EVALUATION OF RURAL RECONSTRUCTION PROJECTS WITH THE AID OF A MODEL OF REGIONAL ECONOMIC GROWTH

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1. INTRODUCTION

At the Institute for Land and Water Management Research in Wageningen (ICW) a method of economic evaluation of rural reconstruction projects is in preparation for the Netherlands Government Service for Land and Water Use. The main lines of this method will be treated below, some comments on differences with current thought will be added. The author is well aware of a lack of scholarly thoroughness on many issues involved.

The rural reconstruction projects concerned cover an earmarked region and consist of a proposal for coherent investments in land, water and buildings, to pull agriculture and recreation. Claims on the land and water resources for main roads and waterways, extension of towns and nature conservancies enter the projects as data, though open to negotiations on design and other details. There are many of these projects in the Netherlands. The investment amounts to some $10.000 per agricultural worker in such a project region.

The method of selection now is use was published ten years ago. A description in English is given in Land Reclamation and Improvement [1960]. However useful that method is, there were critics from the onset. Preparations for a new technique started some eight years ago. At that time the author published the essence of his proposal [Locht 1962]. Now many partial studies have been completed, but the method as a whole is only applicated in retrospective calculations.

2. FRAMEWORK OF THE CALCULATION FOR AGRICULTURE

First and foremost the calculation with regard to agriculture will be treated and that with the aid of the inserted scheme. In the head of this diagram the disciplines and the board concerned are given, in the frames the involved magnitudes. If the magnitudes enter as data-exogenes–the frames are square, if they are consequences-endogenes–the frames are circular. Some of the exogenes are the instruments of the agency concerned. The relations between the magnitudes are indicated with arrows. The frames and arrows are plotted in the matching discipline or board column.

After arguing on one or two features of this scheme under 2.1 and 2.2, the steps in the calculation will be treated one by one under 3, 4, 5 and 6 citing some examples of the researches performed. This will be done proceeding from the right to the left of the diagram. This sequence is preferred because it permits to elaborate on the problem posed to each research step before treating its solution.

2.1 Stepwise working procedure

A feature of the procedure is its stepwise character, e.g. reallotment → scale of lots, in the first step; change of scale of lots → shift in the vector of claims on labour, in the

Figure 1 Map of the areas involved in rural reconstruction in The Netherlands (1–1–1968)

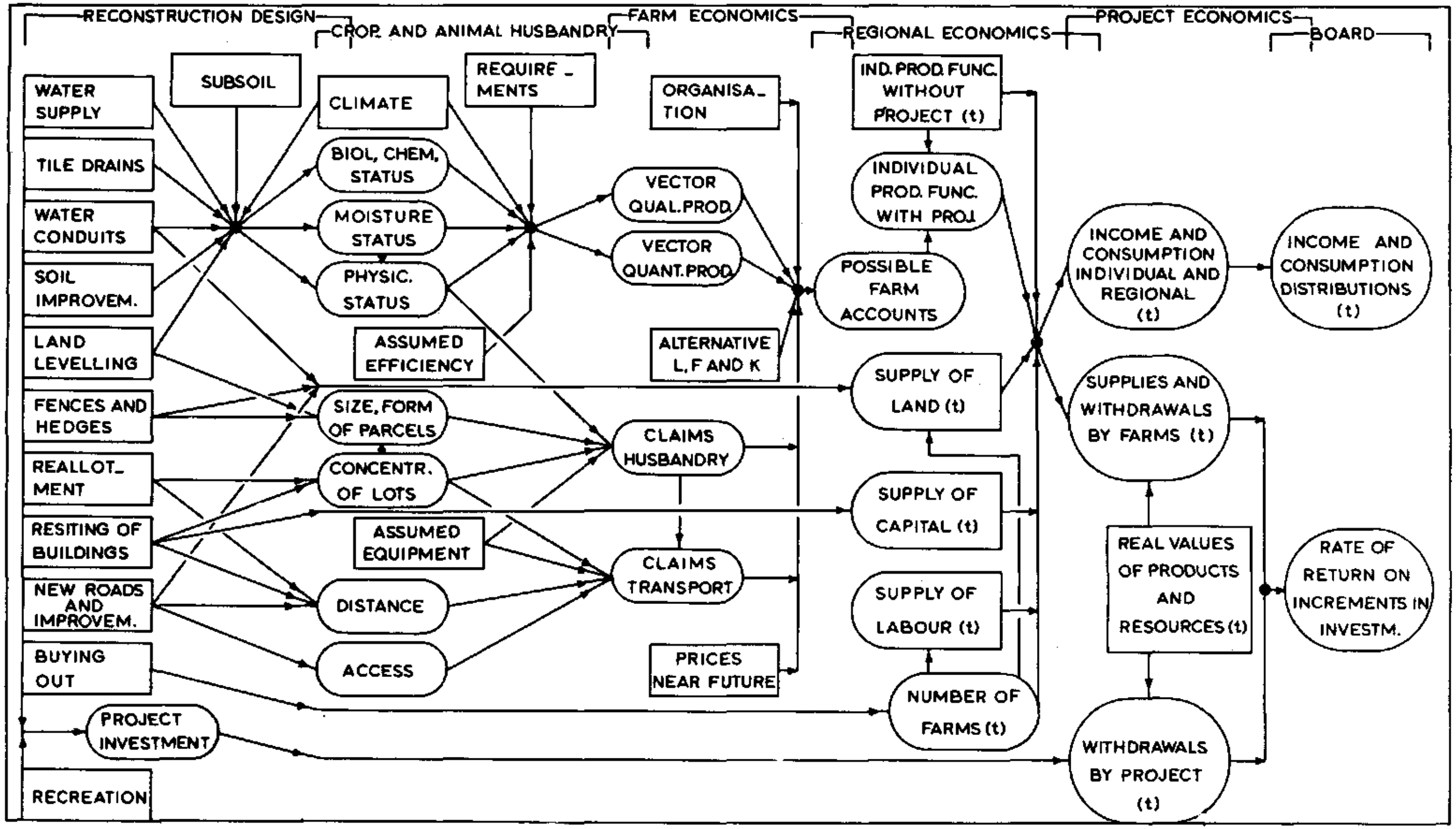

Figure 2 Diagram of the calculation procedure

second step; changes of vector → shift in the production function, in the third; etcetera. Another sequence is: water supply → groundwater table → moisture status → crop yield as a shift of the production functions. Thus the procedure of solving the model to the exogene variables is refuted and with that an uninterrupted computer program as well, at least for some time to come. The stepwise procedure is advocated because:
–the system is so large that otherwise at best only very large computers would meet its requirements; those who propose a closed computation–e.g. Hufschmidt [1966]–seem to be tempted to omit important aspects,
–each researcher solves his own problems with his own techniques, be it optimalization, simulation or estimation. He checks as an expert the results in magnitudes of his own discipline.
–research in each segment is autonomous as usual. The project economist only handles a modest step of his own. His role as the spider in his web seems to have no chance in this case.

