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CONSIDERATION OF DATA NEEDED FOR THE DIFFERENT PLANNING METHODS DESCRIBED

(M. de Veer.)



I Introduction

The answer to a problem can be no more accurate than the data used in the analysis regardless of the technique used. I am convinced that this truth deserves some meditation at this seminar where other papers introduced you to a number of new analytical tools for solving the problem of planning a farm.

In the last five years considerable progress has been made in the development of new planning methods and in the near future even further developments may be expected in the field of solving nonlinear and discrete programming problems.

If the practical value of the results obtained with these new methods is sometimes a bit disappointing, this is partly due to the use of inadequate data and to insufficient knowledge of the things a farmer has to take into consideration in making a plan for his farm. The collection of data and measurement of relationships which have to govern the decisions of the farmer are a serious bottleneck for a successful application of the new planning methods.

II The nature of the data needed

The first question which arises in considering the subject of this paper is whether, differences in planning methods coincide with the differences in the data needed. The need of data depends basically on the problem to be solved and not on the method used. If for one method less data are needed than for another method, it will be because in the first case the problem is simplified and consequently the solution will be covering less ground. The need of data therefore depends on the scope of the method used and the comprehensiveness with which the problem is tackled.

In considering the data needed for farmplanning in general, this paper will deal with all data, which can be taken into consideration for the determination of the optimal farmplan.

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The purpose of all planning methods is to find the optimal feasible plan. It is along these two lines of thought, feasibility and optimality, that we shall analyse first the need of data.

A plan can be best considered as a combination of processes or activities. The way a processor activity is defined depends on the nature of the problem to be solved and the method used. Every crop and every farmbranch like dairy cattle, pigs, poultry and so on can for instance be defined as a separate process. Sometimes however more processes will refer to the same crop or farmbranch, for instance if more working methods are possible, but on the other hand it can be suitable to combine more crops or farmbranches into one process.

In the line of thought of most planning methods the feasibility of a combination of processes or a plan depends on the input-output relations of the different processes and the limitations which are inherent in the technique of the production process and in the limited resources of the farm.

This system of input-output relations and limitations defines a set of feasible combinations of processes or feasible plans from which the optimal plan has to be selected.

An optimal plan is the plan that serves best the ends of the enterprise. In most cases it is worked with the assumption that the goal of the farmer is the highest attainable income. Very often however the farmer is not such a simple single-purpose person and he has got by purposes in his mind; which have to be considered as well.

Besides knowledge of the goals of the farmer for the determination of the optimal plan we need a yardstick to measure the degree in which the aims are fulfilled. We need therefore prices to value the different inputs and outputs and to bring them on a common denominator.

After this analysis of the elements, which play a role in farmplanning we now can sum up the sorts of data, that are needed.

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1. The processes or activities, that possibly might enter into the final plan.
2. The limitations, which have to be observed.
3. Input-output relations
The inputs and outputs can be distinguished into two sorts.
 - a. Inputs and outputs that refer to limited resources.
 - b. Other inputs and outputs.
4. The prices
5. The goals of the enterprise

III The processes to be considered

At the start of the planning procedure the possibilities of the farm have to be looked over. On basis of knowledge of the farming area and the particular situation of the farm has to be chosen which crops and farmbranches will be taken into account. Besides technical aspects like climate, type of soil and other natural circumstances of production, the existing organisation and technical outfit of the farm, the abilities of the farmer and the organisational and legal framework in which the farm is working, amongst other things, have to be considered.

The problem of farm management however is not only which products to produce and which quantities of them, but too how to produce them. Even at the same technical outfit of the farm often different working methods are possible. As this has consequences for the input-output pattern of the product, it is often efficient to define the different working methods for the same product as separate processes. Besides the different crops and farmbranches, different working methods for some of them have therefore to be considered. So for instance the possibilities to substitute contractwork for the use of the farms own labour and implements or to transfer part of the work to the buyer of the product have to be investigated.

