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INTENSIVE GRASSLAND USE AS A CONSEQUENCE OF ECONOMIC DEVELOPMENTS IN
DAIRY FARMING

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SUMMARY

Intensification of grassland use can be defined as changes in utilization, leading to an increase of production per hectare. The main instruments are nitrogen, concentrates and improvement of management.

Intensification is a part of the whole economic process in agriculture. In this process technological progress leads to intensification, improved equipment and an increase in labour efficiency. As a result productivity goes upwards. This leads to an increase in prosperity. Higher productivity and prosperity bring about changes in price ratios and in farm structure, which in turn give new impulses to intensification, mechanization and improvement of labour efficiency as well as to technological progress.

In the Netherlands at the moment milk production per hectare of forage is almost five times as much as it was 80 years ago. This is both caused by more milk per cow and by more cows per hectare. Especially in the seventies the development has gone very fast.

During the last 30 years stocking rate increased on medium sized and larger Dutch dairy farms by 75%, milk yield by 35%, nitrogen use per hectare by more than 500% and concentrate use per cow by about 400%. To some extent, increase in stocking rate is related with increase in nitrogen use and increase in milk yield is related with increase in concentrate use.

Intensification and use of fertilizers and concentrates seem to be affected much by price developments. During the last 30 years price developments have been very favourable for fertilizers and concentrates and very unfavourable for land and labour (compared to output prices). In addition even the choice between more nitrogen and more concentrates might be explained to some extent by price developments.

The acceleration of intensification in the seventies should be connected first of all to structural developments in Dutch dairy farming. Possibilities to reduce labour force per farm have diminished and the introduction of the cubicle housing system stimulated the increase of cows per man.

The use of more nitrogen and concentrates is closely related to an improvement of management methods. Moreover, improvement of management is the main factor for a better utilization of available grass and growing days and for a better quality of the roughage.

Future does not look too bright as far as prices and quotas are concerned. However, the investments which are made for production capacity and the improvement in working methods and in management will prevent a turnback of developments along historical lines. An eventual curtailment of production will affect concentrate use more than nitrogen use as to maintain revenues from grassland exploitation.

Figure 1 Intensification as a part of economic process in agriculture.

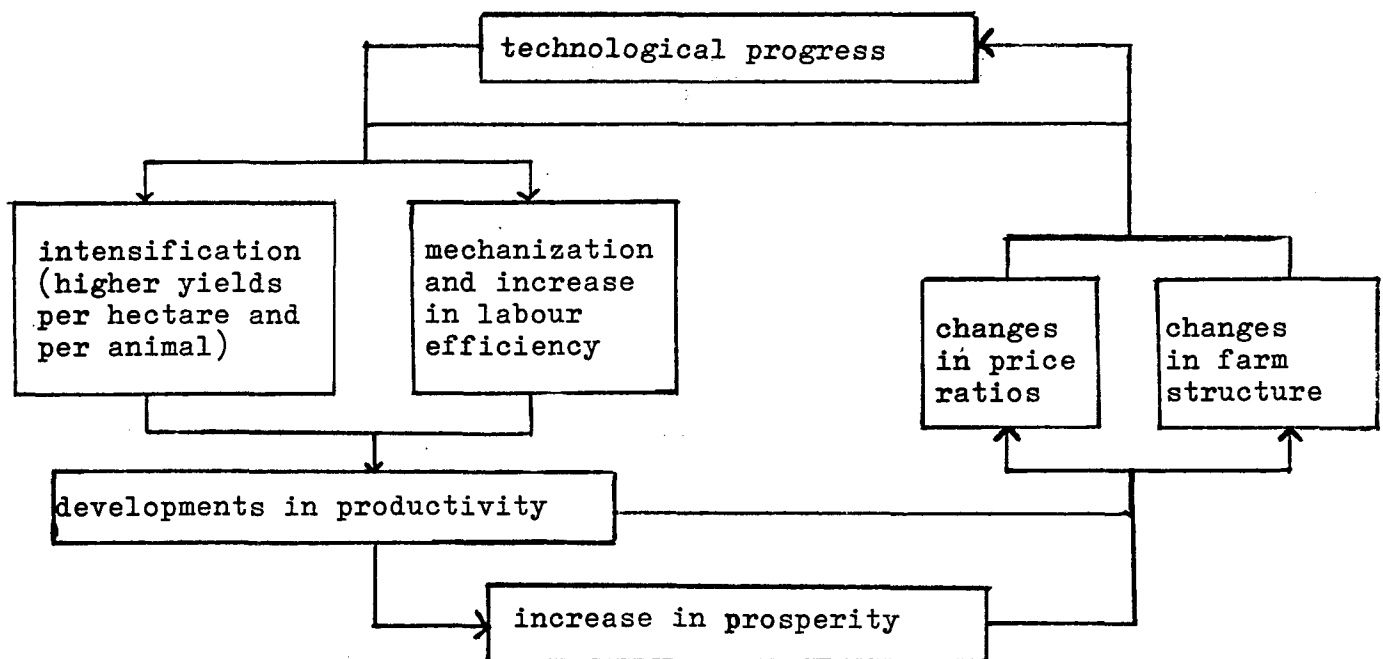
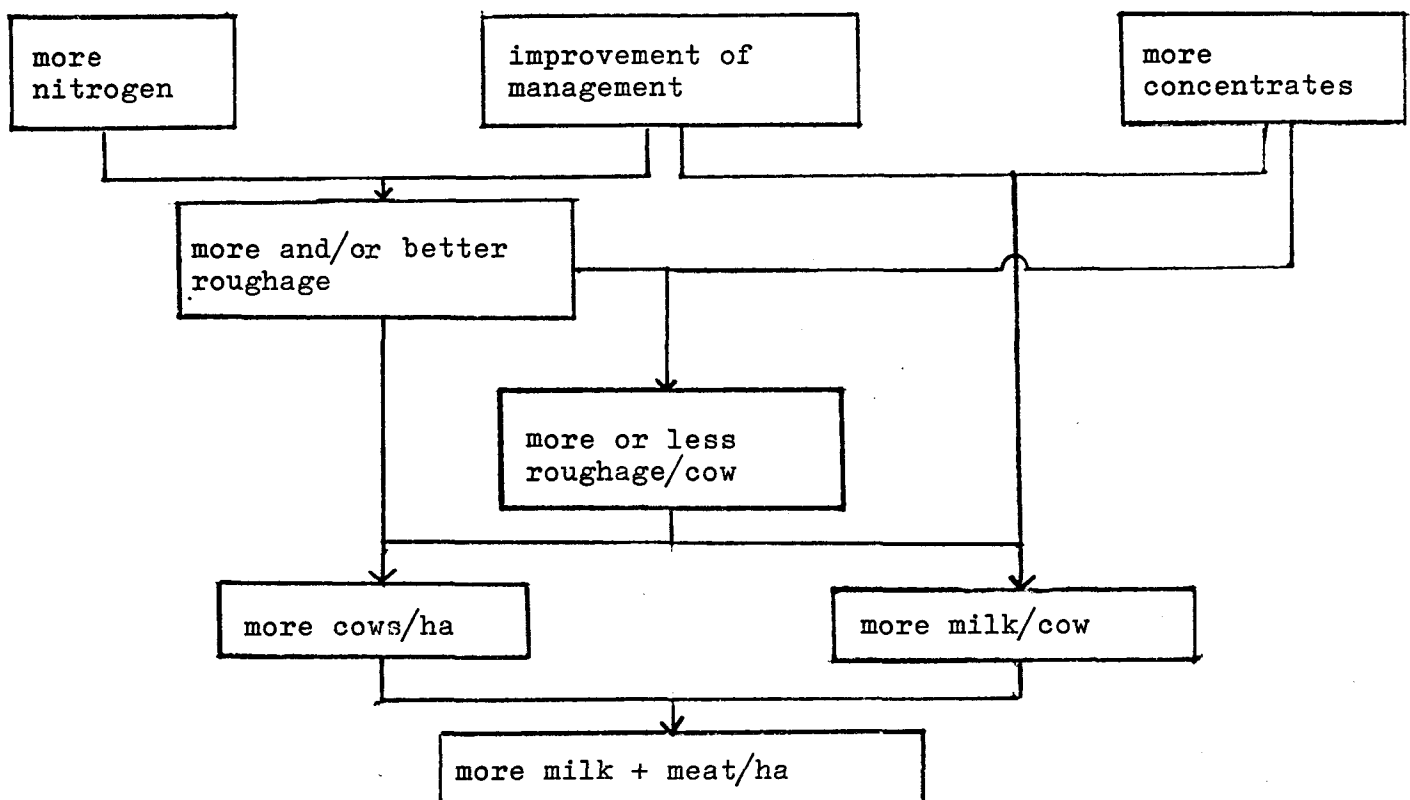