As a consequence the scheme is also a scheme for the distribution of tasks over the researchers. In first instance the separate research steps are run simultaneously: each step is not built on the results of its preliminary steps, but uses possible levels of its input variables. The results of a step are functions, graphs or tables. E.g. the farm economist starts with a range of possible vectors of claims and finishes with farm accounts. Of course there are instances where a research group handles more than one step. In that case the computations may run ininterrupted over this range.

2.2 Model of economic growth

A growth pattern is not an integral part of current benefit-cost approach and that because of the assumed competitive model. At best it appears as an amendment, or as an informational side line for economically underdeveloped nations; e.g. Marglin's contribution to the well-known Harvard Water Program [1962]. Where Marglin treats the selection of investment for India [1967] he does not introduce a growth model either. He seems to take the time streams of benefits and costs as data.

A full drawn justification of the use of a growth model would need a survey of the tests of the here rejected competitive model and this goes beyond the scope of this essay. An early and fundamental rejection is Gunnar Myrdals display of *cumulative causation* [1957]. As is well-known the growth's path is neglected by assuming a competitive model because in the competitive model optimalization of income leads automatically to optimalization of growth of income; this by means of changing prices, mobility of the resources labour and capital and the mobility of the demand for these resources. In the course of the prelimianry studies for the model it was found–as others have found before–that:
–income differentials of farmers are not much good at reallocating labour; granting claims for subsidies interferes,
–on many farms investments depend on savings and imitation. A reasonable productivity is only a constraint,
–marginal products of labour in agriculture are often far below current wages. In several instances those of land were higher than current rents. In this production function study only accounts of 'middle of the road' cases were used. The accounts were very detailed and accurate. The Netherlands Agricultural Economic Research Institute made the data available.

It is the author's opinion that in many regions where projects have to provide a stimulus, the competitive model does not hold at all; neither in this country nor in the U.S.A. Where it holds for the case with the project, it does not hold for the case of reference; and that by definition, because the raison d'etre of the project is that pulling is necessary.

There is nothing new in the rejection of the competitive model [for instance Eckstein, 1961; Bos, 1961; OECD, 1967]. The familiar conclusion is declining the benefit-cost approach or limiting its scope: not much would be gained by representing the involved long term consequences in an individual project appraisal. The author takes, with Bos, the stand that there are no grounds for using quite different benefits for relatively small programs on one side and all embracing investment planning on the other.

If the adaptations of the competitive model occur, they will be taken account of in the here used model of growth, just as far as they occur, and with the appropriate time

Table 1. Cobb-Douglas function applied to accounts of Dutch farms, averaged over three years; compared with application of Rasmussen to accounts of British and Irish farms (marginal productivities are calculated at arithmetic means of variables) ($R \geq 0.96$ in all cases)

	Netherlands* 1961/62-1963/64 coefficients	Netherlands* 1961/62-1963/64 marg. prod.	Great Britain 1954/55-1957/58 marg. prod.	Ireland 1955/56-1957/58 marg. prod.
DAIRY FARMS				
rent	0.118(0.025)	1.5	2.6	1.3
labour	0.097(0.040)	0.28	0.6	0.3
capital	0.194(0.043)	0.18 .	0.16	0.34
purchases	0.583(0.024)	0.96	1.0	1.4
ARABLE FARMS				
rent	0.256(0.032)	1.65	2.1	1.2
labour	0.175(0.046)	0.4	0.8	0.8
capital	0.082(0.036)	0.10	0.20	0.15
purchases	0.436(0.053)	0.61	1.05	1.4
MIXED FARMS				
rent	0.058(0.020)	1.1	1.2	0.9
labour	0.083(0.035)	0.3	1.0	0.5
capital	0.103(0.030)	0.15	0.19	0.25
purchases	0.691(0.020)	1.06	1.0	1.5

* For dairy farms with < 1.9 labour units; arable farms with evaluated wages at < fl. 19,000; mixed farms with < 1.7 labour units. Number of farms is 216, 118 and 233 respectively.

lag: perfect mobility is a special case and merits a place only in a more general model.

3. SUPPLY TO BOARD

According to the given scheme the board is provided with:

a. not just one project design for the region concerned, but a few proposals (I, II, etc.) with their technical content. These proposals are supposed to be the best ones (technical efficiency) at their investment levels. These are only proposals which would lead to an $r_{\Delta J}$–as defined below–between about 8% to 3%; the internal rate of return over total investment being larger,

b. the internal rate of return over the stream of the differences between I, II, etc. in output and resources over a period of 50 years $r_{\Delta J}$. Next an undiscounted total of the claims on resources in the construction period for each of the proposals (J_I, J_{II}, etc.) and the differences between these proposals in sequence (ΔJ).These together are a proxy of a demand curve for investment funds (as in fig. 3 below),

c. estimates of value-added on the farm firms (businesses) in the course of time (Y_{bt}) and its regional total ($Y_{B,t}$); as also the equivalents in consumption (C_{bt} and C_{Bt}). This is the income redistribution effect and the consumption redistribution effect,

d. an impression on the probability of the results. This is not studies systematically yet.

