Production level of livestock			
	1	2	3	4
Fresh milk	0.6	0.5	0.4	0.3
Factory milk	0.6	0.5	0.4	0.3
Cream	0.6	0.5	0.4	0.3
Sheep	0.4	0.3	0.2	0.1
Beef cattle	0.4	0.3	0.2	0.1
(c) INDIFFERENT SOIL	Production level of livestock			
	1	2	3	4
Fresh milk	0.7	0.6	0.5	0.4
Factory milk	0.7	0.6	0.5	0.4
Cream	0.7	0.6	0.5	0.4
Sheep	0.5	0.4	0.3	0.2
Beef cattle	0.5	0.4	0.3	0.2

*ACCEPTED PERCENTAGES I.R.O. SOIL-BUILDING CROPS

On good soil	-	15%
On average soil	-	20%
On indifferent soil	-	33 1/3%