Figure 2 Intensification of grassland use on dairy farms.



Introduction

Thirty-five years ago the Netherlands as well as Western Europe in general, were highly impoverished by the second World War. To satisfy the needs of the country and to contribute to the redevelopment of exports, farmers were activated to improve crop yields, to increase the numbers of animals and to raise milk yields. The agriculturists were asked to explore new farming methods as to find the best conditions for a sharp increase in production.

All these people did a very good job. In 1949 total milk production already recovered to the pre-war level and in the following thirty years it doubled. In 1950 the number of dairy cows did recover and since that year it increased by more than 50%.

At present plenty of milk and meat is produced in our country as well as in the European Community. Unfortunately even more than is needed by the home market or by the world market (at reasonable prices).

By now, the farmers and agriculturists in the Netherlands and in other European countries are asked what for goodness' sake they have done. And they are asked to take care that less milk will be produced as to reduce imports of energy and raw materials and to save some space for protection of nature and landscape.

Briefly spoken that is what this symposium about the use of nitrogen and about intensive grassland production has to do with general economic problems. At first sight it might be a little bit confusing, but that is because economics are a part of real life.

As far as intensification of grassland use is concerned, it is just the same as with all other things: the more there is the less is the usefulness (economists have called this the first law of Gossen).

Intensification as a part of economic process

Which role does intensification play in the whole agricultural economic process? In general lines this is illustrated in figure 1.

The relations are complicated. Technical progress leads to intensification, that is higher yields per hectare and per animal, to improved equipment and to an increase in labour efficiency. As a result of intensification, mechanization and increase of labour efficiency, productivity goes upwards, particularly productivity of land and labour. This leads to an increase in prosperity in agriculture.

Higher productivity and prosperity bring about changes in price ratios and in the structure of the agricultural sector.

Note to figures 3 up to 10 inclusive :

These figures are the result of own calculations and estimations on the basis of data of:

- Ministry of Agriculture and Fisheries (3).
- Netherlands Central Bureau of Statistics (4, 5, 8, 9, 10).
- Agricultural Economics Research Institute (6, 7, 8, 9).
- Farm Buildings and Equipment Advisory Service (10).

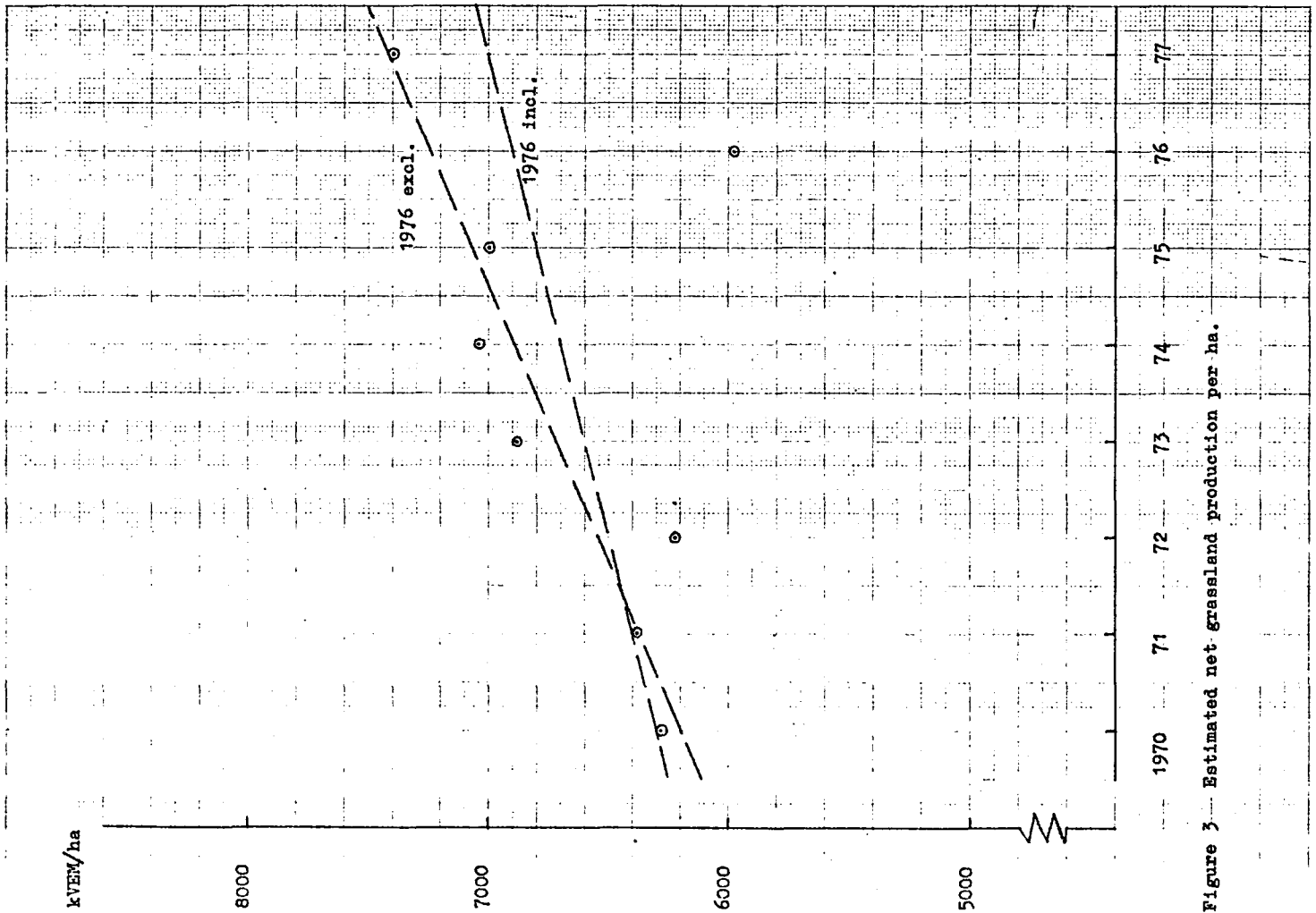


Figure 3 - Estimated net grassland production per ha.