In some models for benefit-cost analyses and project-design, all effects are reduced to a stylish single measuring rod in money, utility or willingness to pay. To reduce the outputs b, c, d to one output it is necessary to use the consumption redistribution preference of the board and its preference with regard to risk distributions. By playing a choice-game with the board their general preferences may be measurable indeed. However, the members of that committee are not willing to play it. Besides they feel that the weight to be given to an impetus for a certain region and the 'possibility' to accept a more risky proposal, is a matter of statemanship to be decided upon at the last possible date. This is one reason for not integrating uncertainty of the results in the computations, however important that aspect is.

In current procedure the quotient of average benefits over the years and the whole of the funds procured by this particular government agency (J_g) is used. This requires that benefits are defined net of depreciation and interest over investments of the agricultural businesses (J_b) and those of other agencies. The proposed criterium–$r_{\Delta J}$–is different in that:

–all investments are treated on an equal footing. Because returns on J_b are usually larger than depreciation and interest, the old rate was always higher the more private investments were involved,

–account is taken of the timing of costs and returns. The arguments are that the calculators can make a better estimate of that timing than the board and that the proposals differ in this respect. The criterion is sensitive in particular for changes in the length of the construction period and the length of the 'adaptation' period,

–attention is focussed on the rate of return on increments in the resources used ('marginal' test). The rate for the whole of the funds used in current procedure is misleading. There was a comprehensive project in which filling of ditches gave a high rate of return, the rate of return for the project as a whole was sufficient. This project–B_3–however did not meet the 'marginal' test (see fig. 3).

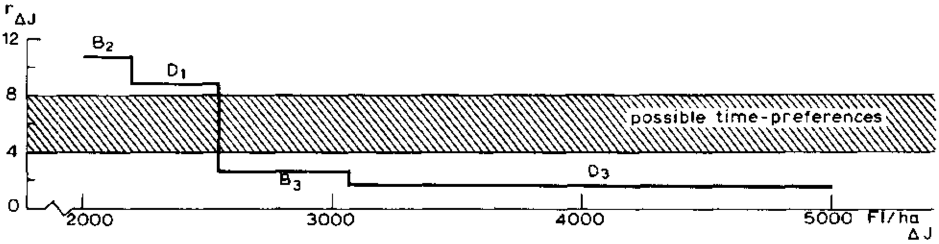

Figure 3 Testing of proposals by the project economist, using returns over increments in investment level as criterion; an application to the proposals of Van Duin et al (1963)

Resistance to the marginal test is often argued with the fact that in other fields in general only one comprehensive proposal is prepared for calculation. However that does not improve the meaning of the mean rate. 'The crying need is to increase the frequency with which increments to projects are analysed' [McKean, 1958]. Spijk [1969] pleads for designing 'alternative' plans in town and country planning in general. This is already done in Switzerland for all the projects for which a public vote is required.

An attempt will be made below to illuminate the decision procedure of the board and the use of the interal rate of return instead of the present value with a fixed discount rate.

The agency operates on a given budget, and in revision of that budget only general conditions and political forces are working. However, it is not a genuine case for capital rationing. It has to be assumed that, if spending its budget would imply that the marginal revenue falls below the minimum rate of time preference, the agency will not exhaust its budget and refuse the marginal-project. If on the other hand the budget constraint would imply that increments to projects with worthwhile revenues have to be cut off, the board will store projects. The board would have conclusive arguments—be it on general grounds—to claim a higher budget for the year, or years, to come. The internal rate of return is sufficient for these decisions. Henderson [1965] arguments that these limits for the *marginal* rate are about 3% and about 8% respectively, are accepted here.

Present values in which discount rates of 3% and 8% have been used, would meet this requirement as well. It is, however, less convenient because the demand curve has to be presented in benefit cost ratios; there will be two curves and for different projects they will start or end at different ratios.

The discussion on time preference does not only show that there are no conclusive arguments for a special rate in between 8% and 3%, but seems to point out as well that there is no unique time preference; consumers time preference varying with the rates of growth of income of the group involved [Feldstein, 1965], producers time preference with the marginal productivity of capital. This, however, does not provide an argument to use a low time preference for stimulation of declining areas in our calculation procedure, because the benefits and costs are the supplies and withdrawals of goods and services to and from the rest of the economy. These may be assumed to distribute throughout that economy and the marginal time preference for the community as a whole is then relevant. As soon as this marginal rate (long term) would be known, it could be used in this case. As will be seen in Section 4 that rate is, however, not yet available.

It is necessary to leave arbitrary decisions to the board if the calculation is sensitive for that decision. It is the internal rate of return which makes this possible.

As mentioned the board is provided with time series of consumption distributions (C_{bt}). Some project plans will be refuted by the board because some–up to now not defined–target will not be reached within a certain period. These will often be the project plans of a small scale. The target may be a grow rate of 4% of the mean income, being the target for the economy as a whole.

After the scheme will have been used for some years it may be tried to derive from the actual decisions of the board a curve for weights on redistribution. This curve is supposed to be sloping downward with the level of C (or Y) attained and with the length of period. In this last case the different time preferences are relevant indeed.

4. TASK OF THE PROJECT ECONOMIST

According to the given scheme the project economist has to compute the internal rate of return over differences between successive proposals and to select a few proposals for transmitting to the board. He received data on the development in the region and the effort involved in the project for a number of comprehensive proposals for investment as they are chosen by the designers. He introduces the value component.

The project economist fills in–in principle–a simple table for each of the proposals (table 2).

Table 2. Net supplies or withdrawals from other sectors by the farms concerned

Kind	Time in years				
	1	2	...	...	50
Output (O, p_O)	.	.			
Labour (L, p_L)	.	.			
Accumulated Savings (S)	.	.			
Land (F, p_F)	.	.			
Non factor input (I, p_I)	.	.			
Δ national income ($Y. p_Y$)	Σ	Σ	...	...	Σ

The components of this table are drawn from the well-known equations $(O\text{-}I)\, p_i = Y.\, p_Y$ and $Y.\, p_Y = (L + \dot{S} + F)\, p_i$, where p are the prices. The addition to national income Y_R may be computed with $\Delta O_r - \Delta I_r$ providing for the addition to Y_R in the sector-region r, and $\Delta L_{R\text{-}r} + \Delta \dot{S}_{R\text{-}r} + \Delta F_{R\text{-}r}$ providing for the addition to Y_R in the other sector-regions of the country. The table does not therefore refer to the resources used on the farms, but to their supplies and withdrawals to and from other sectors. The differences are that in the last case:

–resources which are pushed out of agriculture but stay unemployed are not included (this refers especially to labour and land);

–resources which are procured by way of the project are not included either (this refers to savings and land). It is for this reason that the magnitude savings is used instead of capital; the deliveries of capital goods to the farms are not meant. The withdrawal of savings is equal to the value of the deliveries of capital less the farmers own savings.