On the other hand it is sometimes useful to combine more products into one process. This of course is the case for joint pro-

ducts but too if the branches of production have a highly complementary character (e.g. feeding crops-cattle). Because of the complicated competitive and complementary relations between different crops in a cropping plan the rotations are often defined as processes instead of the separate crops.

IV The limitations and the inputs and outputs which refer to limited resources

The technical outfit of a farm is more or less fixed and in most cases cannot be changed at short time. Moreover the changes in the equipment often do not have a continuous character. So for instance you can have one tractor or two tractors but not half a tractor or a third part of it.

The procedure of most planning methods now is to start from an existing or supposed outfit of the farm with land, buildings labour, machinery and capital and to look for the plan at which an optimal use is made of this outfit.

The most important limitations which may be inherent in the outfit of the farm are:

- a. land
- b. labour
- c. implements and machinery
- d. buildings
- e. capital

a. Land

On family farms of Western Europe the total acreage often will be the most important limiting factor while moreover it is difficult to widen this limitation by buying or renting additional land.

Because of this it is in most cases efficient to express the other inputs and outputs for the different processes, if possible, pro unit of land. The difficulties of the collection of data of course then are shifted to the other inputs and the outputs for which the relation with the input of land has to be determined.

We have to know the technical qualities of the soil to establish the corresponding input-outputrelations. For the inputs of labour and implements the size and shape of the different plots and the distances to the farm-yard may be important as well.

Difficulties arise when the land is not of a homogeneous quality. For the different parts of the farm then has to be worked with different input-outputrelations. This means in practice that the landlimitation as well as the different processes have to be split up.

b. Labour

Determining the limitations originating from the limited capacity of the labourforce of the farm and the inputs of labour needed for the different processes is perhaps at the same time the most difficult and most important problem of farmplanning.

As a consequence of the seasonal character of the farmwork it is not allowed to work with one limitation, which covers all labour inputs.

While the labour-force supplies a continuous flow of work-units, most operations in agriculture have to be carried out in specific periods of the year and cannot be shifted to other periods. Thus in a year a number of periods have to be distinguished in each of which the limited capacity of the labourforce can be a bottleneck at the development of the optimal farmplan. It even happens that particularly for dairy cows, poultry or pigkeeping, at some part of each working day or at the weekend labour will be a limitation.

To solve this problem, sometimes the year is arbitrarily divided into fortnightly or monthly periods. It is preferable however to divide the year according to the timepattern of the operations. On basis of a study of houradministrations or other labourrecords operations, which have to be carried out at about the same time, are taken together in that case and the length of the period, in which these operations have to take place, is

determined. In Holland experience has been that the length of the periods found in this way does not vary much from one year to another. Only the time that passes between the periods in which the sowing, and further springlabour has to be carried out and the beginning of the harvest varies a little according to differences in the duration of the growth from one year to another. This however does not affect generally the length of the periods in which labour can be a limiting factor.

The execution of the fieldwork too depends on the weather conditions. Consequently not the total number of available hours can be considered as workable hours for the execution of these operations. Often the bottleneck in some period of the year does not consist of a shortage of hours on the whole but in a shortage of workable hours in which the weather is such that operations, that are vulnerable in this respect can be carried out. For each period therefore has to be considered which part of the available hours with respect to the operations to be executed can be considered as workable hours. Because the measure of vulnerability of the different operations in the same period often is not the same it may be necessary to distinguish more limitations each pertaining to hours available for operations with the same degree of vulnerability. On the other hand often operations, which are not vulnerable or which can easily be shifted to other periods can be neglected because these most likely will not affect the critical limitations.

Of course the number of workable hours will vary from one year to another. At the same time the labour inputs for the different operations will often be higher in years with poor weather conditions. The data have, as many others in farmplanning, a stochastic character. The difficulties and problems caused by the stochastic character of many data will be discussed later on.

The capacity of the labour force also depends on subjective factors. The ability and attitude of the farmworkers and their willingness to work harder or longer in the critical periods of the year have to be considered.