Changes in prices and in farm structure give new impulses to intensification as well as to mechanization and improving labour efficiency. Moreover, they invite for the introduction of new technics, by which the circle is closed.

Technical progress is the starting point of the whole process, increase of prosperity (in a wide sense) is the final result. Farm management is concerned with the intermediate stages of intensification, mechanization, changes in prices and changes in farm structure.

Intensification of grassland use

What is intensification of grassland use? Intensification of grassland use can be defined as changes in utilization leading to an increase in quantity and/or quality of the production per hectare. The way in which this is realized is demonstrated in figure 2.

More nitrogen and better management lead to more roughage per hectare, to a better quality of the product and, as a consequence, to more cows per hectare. More concentrates and better management lead to more milk per cow. More cows per hectare and more milk per cow lead to a larger production per hectare. Indirectly stocking rate and milk yield are also influenced by the use of nitrogen and concentrates and by improvements in management through quality of roughage and quantity per cow.

Intensification in a wide sense includes all which leads to a higher milk and meat production per hectare. Intensification in a more restricted sense only includes that which leads to a higher net roughage production (in terms of energy) per hectare.

In the following attention will be paid to the intensification in a restricted sense as well as to the intensification in a wider sense. Attention will also be paid to the main pushing powers: nitrogen use, concentrate use and improvement of management.

This will be illustrated by figures about Dutch dairy farming.

Historical trends in grassland production, stocking rate and milk yield

For the Netherlands, intensification in a wide sense can be described in general lines since the beginning of the twentieth century. On the contrary there are hardly any figures concerning the intensification in a more restricted sense. The only recent information on this matter is an estimation of the net energy production of grassland by the Ministry of Agriculture concerning the period 1970 - 1977.

This estimation is shown in figure 3. Indeed a certain upward trend seems to exist. Under the influence of weather, the calculated yields

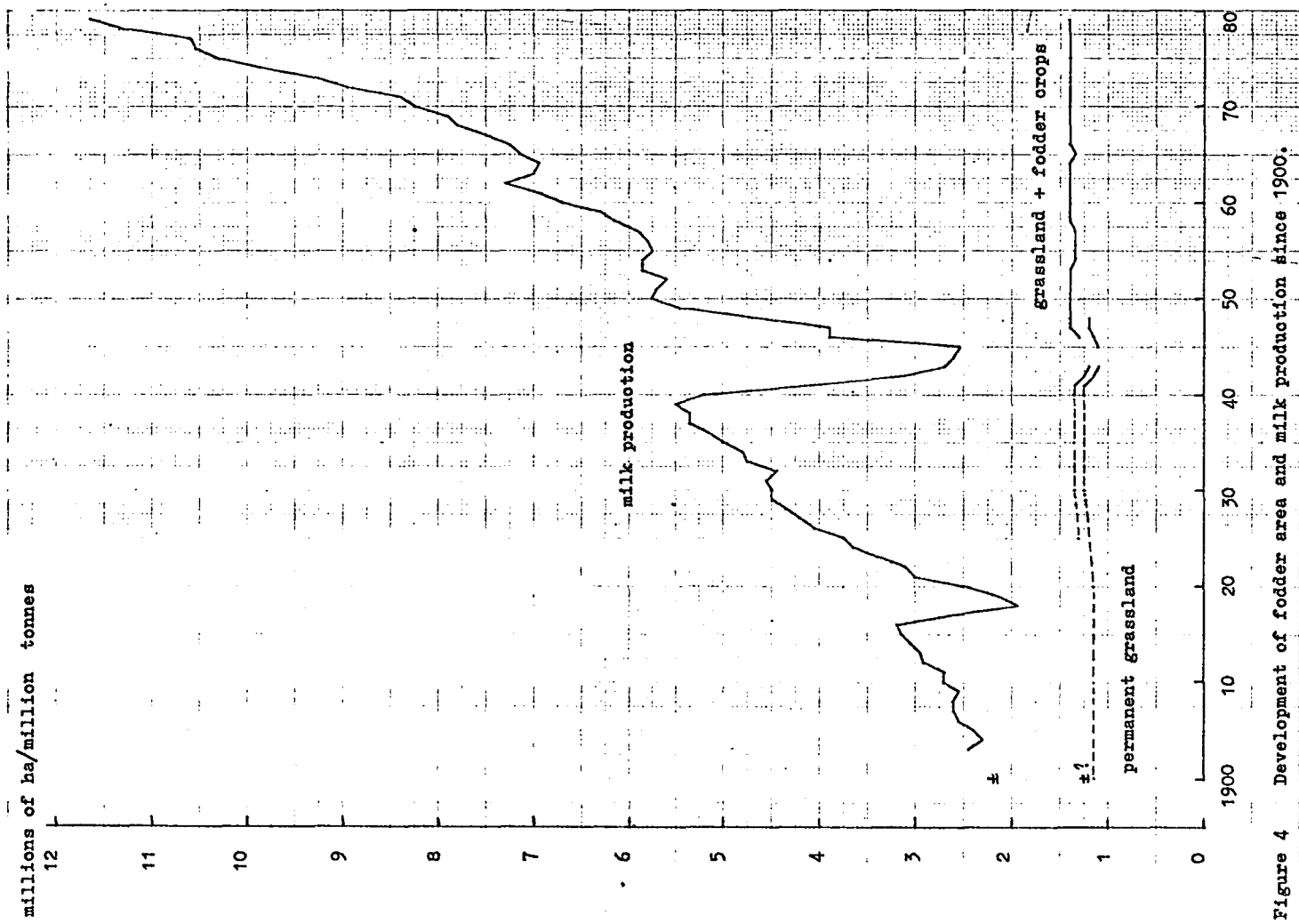


Figure 4 Development of fodder area and milk production since 1900.