The quantity component of each cell is supplied by the regional analysis, and is multiplied by the value component, of which the project economist has to derive an estimate. He assumes that the resources distribute throughout the national economy and therefore makes use of national data. For The Netherlands a medium range national plan is already available [Centraal Planbureau, 1966]. This provides the value component for some years which, however, cover at most only the period of construction. The building of models for long range planning receives much attention nowadays in Europe [e.g. E.E.C., 1960]. As soon as these plans are turned out these models may be used to derive the production value of L and S in the course of time. The latter would be the time preference in production. For the time being crude estimates from trend extrapolations are used for values O, I and L. For S inserting of a value is avoided, it is incorporated in the internal rate of return.

An analogous table is produced for the net supplies and withdrawals by the governmental agencies concerned. Its content is mainly the funds for investment and the costs for maintenance of the project proper. The quantities are supplied by the project designers, the prices may be shadow prices but are mostly actual prices in the near future in our case. It is essential that maintenance, reinvestment or liquidation, providing the foreseen operation over a uniform and long period—here 50 years— are included.

The streams of benefits and costs in 'cash flows' are added for each proposal. Then the differences between successive proposals are figured out. For the proposals as such and for the differences, the internal rate of return is computed with the well-known formula. The mere entering of re-investments into the computations causes negative cash flows. The experience is that the multiplicity of solutions is not of practical significance in the iterative procedure of the electronic computer. This could be expected [Wright, 1964].

The results are passed on to the designer:
- the proposals which do not meet the 3% requirement, as refuted
- those which are followed by other proposals with higher 'marginal' rates, as inefficient
- those with a marginal rate amply above 8%, for testing a possible intensification of the effort
- those with marginal rates between 8% and 3%, for more details.

Most of the procedure is of course also valid in retrospective calculations. The author performed a calculation for the region Waarland which was retrospective over 10 years and prospective over 40 years. Most the data were drawn from accounts of the individual farms. The reference development was deduced from data on farms in a nearby region. The internal rate of return over the whole investment showed up to be about 8% [Locht, 1968]. This was a case where good results were evident: small holdings were involved, the fields could only be reached by boat, cabbage (which has a negative income elasticity in this country) was cultivated in particular. Important aspects of the reconstructions were reclamation of land (20%) and water discharge, which led the way to the cultivation of tulips and the like.

It is experienced that differences in supplies of L, S and F between proposals are often small. A typical case of a good project is therefore one that attains a good–real–value of O, which would deteriorate without the project. These projects attain a fundamental change in production, mostly to horticulture, ornamental nurseries, meat production.

Aside from economic growth and income redistribution, also for agriculture other objectives are sometimes stipulated. This results for example in benefits from a fine scenery and in particular from leisure. For the time being these are not considered. At the Institute, Spijk [1969] developed a point system of benefits. It may be used to compile these effects and transfer them in an income equivalent.

5. TASK OF THE REGIONAL ECONOMIST

This is an attempt to reduce the complicated process of economic growth in agriculture to a simple model 'Ce qui est simple est toujours faux, mais ce qui ne l'est pas est inutilisable', Valery). This model consists of:
–a production function on the micro-level. The Cobb-Douglas model is used in the form

$$\log (O.p_O)_{bt}=t \log (1+\Sigma+\pi) + \lambda \log L_{bt}+\mu \log K_{bt}+\gamma \log F_{bt}+\lambda \log (I.p_I)_{bt} \qquad (1)$$

where O, L, F and I are output, labour, land and nonfactor inputs as before, K is capital, b represents the farm firm (business) and ϵ *its efficiency*, π the rate of growth of the price level of O. Also used is

$$\log (O_{bt}.p_O \cdot I_{bt}.p_I) = \log (Y_{bt}.p_Y) = t \log (1+\Sigma+\pi), \text{ etc.} \qquad (1a)$$

–a function specifying the probabilities that a business will be liquidated (2).
In general form this relation is:

$$P=f (A, Y_b, m, d, r, s, t) \qquad (2)$$

where A is the age of the farmer, m the coefficient of professional mobility of the farmers in the region, being a probability for the individual farmer, d the mortality rate, r the retreat rate, s the shift rate. P is defined for periods of 5 years. Applying P to the holdings in existence at t-5 provides the number of businesses (B_t),
–functions for the development in the course of time for each of the inputs.

The regional economist analyzes the region concerned by means of the parameters of the model as they have been without the project. Continuing with these same parameters provides an estimate of the development without the project. (In retrospective calculations, derived parameters for another region are used to check the parameter extrapolations. The results cannot be checked: experience is that in The Netherlands there are always differences between regions in that respect). Next, he inserts a new production function as derived from data of the farm economist for a case with the project and inserts also the buying-out of farms as realized in the project, this is supplied to him by the designer. Continuing with the growth model in this form provides an estimate of the development with the project.

The computations produce the workers which will be pushed out of agriculture in the course of time and their age at the moment this will happen. As also the amounts of savings and investments. These are used to estimate the supplies and withdrawals of S from the rest of the economy.

Below some more remarks on the model are made, the application is not treated here. Some experience is acquired in calculations which were partly retrospective and partly prospective. This concerns Waarland, the region mentioned above in the northwest of The Netherlands and a region in the southeast (Broekhuizen). In both regions the cropping pattern is tending to horticulture. Although many difficulties did arise, they were not refuting the model as such. Data are assembled for a dairy and fruit region in the central part of this country (Tielerwaard-West). This seems to be a more difficult case to handle.