On family farms especially the ability and task setting of the farmer and his family affects the extent of the limitations. In discussing the aims of the enterprise we shall be able to say more about it. For establishing the inputs of labour, we have to know the working methods which of course depend on the equipment with implements and machinery. The labour inputs can be best derived from hour-administrations of the same farm or comparable farms. The use of standards which result from technical research is dangerous. These standards are generally based on normalised conditions (shape and size of plot, distance to the farm, crop yields working conditions etc.) and do not contain idle time, which often cannot be avoided in practice.

If these standards are used they ought to be corrected for this and adopted to the working conditions of the farm we are planning for.

c. Implements and machinery

These data are for the main part incorporated in the labour inputs, as the technical outfit determines the working methods, that can be applied. It is however possible that the capacity of some machines or tractors will be the real bottleneck instead of the capacity of the labourforce. The difficulties and problems as to seasonal character, workable hours and so on are of the same nature as for labour.

d. Buildings

The limited storageroom or the number of stables for the different sorts of cattle can be a limitation for the development of the optimal plan. The data for this can only be collected on the farm itself (and from the farmer himself). It is often possible to include in the planning procedure expansion of the buildings

as an activity to be considered. In that case the buildingcosts of course have to be taken into account at the assessment of the attractiveness of a process, as soon as the existing buildings are fully used.

e. Capital

If the farmer can only dispose of a limited amount of capital this may be a serious restriction.

In general it will be necessary to consider the limitations set by capital in the different periods of the year in about the same way as for labour. For the determination of the capital inputs of the different processes, the time upon which expenditures have to be done and payments for products are received have to be investigated. The possibilities to get credit of course may have to be considered as well.

f. Other limitations

Besides the limitations set by the limited resources of the farm the limitations inherent in other technical requirements have to be considered.

The percentage of arable land which can be used for the different crops on the long run is restricted by the requirements of good croprotation. For potatoes in Holland this restriction even is legally enforced as it is not allowed to grow more potatoes on each plot than once in the three years. Other technical requirements may restrict the percentage of sugarbeets, rootvegetables, flax, peas, cereals and so on. Some crops have to be sown under or after other crops like carroway under peas, alfalfa under flax, flax after cereals and so on. Moreover not all crops are fit or equally fit to grow aftercrops like clover and turnips. Because of these complicated relations different rotations, which satisfy these technical requirements are often considered as processes instead of the separate crops. Moreover this is done because the measuring of the effect which a crop will have on next

year's crop via the structure, nitrate content, humus content, etc. etc. of the soil is difficult especially if this has to be done apart from a definite croprotation. This procedure however is more rigid and might restrict unnecessarily the set of feasible plans.

Another complementary relation, which can be dealt with as a limitation, is the relation between the feed grown on the farm and the size of the herd of cattle. It is often useful to include in the planning procedure the determination of an optimal diet for the cattle on basis of the farms possibilities to produce fodder.

Another example is the relation between the number of milking cows and the number of calves which are borne and can be reared for different purposes.

V The prices and the inputs and outputs which do not refer to limited resources

The collection of prices in general will not be the most difficult job. There are only two points I want to discuss.

In the first place the prices have to be farmprices.

Especially the product-prices recorded in statistics and so on often pertain to some standard-quality which may not coincide with the quality of the products on the farm. An important source for farmprices are farmrecords.

For the determination of the optimal plan the price-relations between the different costs and products are more important than the absolute level of prices. Since prices of many agricultural products tend to fluctuate strongly from one year to another, study of the price-relations over a longer period are often a better basis for planning than the incidental price-situation in one year.

Plans however are always made for the future, so we have to reckon with future price-relations. Besides investigating the trends in the price-relations in the past, study of economical,

technical and last but not least, political developments, that may affect future price-relations, is important. So the relative rise of wages with 3 - 5% yearly in comparison with the prices of other costs and products in agriculture, which can be stated in industrial countries, deserves the attention of the farmplanner.

The inputs of non limited resources only influence the optimal plan as far as they affect the results of a process. Those results can be best expressed in the balance of revenue less direct costs. In this figure all costs and revenues, of which the level is proportional to the level on which the process is carried out, are taken together. Calculation of this balance enables to an easy and quick comparison of the results of different plans because a whole complex of cohering costs and revenues is expressed in one figure. The difficulties arising out of non-linear relationships will be discussed later.