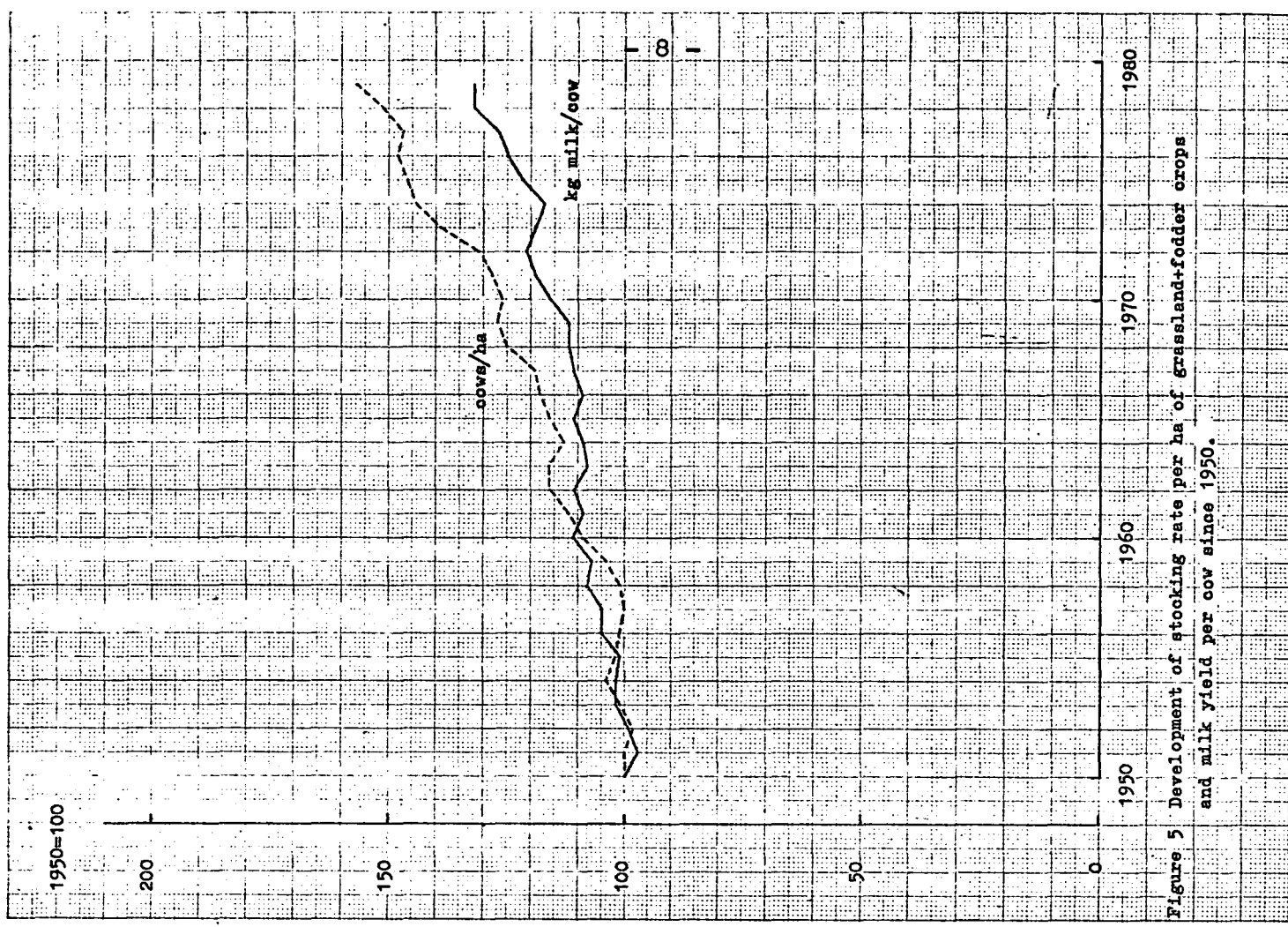


Figure 5 Development of stocking rate per ha of grassland+fodder crops and milk yield per cow since 1950.

are fluctuating quite a bit. For that reason, the series is really too short to draw hard conclusions with regard to the speed by which energy production of grassland is tending upwards.

This is for instance evident with regard to the influence of the extremely dry summer of 1976. Including 1976 the average rise is 1.5 % per year, excluding 1976 the average rise is 2.6 % per year.

Intensification in the wider sense can be traced by comparing figures about total milk production with figures about area of grassland and fodder crops (figure 4).

Between 1900 and 1979 total milk production in the Netherlands increased from about 2.2 million tonnes to about 11.6 million tonnes, a 425% increase. The area of grassland and fodder crops went up from about 1.25 million hectares to 1.38 million hectare, only a 10% increase. In other words: at this moment milk production per hectare of forage is almost five times as much as it was 80 years ago.

Apart from the interruption caused by both world wars, the increase has gone faster and faster. During the last ten years the annual increase in milk production per hectare was almost 4%.

This increase in milk production per hectare is both caused by more milk per cow and by more cows per hectare. For the post-war period figure 5 shows that the average increase in stocking rate has been of more importance as the average increase in milk yield. Especially, this applies to the period since 1958. During the last ten years both the increase in stocking rate and the increase in milk yield have gone very fast.

With regard to the period before 1940 it is not easy to get a clear picture. In that time both factors seem to have been more or less in balance. Maybe originally the increase in milk yield will have dominated.

Historical trends in use of nitrogen and concentrates

The extremely fast intensification in Dutch dairy farming is highly related to an increased use of nitrogen and concentrates.

Unfortunately the normal statistics are not very much detailed with regard to these matters. For that reason the use of nitrogen on grassland and the use of concentrates for dairy cows will be illustrated with the help of data from farm accounts. These farm accounts are sampled at random by the Agricultural Economics Research Institute. The figures for the whole period since the second World War are obtained by joining a number of distinct series, all of which have been converted to the level of the present day group of medium sized and larger grassland farms.