The relative simplicity follows among other things from assuming that:
- –a continuous production function on the farm level with aggregated inputs does suffice,
- –the effect of the project on the rest of the economy fades away; it cannot turn back to agriculture,
- –the multiplier may be omitted for the time being. Van Der Lely [1965] did research to construct an input-output table,
- –prices are automomous with regard to this context (the prices are inserted in the farm economists step).

Data for the input-output relation (1) are drawn from two sources: accounts of actual farms in the region before reconstruction provided by accountants and computed

Table 3. Cobb-Douglas function applied to 31 farms in the region Broekhuizen for two periods in parallel planes ($\epsilon + \pi = 1{,}8\%$). Means over three years are used to subdue the effect of weather (R = 0.985)

	Coefficients	Mean values infl. 1956/58	1963/65	Marginal productivities 1956/58	1963/65
Labour	0.200 (0.043)	8 185	11 400	0.50	0.60
Tenants wealth	0.137 (0.081)	13 910	21 840	0.20	0.22
Buildings	0.011 (0.021)	11 430	21 610	0.02	0.02
Land*	0.005 (0.049)	56 740	52 340	0.02	0.03
'Imports'	0.718 (0.052)	11 890	21 650	1.25	1.14

* The value for land used here is the market price it would have after 'maximum' improvement

accounts for several production systems, provided by a farm economist as will be treated under 6. Both are still laborious tasks. It is supposed that access to the actual accounts will be simplified becuase many of the accountants involved have opted for uniform and mechanical data processing.

The results with actual accounts for mixed farms in Broekhuizen are given in table 3. For the procedure may be referred to Rasmussen [1962].

As could be expected from the small number of farms included the range of possible coefficients is rather wide; this is a drawback especially in the case of tenants wealth. Besides the function is only valid within the range of the input combination that happens to be in existence. For these reasons the same procedure is applied to computed accounts for the same situation (without the project).

From the computed accounts a function is derived valid for the situation with the project. The direct effect of the project is foremost the difference in the production function: a once and for all shift in the efficiency level and in the coefficients for the resources.

Five main problems still have to be discussed: the Cobb-Douglas model as such, its application on the microlevel, the aggregation of the inputs and the use of any continuous function and the shift in efficiency and price level.

The logical implications of the Cobb-Douglas function and the method of identification used, do meet some objections. At the Institute a conceptionally more promising function is elaborated [Visser, 1968].

For analogous problems the regional production function is sometimes used: data are aggregated over the firms and the parameters are derived from the resulting time-series. In the case treated here, however, it is important to know each farmers position (his residual in the cross-section analysis).

The basic data–whether actual or computed–are in elementary variables: tools, implements, etc. To confront demand and supply in the model, these elementary variables have to be transformed into the units of supply: capital, labour and land with a few subcategories. Up to now, this is done by simple addition of the values of the elementary variables. A conceptionally better approach is to run a programming model for the farm, with the resources as such as constraints.

In fact the data by themselves provide already on input-output relation; computation of the Cobb-Douglas function provides only for the averaging over the original data interpolation, and a method for extrapolation in time. Neither of the first two is by itself necessary with computed accounts. In some research on spacial equilibrium of production is is therefore preferred to use directly the computed accounts–after aggregation; Fahri and Vercueil [1967] for instance have their program select the best 'systeme de production'. That method was proposed for our case by the computer centre RAET at Arnhem. The efficiency of that method depends on the existence, the width and the possibility of perception of the gaps between the production systems. The systems–and with that the gaps–are what indeed is studied with linear programming. In spite of that many positions in between are possible: for instance by using an old implement, sharing one with a neighbour. Next: the gaps may be

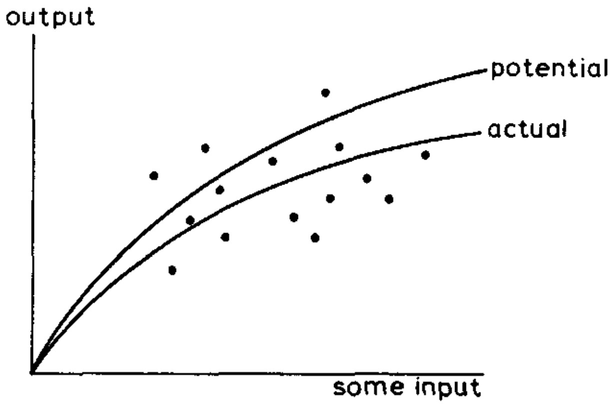

Figure 4 Schematical presentation of the derived function from actual accounts and that from computed accounts ('potential') in parallel planes computations. The difference between these curves is the overrating of efficiency implied in the procedure with computed accounts

perceivable for some 10 years in the future which covers, at most, the construction and adaptation period. Fahri can bypass this problem because he only looks ahead to 1970, in the case here interpolation is preferred be it within broadly farm-types. Change of farm-type is only envisaged as accomplished by the project in the construction and adaptation periods.

The results with linear programming imply a certain level of efficiency. This stems from the standards used and from the optimalisation the program performs. An estimate of the overrating of efficiency is derived from solving the Cobb-Douglas function with actual data and computed data in parallel planes (both without the project). The thus deduced factor of overrating has to be applied to the computed data for the cases with the project. Fig. 4 may illuminate this matter.