These inputs and outputs have also to correspond with the quality of the soil and the further technical outfit of the farm. The yields of crops and cattle have to be normalised on basis of data of more years.

For the collection of data about inputs and outputs, referring to non-limited resources, farmrecords are an important source.

VI Further remarks on data

A criticism of the new planning methods is that they are devoted to evolving an optimal plan for a given technical outfit of the farm and that the more realistic and complicated problem of the optimal equipment with implements and buildings and the optimal size of the labourforce is not investigated. Although it is true, that the underlying theoretical assumptions of most planning methods make them less suitable for solving these problems, it is my opinion that nevertheless in this field the new methods will prove useful.

Collection of data on new implements and working methods and their practical applicability on the farm will be necessary

for this widening of the scope of the planning methods. The different inputs of a process can often substitute within certain limits one another. For instance on a dairy farm nitrates can be substitute for land or, put otherwise, the number of cows pro hectare can be raised if the input of nitrate pro cow is raised. If the substitution refers to limited resources, as in the case described the determination of the optimal proportions has to be made a part of the planning procedure. If the substitution however refers to non-limited resources only, the problem of optimal proportions can best be dealt with before and apart from the planning procedure. So for instance the optimal inputs of different sorts of fertilizer can be best determined before on basis of technical research. At the collection of data the possibilities to vary the inputs and outputs have to be considered and the relations have to be measured.

Often the substitution will have a non-linear character and will be influenced by the law of diminishing returns. Although most planning methods are based on the assumption of linear relations between the inputs and outputs belonging to one process, it will often prove possible to deal with these non-linear relations satisfactorily.

Often there is a non-linear relationship between the level of output of a process and the input of labour. Especially for cows, pigs and poultry the inputs of labour pro animal tend to diminish as the number of animals is increased. Exact measuring and determination of such relationships which indicate economics of scale, will be often important.

Many data, used in farmplanning, have a stochastic character and vary from one year to another. The planning methods however work with discrete values. This means that in most cases the most likely value will be taken. Yields and prices therefore, as we already discussed, have to be normalised. The planning then is directed to the highest average income being expected over a longer period and the problem of the stability of the income that may be

very important for the farmer, is overlooked. Although it is very difficult to deal with these problems, at the end of the planning procedure a comparison of the stability of income for different feasible plans, of which the results are near the optimum, may be possible. An estimate of the variance of the different yields and prices therefore is needed. A special problem is in the stockastic nature of the labour data. The workable time as well as the number of hours vary from one year to another. Moreover if the weather is bad, the workable time will decline and the hours needed for the different operations will increase. It is not however realistic to base the data on worst weather conditions. The farmer will be prepared to take a risk and often will be able to improvise if the worst comest to the worst. Of course he will have to compare the gain to be won by setting a bigger task and the losses he may incur if in a bad year he cannot finish the jobs or he has to make high costs for contractwork or casual labour. Considering this, the best thing to do is to determine the limitations and inputs of labour so, that the risk will be within reasonable limits and is acceptable for the farmer. Of course this is a subjective decision the planner has to take on basis of his practical experience and knowledge of farming and farmers.

VII The aims of the enterprise

In most planning procedures the assumption is made that the aim of the enterprise is the highest attainable income. The farmer however will often have bypurposes in his mind. We already discussed that he may be interested as well in the stability of his income. Besides the income he will mind the number of hours to be worked in carrying out the plan. These bypurposes can often be taken into account at the planning. So for instance in linear programming the spare time can be valued according to the psychic income that the farmer will derive from leisure.

Another possibility is to create limitations in the same way as for technical requirements. If the farmer does not want to have

more than 10 cows, the set of fensible plans can be limited to plans with no more than 10 cows. Labour restrictions on a family farm have to depend in a large measure on the attitude of the farmer and his family. In that case the number of available hours and the inputs of labour really are a task setting for which besides the income other factors will play a role.