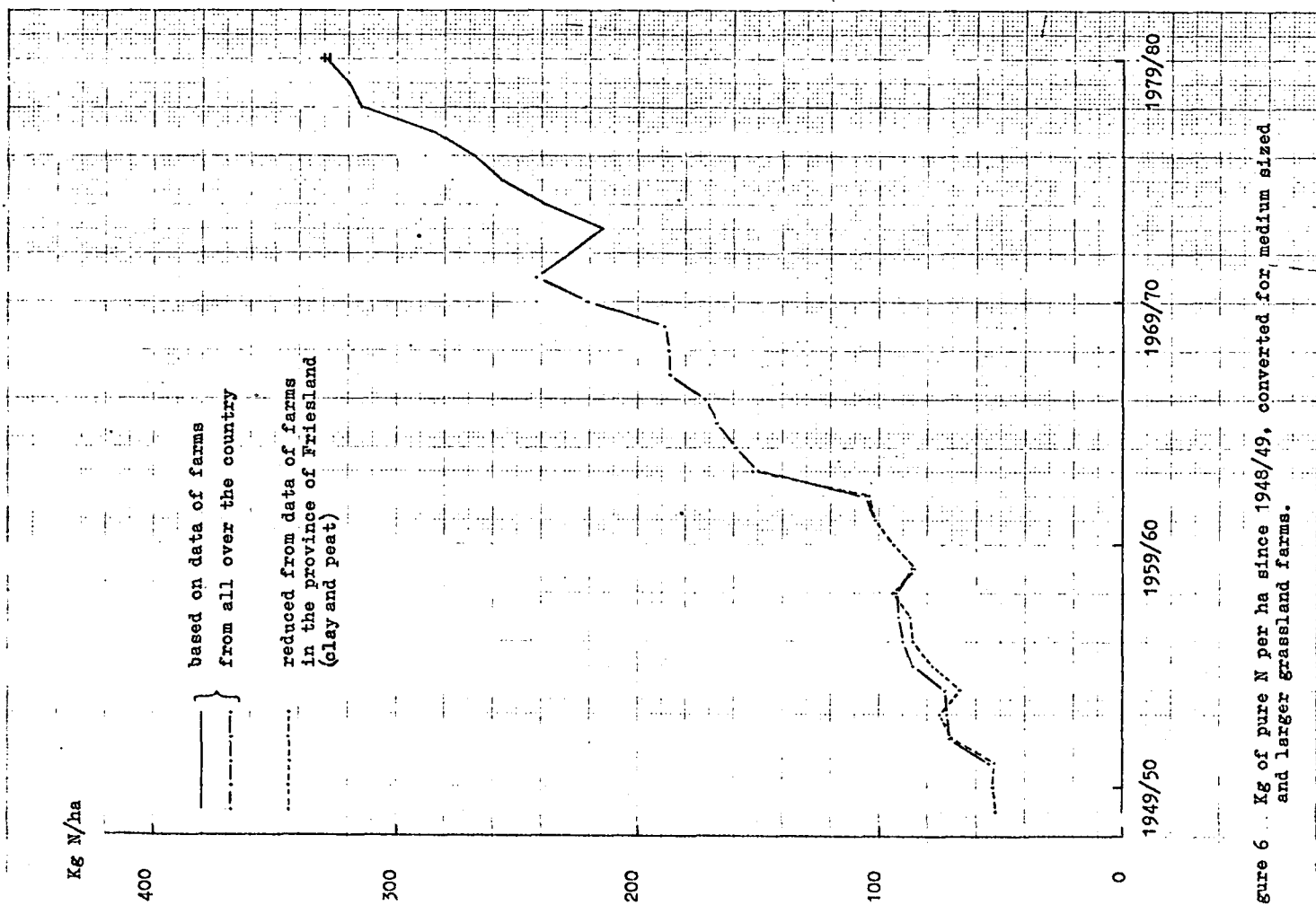


Figure 6 Kg of pure N per ha since 1948/49, converted for medium sized and larger grassland farms.

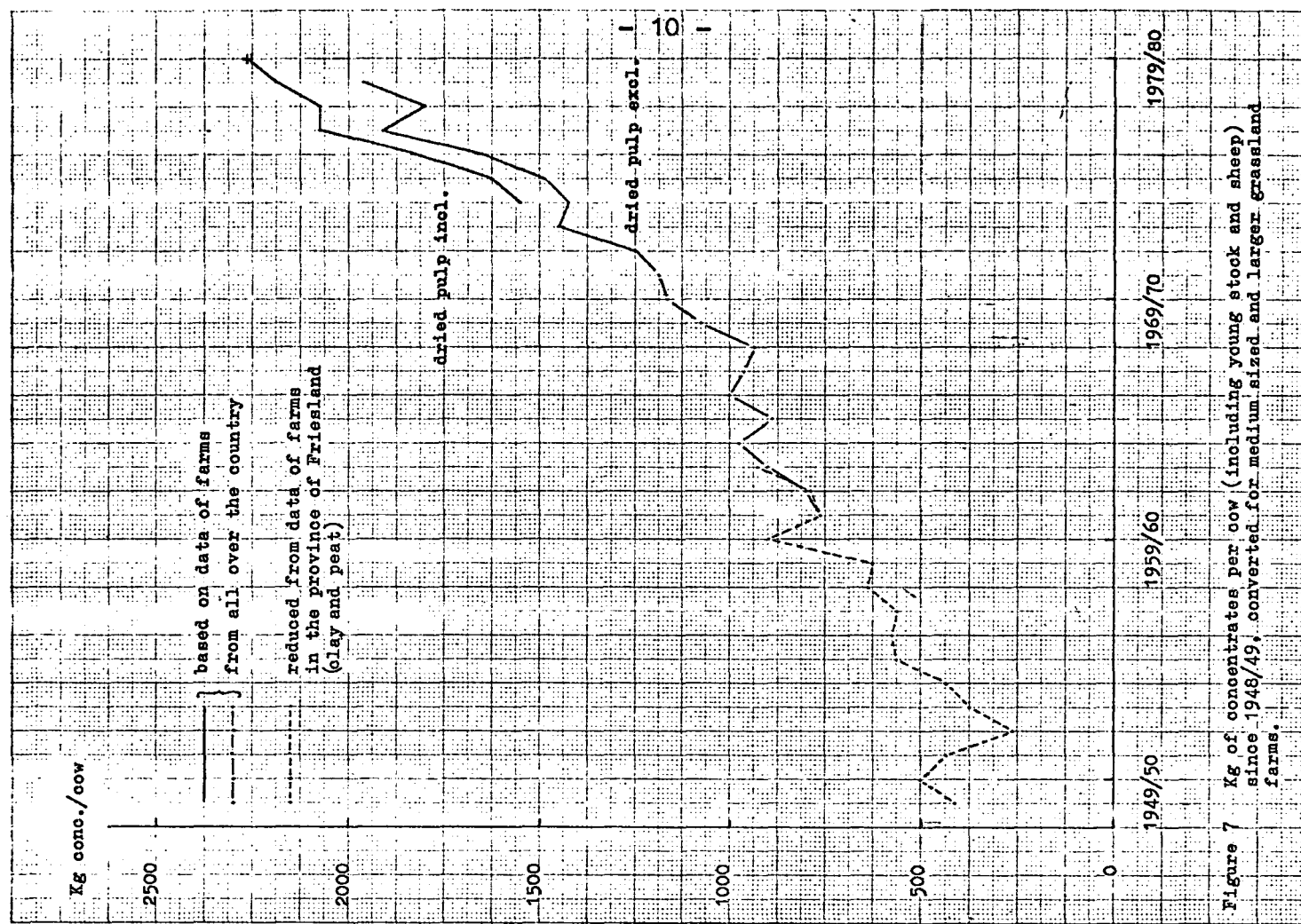


Figure 7 Kg of concentrates per cow (including young stock and sheep) since 1948/49, converted for medium sized and larger grassland farms.

As far as stocking rate and milk yield are concerned, trends calculated in this way are the same as trends derived from national statistics. However, the general level of the farms accounts is somewhat higher than it is in the national statistics.

Around 1950 nitrogen use on this kind of farms was about 50-60 kg per ha (figure 6). By now it is 6 times as much. Especially since 1958 this enormous increase occurred. Since that year the average annual increase was about 20 kg per hectare. This is markedly corresponding with the increase in stocking rate since the same year.

Unfortunately these data are not available for the pre-war period. What we do know is the use of nitrogen on all agricultural land in the years 1938/1940 and the development of nitrogen use on all agricultural land as well as on grassland farms during the period 1950/1962. On this basis the pre-war figure for the grassland farms can be estimated to be about 30 kg per ha.

The increase in concentrate use per cow has almost been as striking as the increase in nitrogen use (figure 7). Around 1950 concentrate use per cow (young stock and sheep included) was 400-500 kg. By this time it is about 5 times as much. Dried pulp included, the present use is 2200-2300 kg, 1800-2000 kg of which will be used for the cow herself.

The increase in concentrate use has speeded-up since 1967. Roughly, this corresponds with the increase in milk yield since the same year.

As a result of these developments the picture of Dutch dairy farm feed supply changed drastically. Imputing feed supply precisely to land, nitrogen, purchased roughage and purchased concentrates is not possible. However it is clear that land lost its dominating position, despite of a certain increase in net productivity. It is clear, too, that the importance of purchases of feedstuffs and nitrogen did grow enormously. In a quantitative sense feed purchases continued to be the most important of both. However this says little or nothing about productivity of both of them.

Influence of changes in price ratios and farm structure

What is the relationship of these developments in production and in use of means of production to changes in price ratios and in farm structure?

The development in prices is demonstrated in figure 8. The figure starts around 1950. However, the years 1953/1954 - 1955/1956 have been fixed at 100 in order to avoid the influence of war, distribution and Korean crisis.