The deduction of a quantitive relation for the probabilities that a business will be liquidated, has taken a large part of the time of the author's group at the Institute in the period of the preliminary studies. A statistical procedure was formulated for deriving the components of change—death, retreat, professional mobility and shifts—from available data [Locht and Ploeger, 1968]. These data are the registration numbers of the farms in the region, broken down according to the age classes of 5 years of the farmers. Series of these data, with 5 years of time in between, are compared. From these basic data, exits and entries are deduced for every age class separately (fig. 5). To these derived data on exits for instance, a function is fitted with

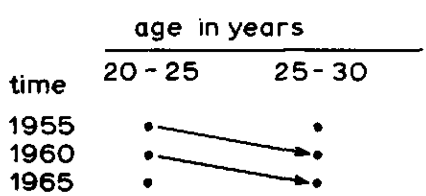

Figure 5 Schematical presentation of the deduction of data exits and entries for a number of age classes

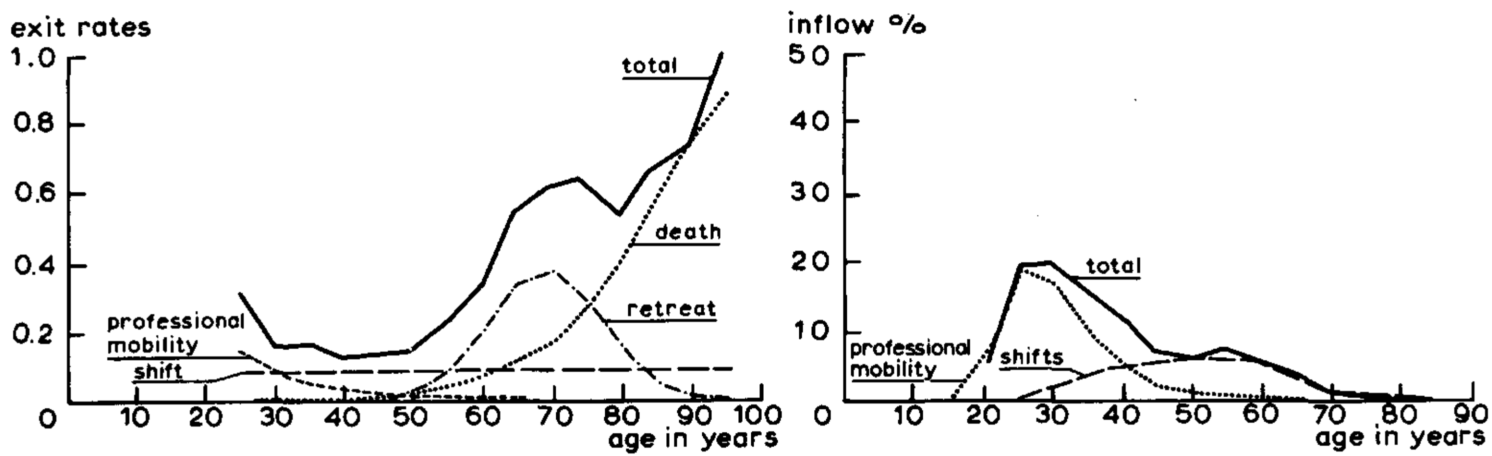

Figure 6 Exit rates (decrease in number of farmers divided by present number of farmers) and inflow (in % of total inflow) of farmers in relation to age (mean of interval, midst of period). Means of 15 agricultural areas with, in total, 6229 holdings larger than 2 ha

consists of death (using a predetermined rate), retreats (using a normal distribution with predetermined σ and deducing the parameters), professional mobility (using a log normal distribution) and shifts (using a constant rate for all age classes). Fig. 6 gives some results.

The parameters derived from this analysis are correlated with other characteristics of the region, especially with growth of income.

The labour on the farms is foremost that of the farmer himself (L_1). The outcome is therefore identical to that above. Labour of members of his family (L_2) is calculated with a trendwise changing rate (L_2/L_1). With foreign labour (L_3) the farmer is assumed to equate marginal output and wages as in the competitive model. The derived formula implies that the impetus of the project to growth of income per capita, is to some extent offset by a difference in decrease of the number of workers.

The development of capital, is the star turn in deduction of the growth rate and its content of cumulative causation. The stand taken here is that in many cases the amount of private investment depends on previous savings and that the investment opportunities do operate only in the selection of the kind of capital goods to be acquired and as a constraint which is actual only in a few cases. The main argument is that in agriculture in The Netherlands research and even knowledge of techniques, is far ahead of application. Might ever there be accumulated savings and no opportunities on a large scale, research and development would pounce upon this. This refers to the supply of opportunities. The demand for opportunities is small because:
–the use of outside accumulated savings is limited by the farmers own savings; the rate between these variables varying with age and sociological factors,
–the amount of the farmers own accumulated savings is small because in the regions where the agency wants to push agriculture, income on many farms is rather low. Besides that, savings are drained some every thirty years.

The argument on this point has to be cut short. A simple graph (fig. 7) is added as an illustration.

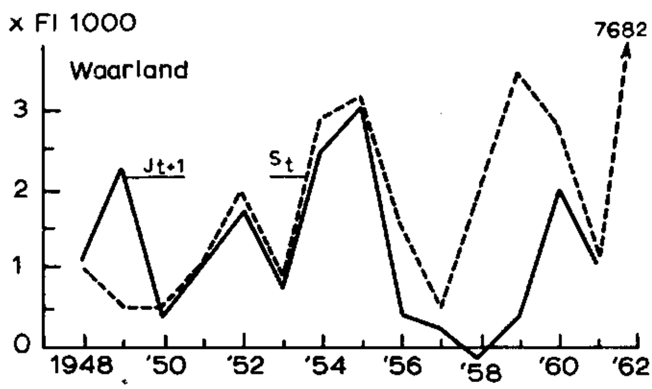

Figure 7 Course of net savings (S_t) and net investments in the following year (J_{t+1}) of farmers in Waarland