1953/54-1955/56 = 100

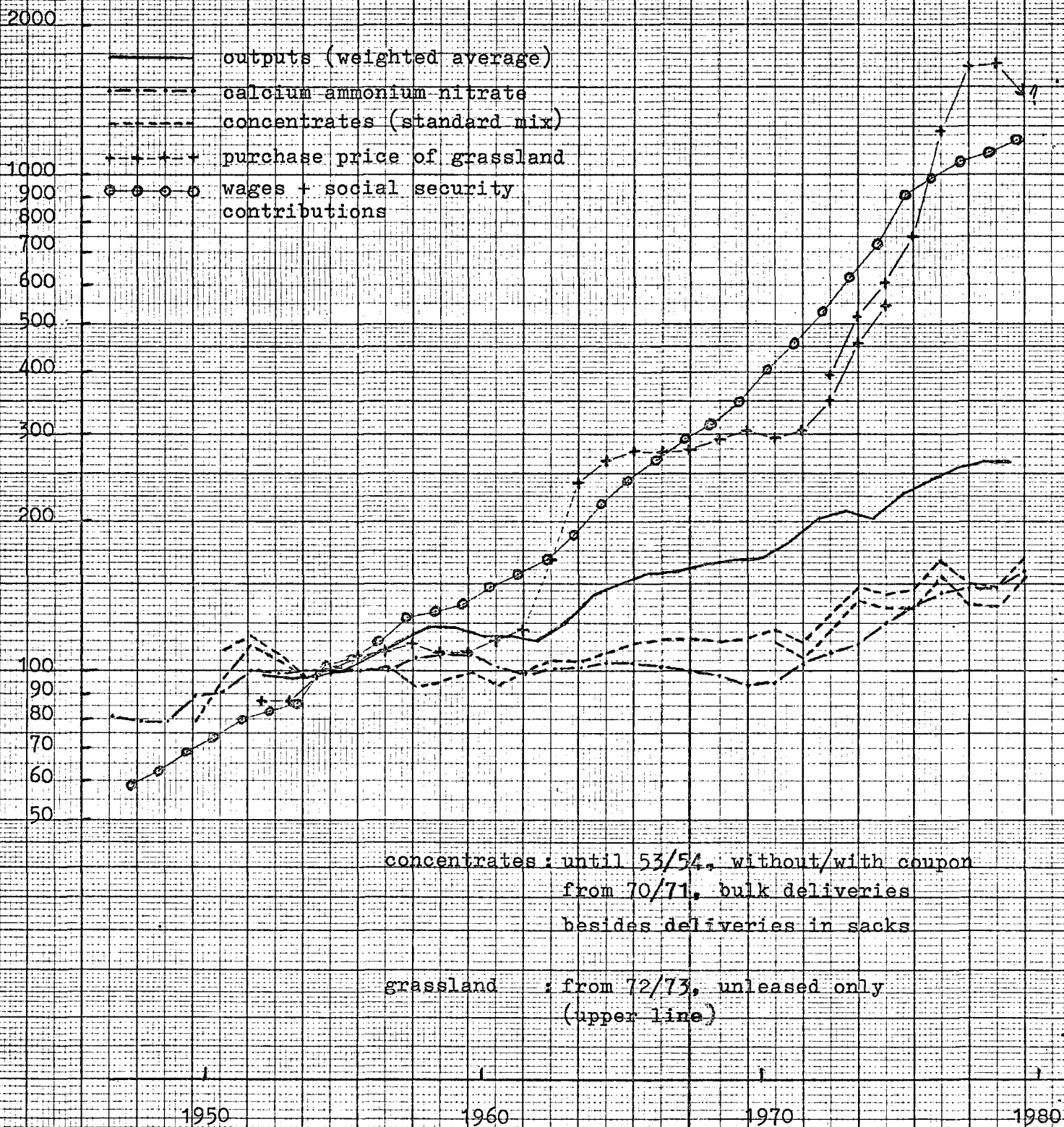


Figure 8 Development of prices in the dairy sector since around 1950.

Two things are very clear in this figure :

- price increase has been much sharper for land and labour than for outputs (milk and cattle),
- on the other hand price increase has been much weaker for fertilizer and concentrates.

The jump in 1962/63 of the price of land is a consequence of the abolishment of price control by the government.

After 1970 all prices speed up faster than before. This is the result of matters like higher inflation, crises on the markets for raw materials, energy crisis and land speculation.

During the period 1958 - 1970 the development of nitrogen prices was even more favourable than the development of concentrate prices. This might explain the faster increase in nitrogen use in this period compared to the increase in concentrate use. After 1970 concentrate prices increased less than nitrogen prices, while concentrate use has increased more than nitrogen use.

In general, price developments seem to affect much intensification and use of fertilizer and concentrates. However, this can not be said with regard to the acceleration of intensification since around 1969. This should be connected much more to structural developments in Dutch (dairy) farming.

Figure 9 demonstrates the decline in number of sons working on the farms and in number of other regular workers per full-time farmer. In 1950 in average per farm about 2 full-time workers were available. By now this has been reduced to around 1.2. In recent years this decrease is not so sharp as it was in the sixties. This is completely self-evident: continuation of the trend in the sixties would by now have left no son or other regular worker on any farm.

In consequence, in the seventies the possible improvement of labour efficiency could be realized much less than in the preceding period by reduction of labour force. So the increase in number of cows per farm became the main point. As is demonstrated before this has been realized by speeding up nitrogen and feedstuff purchases. The enlarged share of concentrates in the rations contributed to the higher milk yields per cow.

In the seventies the impuls to more cows per man has been stimulated very much by the introduction of the cubicle housing system. The phenomenal uprise of cubicle houses in Dutch dairy farming is demonstrated in figure 10. In 1971 only 5.5 % of the cows were housed in cubicles. At the moment, nine years later, 55 % of the cows are housed in cubicles.