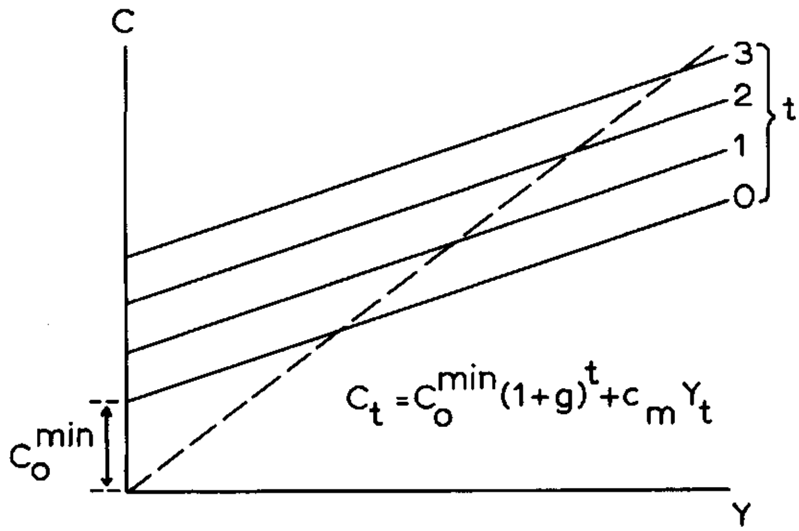

Figure 8 The applied consumption function. With this function it is assumed that minimum consumption (C^{min}) shifts every year with the rate (g); C_t depends on C^{min}, the marginal rate of consumption (c_m) and income (Y). It will be clear that the mean rate of consumption will only be constant over the years at a growth rate of Y equal to g. For the region Broekhuizen C^{min} is Fl. 3059 (prices 1962), the shift g is 1.5% and c_m, 0.43 (R=0.74, n=372): the equilibrium growth rate of income being also 1.5%. In the years of a small increase in income, the mean rate was between 70 and 75%; in the years of more rapid growth, between 63 and 66%

Using this model the effect of the project is very sensitive for the savings quote. In both regions studied this quote showed up to be very high (net savings over 20% of net income before tax).

In our model the savings function shifts every year and the marginal rate is larger than the mean. As long as the marginal rate and the shift are fixed there is only one rate of income growth for which the mean savings rate is constant (see fig. 8). A typical case of a good project is one that operates in a region where without the project the growth rate on many farms is below the equilibrium level and which starts an income growth above the equilibrium level, (it has to be remembered that the project economist inserts the real values for the products. If these real values are much below the actual prices—a heavy subsidy—a good project from the regional point of view may have still a low $r_{\Delta J}$ and be a bad project from the national point of view.

This essay does not deal with the regional growth model in full. It may therefore suffice to state about the other variables:
—that the available land on the farms depend among other things on the continuation of the other farms as in (2). The problem how to distribute the land over the remaining farms is not yet solved in a satisfactory way.
—the estimate of the efficiency of the farm is the mean efficiency and the residual in the cross-section test of (1). The yearly shift of the mean efficiency is derived from

computation with (1), fitting parallel planes to two series of data (each being an arithmetic mean over three years). Whether this development has to studied embodied, disembodied, etc., receives much attention in economics nowadays. The proposed model of growth can follow suit.
–the number of farms in the region B_t follows them (2) and the compilations O, I, L, K and F over the farms bear no problem.

6. TASKS OF THE OTHER RESEARCH GROUPS

Research in the first three steps of the calculation procedure will only be discussed briefly. Farm economics, crop and animal husbandry and rural reconstruction design are involved.

The problem posed in the scheme to the farm economist is as mentioned to supply computed accounts. At the Institute, Meyerman [1966] and Righolt [1967] derived potentialities for income on farms under the different conditions stemming from proposals for specific projects. They used the technique of linear programming and made their computations for different land input (parametric), a few levels of labour input and a few different equipments. They used vectors for 'normal' claims on labour and capital goods in each season for each crop and vectors of claims when land and water resources would be of the different quality that the proposals for the project assume. Next they used standards for yields per hectare, for fertilizers to be applied, etc. They in fact integrated in some way all the variables for the first three steps in the calculation procedure. They used the actual prices of the past.

For the use of their results in the given scheme some minor adaptations are necessary:
–the number and selection of the programs to run has been set at 27 for each of the possible projects: three levels each for labour, capital and land. The large number of programs is thought to be warranted because the investment involved is considerable;
–in the computations for the cases with the project, prices of the near future have to be used. The prices to be used are not the values used in 4.1, but the actual prices (inclusive of grants). These are provided by a national supply and demand analysis [Agricultural Economics Research Institute, The Hague, 1967];
–instead of only an income level, an account has to be deduced; stipulating the outputs and the inputs. This bears no problems;

The computations with linear programming are indicated in fig. 2 with a dot under the heading farm economics.

The research on crop and animal husbandry has to supply vectors of claims and standards for yields. The Institute for Rationalisation of Agriculture (I.L.R.) at Wageningen published lists of such claims [Postma and Van Elderen, 1963, a revised edition is in press]. At the Institute research is performed based on land-wide inquiries. Some differentiation after size of lots, distance to farm buildings is already incorporated. More differentiation in claims according to factors which vary with the proposals of the project is object of research at the Institute for Land and Water Management Research, for instance on the effect of turning and side borders, a conspectus of this research is given in Van Den Berg, et al [1968].

The vectors for the output have to be provided, differentiated after moisture status of the soil, chloride content of the water, etc. The field is very wide; for the research performed at the Institute may be referred once more to the conspectus mentioned. Although many relations have already been provided in some form, others are still unknown. In those cases the calculation proceeds from an estimate by an expert. The computations on the plant and animal level are indicated with a dot in the matching column.

Rural reconstruction design covers drainage, reallotment, resiting of farm buildings, buying out, etc. Two kinds of data have to be delivered: data to research in husbandry and the costs of the projects as supply to the project economist.

Some of the data from the first group do need computer programs. Van Gelderen [1966] developed such a program for resiting of farmbuildings → distance and concentration of lots; a Working Party of the ICW [1968] for change in groundwater table → moïsture content in areas with a microrelief. Each of the relations plotted in our diagram can already be covered in some way.

Research on the costside is mainly performed by the contractors as the Royal Dutch Heath Company and the sub-contractors. It is only partly available for general use [Heath Company, 1963]. On some aspects, such as investments in drinking water supply, telephone and electricity, cost functions are available [Spijk, 1967].

On most aspects the designer has to assume some execution technique, and to figure out the machine and labour time, next he has to apply a tariff. Because of the lack of cost functions it is impossible to build a program for the selection of design. This is the reason that in the given calculation scheme, the procedure starts with proposals of the designer. As is mentioned in Section 4, some proposals are referred back to the designer for more details or testing the scope for intensification of the effort. In this step the designer has to test his design on details with regard to costs and technical efficiency. Deducing of accounting prices from the model is envisaged.

7. RECREATION

In the actual projects design hardly any recreational facilities whose benefits accrue to farmers or other groups for which the competitive model is not reasonably valid are incorporated. Therefore the calculation procedure envisaged for recreational facilities, has not the characteristics which take the leading part in this essay; a special regional development is not accounted for. The principle of the calculations made for recreation is that a demand curve is derived for the facility, using distance as a proxy for price. The benefits from opening up a new facility are the differences in travel costs and time, an the increase in the consumers surplus. The conceptionally interesting proposal of Klaassen [1968], to measure the benefits as the effect of recreation on the productivity of those who have recreated seems to be rather difficult to apply.

SUMMARY

An explanation is given of a method of evaluation of rural reconstruction projects as suggested to the Netherlands Governmental Service for Land and Water Use. The main feature of the method is an estimation of development in the long run with and without the project. For the project a few proposals are calculated and they are tested on the benefits of the increments in investment.

The method may seem to be a specimen of perfectionism, the funds involved, however, are large so application may be warranted. After the procedure will have been used for some time, it may show up to be unsensitive for some factors and some short-circuiting may possible by introduced.

REFERENCES

Agricultural Economics Research Institute. 1967. Supply and demand, imports and exports of selected agricultural products in The Netherlands. Forecast for 1970 and 1975. 's-Gravenhage.

Berg, C. Van Den, W.C. Visser, J. Wesseling, J.F. Bierhuizen, G.P. Wind, C. Bijkerk and E.W. Schierbeek. 1968. A decade research in land and water management 1957-1967. *Techn. Bull. ICW* 60.

Duin, R.H.A. Van, Th. J. Linthorst and J.B. Sprik. 1963. Cultuurtechnische verbeteringsplannen voor de Veenkoloniën. Rapport ICW 18.

EEC, 1960. Ramingsmethoden voor de economische ontwikkeling op lange termijn 6. Statistical Office, Brussels.

Farhi, L. et J. Vercueil. 1967. Etudes concertées pour la definition d'un programme agricole: Le modèle de prevision 1970. Article pour Economie Appliquée. *Econ. Appliquée.*

Feldstein, M.S. 1965. The derivation of social time preference rates (unpublished paper quoted by Henderson, 1965).

Gelderen, C. Van. 1966. Bepaling en gebruik van de minimale gemiddelde kavelafstand. *Landbouwk. Tijdschr.* 78.6:230-239. Misc. Repr. ICW 35.

Heath Company, Royal Dutch. 1963. Calculatie Vademecum. Arnhem.

Henderson, P.D. 1965. Notes on public investment criteria in the United Kingdom. *Bull. Oxford Univ. Inst. Econ. Statistics* 27.1:55-89.

Hufschmidt, M.M. and M.B. Fiering. 1966. *Simulation techniques for design of water-resource systems.* Harvard University Press, Cambridge.

Klaassen, L.H. 1968. *Social amenities in area economic growth.* OECD, Paris.

Land Reclamation and Improvement, International Institute for. 1960. A priority scheme for Dutch land consolidation projects. Publ. 6 Wageningen.

Lely, G. Van Der. 1965. Nacalculatie van het effect van cultuurtechnische werken. *Landbouwk. Tijdschr.* 77.22:877-884.

Locht, L.J. 1962. Het effect van cultuurtechnische investeringen in afhankelijkheid van de mobiliteit van arbeid en vermogen. *Cult. Techn. Tijdschr.* 2.4:156-168.

Locht, L.T. 1968. Calculatie van het effect van cultuurtechnische projecten, toegepast op het tuinbouwvaargebied Waarland. *Meded. Dir. Tuinb.* 31.9:358-365. Med. ICW 113.

Locht, D.J. en J. Ploeger. 1967. Een methode voor raming van de toekomstige agrarische beroepsbevolking in het bijzonder het aantal bedrijfshoofden, ten behoeve van een cultuurtechnisch plan. Nota ICW 428.

Marglin, S. A. 1962. Economic factors affecting design. In: *Design of water-resource systems.* Harvard University Press, Cambridge : 159 - 225.

Marglin, S. A. 1967. Public Investment criteria. *Studies in the economic development of India 4.* George Allen, London.

McKean, R. 1958. Efficiency in government through systems analysis with emphasis on water resources development. *Operations Res. Soc. Publ. 3.* John Wiley, New York.

Meijerman, G.C. 1966. Cultuurtechnische factoren en ontwikkelingsmogelijkheden voor veenkoloniale bedrijven. V.L.O. 686. Pudoc, Wageningen.

Myrdal, G. 1957. *Economic theory and under-developed regions* Gerald Duckworth, London.

OECD. 1967, Quantitative models as an aid to development assistance policy. Expert group on the use of analytical techniques, Paris.

OEEC. 1960. Regional Economic Planning. Techniques of analysis for less developed area. *Proceedings Conference on Regional Economic Planning,* Paris.

Planbureau, Centraal. 1966. De Nederlandse economie in 1970. Staatsuitgeverij, 's-Gravenhage.

Postma, G. en E. Van Elderen. 1963. Arbeidsbegroting met behulp van taaktijden. Publ. ILR 70.

Rasmussen, K. 1962. *Production function analyses of British and Irish farm accounts.* Univ. Nottingham.

Righolt, J.W. 1967. Bedrijfseconomische aspecten van de landindeling in het veenweidegebied. *Landbouwk. Tijdschr.* 79.8:262-268. Med. ICW 102.

Spijk, P. 1967. Invloed van de situering van boerderijen op de investeringen in openbare nutsvoorzieningen. *De Ingenieur* 67.7:1-9. Misc. Repr. ICW 41.

Spijk, P. 1967. Gedachten over de wekwijze ten aanzien van landinrichtingsplannen: alternatieven en beoordelingsaspecten. (in press).

Visser, W.C. 1968. Some research techniques for multivariate land improvement problems. In: *A decade research in land and water management 1957-1967.* Techn. Bull. ICW 60.

Working Party of ICW. 1968. Determination of the optimum combination of water management systems in areas with a microrelief. Techn. Bull. ICW 56.

Wright, J.F. 1964. The marginal efficiency of capital. *Oxford Econ. Papers.*