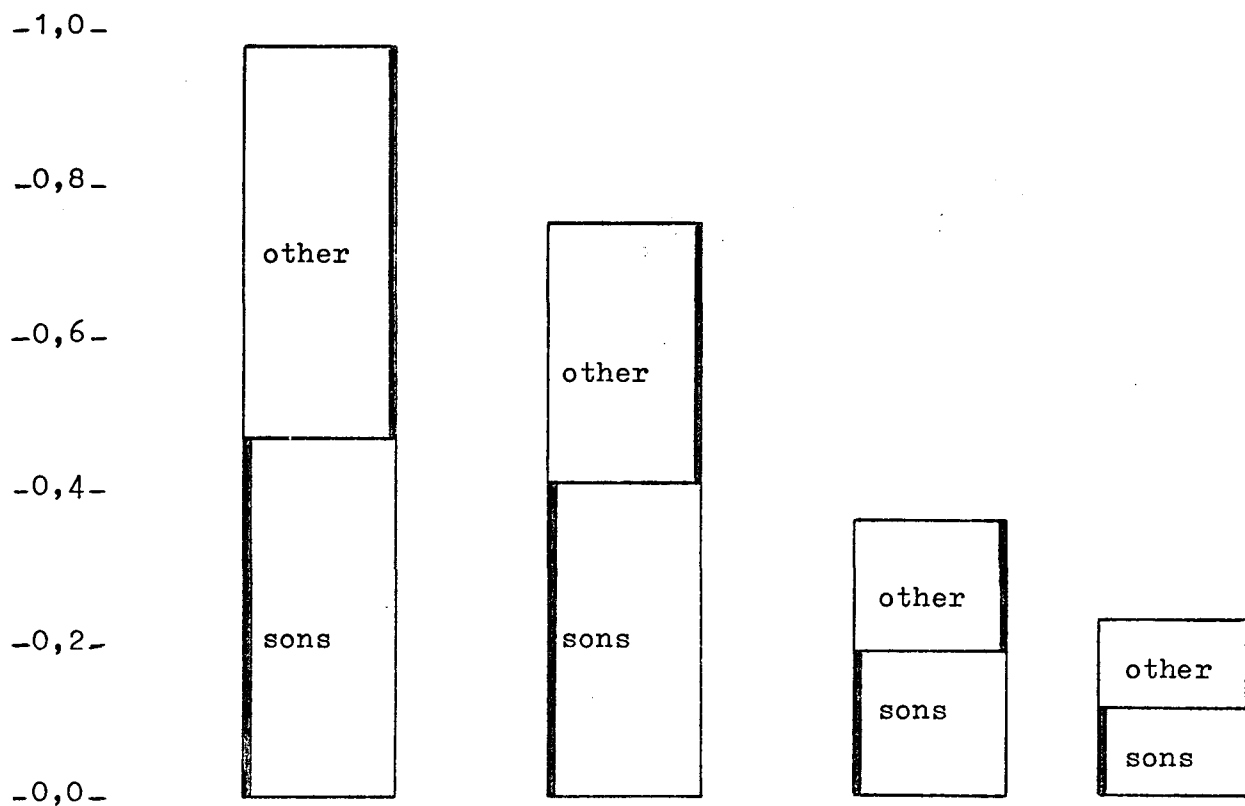


Figure 9 Number of sons and other regular workers per full-time farmer in Dutch agriculture.

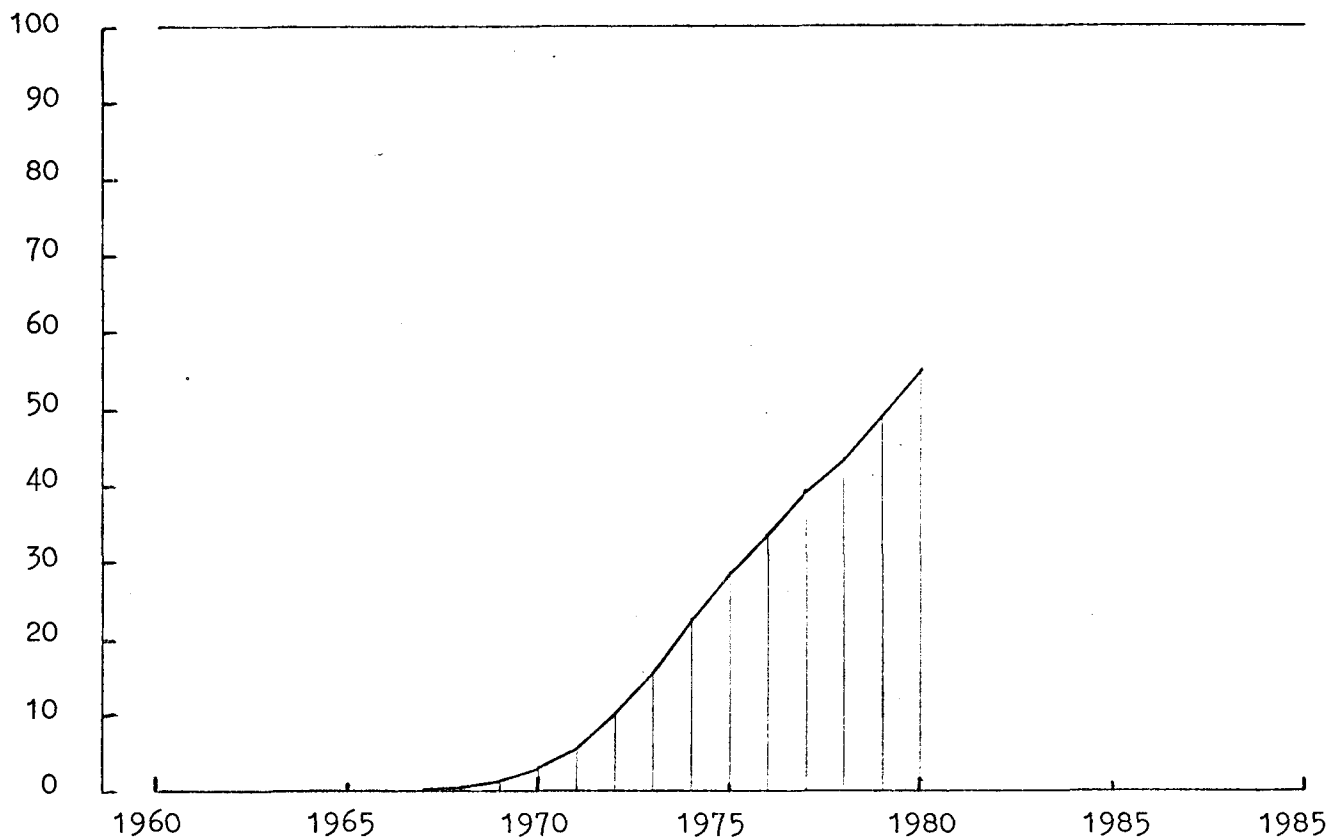


Figure 10 Percentage of cows housed in cubicles.

In practise, the replacement of a traditional tying stall by a new cubicle house nearly always implies a substantial expansion of the dairy herd and considerable better working conditions. This is a distinct example of the role of technological progress in the whole economic process in the dairy sector.

Importance of growing knowledge in the management field

In the preceding much has been said about the increased use of nitrogen and concentrates. However, the importance of the growing knowledge in the management field is not discussed yet. On this matter hardly any statistical information is available. Anyhow it is an important factor. This becomes evident in an examination of the elements which constitute grassland use and of the necessary ingredients. This examination will be confined to the intensification in the more restricted sense.

Intensification stands for increase in net production per hectare.

This can be realized by:

- higher growth rate of the grass,
- better utilization of available growing-days,
- better utilization of available grass,
- better quality of the product.

This requires an adjustment and improvement of grassland management.

Important examples are:

- rotational grazing instead of the traditional form of set-stocking,
- speeding up the rotation,
- alternately grazing and mowing,
- making wilted silage instead of hay,
- grazing and cutting in an earlier growth stage,
- keeping the cows indoors at night,
- applying more nitrogen,
- applying sprinkler irrigation,
- using improved grass varieties and mixtures.

For all these measures, which lead to a more intensive grassland utilization, knowledge is essential, improvement of management in the more restricted sense. In many cases indeed this extra management input is the most important means of production (figure 11). Especially this applies to the measures leading to a better utilization of grass and growing days and to a better quality of the product.

Nearly all measures ask for some additional labour and capital, for instance for fencing and for extra operations. This however, is of secondary importance.

Figure 11 Inputs required for improvements in grassland use.

| MEASURES | MEANS OF PRODUCTION | | | |
|-----------------------------|---------------------|-------------------|--------------------------|--------------------------------|
| | ferti- lizer | concen- trates | labour and capital | knowledge (mana- gement) |
| rotational grazing | . | . | + | ++ |
| speeding up rotation | . | . | + | ++ |
| alternate use | . | . | + | ++ |
| wilted silage | . | . | +/- | ++ |
| harvesting in earlier stage | . | . | + | ++ |
| cows indoors at night | . | ./++ | +/- | ++ |
| more N | +++ | . | + | ++ |
| sprinkler irrigation | . | . | +++ | ++ |
| grass varieties/mixtures | . | . | + | ++ |

Importance of inputs: +++ very important
 ++ important
 + additional only
 . no significant relation
 - some savings possible

Only for a limited number of measures emphasis is put obviously on an increase in the material means of production: nitrogen, concentrates, capital and labour. In this context speeding up grass growth by more nitrogen is of great importance.

Within the entire framework of a more intensive grassland use improvement of management methods and the use of more nitrogen are without doubt the dominating ingredients.

Recapitulation

In figure 12 the whole picture is summarized. At the bottom the scheme of intensification of grassland use is repeated briefly. At the top the most important causes of this intensification are summed up: technological progress and changes in price ratios and, in addition, adjustments in labour productivity and structure of the farms.

New technics and higher labour costs lead to more cows per man and per farm and thus to higher feed requirements. Because of the sharply increased land prices this is especially produced by buying more nitrogen and concentrates, items which became relatively cheap.

Together with improvements in management methods, which can be considered as a part of technological progress, this leads to more and/or better roughage per hectare, more cows per hectare and more milk per cow. In turn this results in a higher final production per hectare.

The future

What developments might be expected in future? In respect of this a number of things are uncertain, however a number of other things are rather certain.

For instance future developments are uncertain with regard to:

- energy prices, affecting prices of fertilizers and concentrates;
- prices for raw materials (for instance feedingstuffs), influenced by world market and EC-policies;
- milk and meat prices as fixed by the EC;
- quotas for milk production.

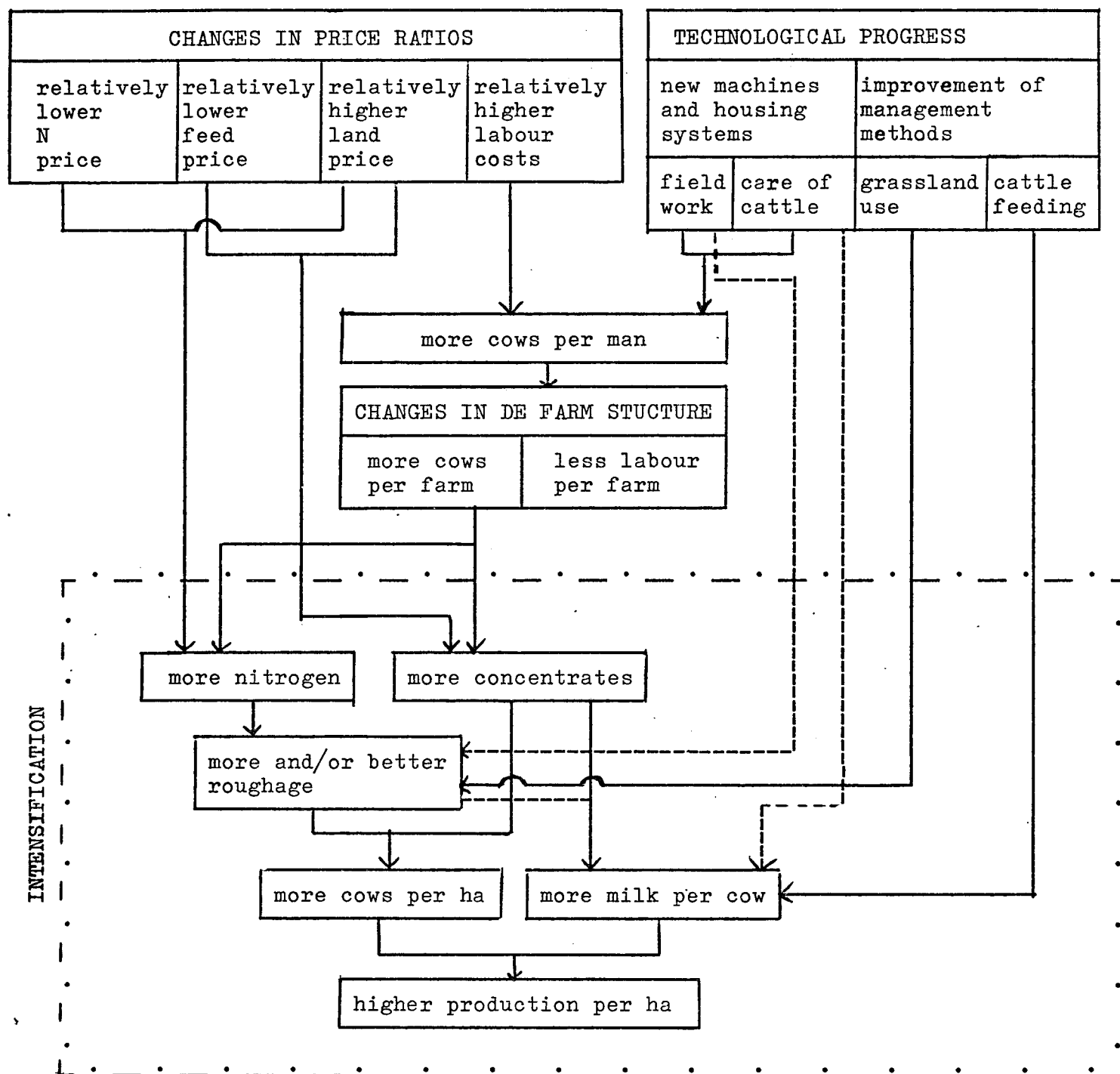
Certainly the future does not look too bright as far as price developments and quotas are concerned.

Still there are a number of things which are rather certain:

- the investments of the last ten years for renewal and enlargement of production capacity will last for many years;
- the increase in labour efficiency will not be undone;
- the improvements in management methods will not be undone either.

All the knowledge and skills obtained will last and technological progress, including development of management methods, will continue.

Figure 12 Intensification of grassland use: cause and effect



As a consequence of these permanent adjustments and improvements a possible worsening of price ratios or a rationing of production will not have the effect which might be expected on the basis of historical developments.

In addition it is likely that an eventual curtailment of production will affect concentrate use more than nitrogen use. This has at least two reasons.

- (1) A smaller production means a surplus of labour and machinery capacity. As a result grassland exploitation and forage production become very cheap.
- (2) The tendency to buy more land, however, will not be very great under those circumstances. Not only land prices will fall down, but also the investments will. For the investments are highly dependent on financial savings.

Locally, nitrogen use might be restricted sharper as a consequence of measures for nature protection.

In the case of curtailment of production the only reason for maintaining of concentrate use will be the relation with the milk yield per cow. An important advantage of upholding milk yield per cow in the case of curtailment of total milk production is saving of feed for maintenance. This might lead to areinforced strive for raising milk yield out of roughage, thus for improvement of feed intake and quality.

In this way even a decrease in production might stimulate the improvement of management methods.