POSSIBLE CHANGE IN FUTURE LAND USE IN THE EUROPEAN COMMUNITY

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ABSTRACT

The Netherlands Scientific Council for Government Policy has conducted a study on the future of rural areas in the European Community. Four different model scenarios for land-based agriculture and forestry in the European Community up to approximately 2015 have been set up. The scenarios indicate how land can best be used in rural areas, depending on the choices which ensue from a number of different philosophies for the future. The scenarios are technical surveys which define the limitations of *every* future development that is in line with four political philosophies based on the main positions in the current debate on European agricultural policy. The outcomes of the four scenarios differ by a factor of 2 to 7 in terms of the amount of land required for agriculture, costs, employment, and use of fertilizers and pesticides. They also differ greatly from the current situation.

These differences can be regarded as significant for policy in two ways. Firstly, the differences between the scenarios indicate that widely varying policy options lead to widely varying results. Secondly, the scenarios unmistakably point to a number of structural developments in land-based agriculture and forestry, which will have to be catered for in future policy. For example in all scenarios land surpluses will increase. Therefore, policy which is not geared to reducing the amount of land under cultivation would be counterproductive.

The study does not give rise to recommendations which can be translated into specific policy measures, but simply sets out a research and policy agenda. As far as the latter is concerned the results of this study can be used as a framework for decision-making. Its findings offer starting points for a more fundamental approach, at both national and European level. The need to pursue an active land policy is at any rate clear.

INTRODUCTION

Agriculture in the European Community is becoming ever more productive. The combination of better production conditions, increasing knowledge of cultivation techniques and high-yielding varieties have led to a period of growth whose end is not yet in sight. Even greater productivity may be expected in the future as a result of (bio)technological innovations. There are both positive and negative sides to this picture. A positive feat is the achievement of food security, the primary objective of the European Common Agricultural Policy (CAP). However, if one carries this increase in productivity to its logical conclusion, a more somber picture emerges. There has already been a dramatic rise in the costs of the agricultural policy; there is conflict with important trading partners over the subsidized dumping of EC surpluses on the world market; the market is distorted, mainly to the detriment of developing countries; and there are increasing environmental problems resulting from current production methods. If we carry on along the same lines, these problems will become intractable.

It is therefore generally recognized that the CAP must be reformed. However, it is not clear what form this reform should take. The reforms recently agreed in Brussels have been hailed as a breakthrough[1]. This is certainly true as far as pricing policy is concerned. A 29 % fall in grain prices over three years is considerable and would bring European prices into line with those on the world market. However, the compensation scheme for land taken out of production leaves the basic problem untouched, since there was no fundamental debate on the *aims* of the policy and the changes were almost exclusively limited to the instruments used. There was inadequate discussion of the extent to which these goals - and/or any adjustments deemed necessary - give rise to a need for a policy review.

In the report 'Ground for choices' the Netherlands Scientific Council for Government Policy tried to focus the attention to the goals of agricultural policy[2]. The reasons for the Council to do so were threefold:

1 - the widespread increase in agricultural productivity seems to continue, which means that growing surpluses are being produced on the land already under cultivation;

2 - the forecast growth in the budgetary burden on the Community if policy is not amended;

3 - the social pressure for attention to be devoted to matters other than productivity, such as the sustainable protection of the environment, nature and landscape, is growing.

As a result of these developments the member states of the European Community, and therefore also the Dutch government, have been confronted with the need to make strategic choices concerning the future of agricultural areas. In this paper we describe the approach that we have chosen to investigate possible future changes in land use and some of the results will be presented.

The study presents an analysis of possible variations in land use within the EC up to the year 2015. We developed the linear programming model GOAL (General Optimal Allocation of Land use) to examine where, depending on various policy options, land should be used for agriculture and forestry and what methods should be employed to achieve certain combinations of policy goals as effectively as possible. The allocation of land use would thus be guided by the relative value attached to different policy goals. The pattern of land use was determined which emerges when priority is given to varying policy aims relating to employment, the environment and economics, assuming a certain level of demand for agricultural products and use of the best technical means currently available. This gave rise to a sometimes radical reallocation of production and land use.

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1 Commission of the European Communities, *The development and future of the Common Agricultural Policy. Proposals of the Commission*, COM(91) 258 final, Brussels, 11 July 1991.

2 Netherlands Scientific Council for Government Policy (WRR), *Ground for choices. Four perspectives for the rural areas in the European Community*, Reports to the Government no. 42, The Hague, Sdu Uitgeverij, 1992.

Since the differing values placed on goals determines outcome, the chosen approach made it possible to devise possible scenarios corresponding to contrasting political *philosophies* about the desired policy on land-based agriculture and forestry in the EC. A philosophy can be defined in this context as a cohesive set of preferences with regard to a number of goals. The core of this study comprises four such scenarios. Besides agricultural production as such, they also encompass aims relating to socioeconomics, the environment and nature conservation and development.

THE FOUR SCENARIOS

Four contrasting philosophies have been devised on the basis of the main movements in the current debate on agriculture. These are extreme philosophies, in which the ideas which have been put forward in the debate are taken to their logical conclusions. They determine the order of policy goals which form the basis of scenarios.

Scenario Free market and Free trade (FF)

Under the free trade scenario agriculture is treated in the same way as every other economic activity. Production is as low-cost as possible. A free international market for agricultural products has been assumed, with a minimum of restrictions in the interests of social provisions and environment. The philosophy which dominates this scenario is similar to the American approach to the current negotiations on the General Agreement on Tariffs and Trade (GATT).

Scenario Regional Development RD)

This scenario accords priority to regional development of employment within the EC, which creates income in the agricultural sector. The predominant philosophy can be regarded as a continuation and extension of current EC policy.

Scenario Nature and Landscape (NL)

Under this scenario the greatest possible effort is made to conserve natural habitats, creating zones which divide them from agricultural areas. Besides protected nature reserves, areas would also be set aside for human activity. Nature conservation groups are exponents of this philosophy.

Scenario Environmental Protection (EP)

The primary policy aim under this scenario is to keep alien substances from entering the environment. In contrast to scenario NL, the main aim is not to preserve or improve certain species of plant and animal, but to protect the soil, water and air. There is therefore no physical division between natural and agricultural areas; on the contrary, these are integrated. Farming may take place anywhere, but subject to

strict environmental requirements. The philosophy behind this is in line with the concept of *integrated agriculture* as developed during the last decade, partly at the instigation of the WRR[3].

Land requirement assessment

The four scenarios developed with GOAL do not comprise all the problems dealt with in this study. Goals relating to nature and landscape cannot be expressed in figures in such a way that the model can interpret them. To remedy this situation, maps have been drawn up which represent the best division of land from the point of view of landscape and nature conservation. The outcomes of the models were assessed on the basis of these maps. It could be that the results produced by the model will have to be amended as new space requirements arise.

ROLE OF THE SCENARIOS

In the report *Ground for choices* the GOAL model and the needed input are described in detail. In this paper, by way of an introduction to the model, we will only give an indication how the model works and what results are obtained.

The model does not produce forecasts. The scenarios explore *options of technical possibilities* based on a series of well-founded assumptions and presuppositions from which, however, a number of factors have been excluded (such as price changes, assumptions about the behavior of actors, institutional obstacles). What we are concerned with is not, therefore, a study of the effects of a number of possible amendments to the CAP. The model does indicate the technical limitations within which these changes will have to be made. In many other policy areas such a definition of technical limitations would be impossible. (for example, when should a country be considered 'full', or what level of prosperity is 'enough'?). This is possible for land-based agriculture in the EC, though, because it can be based on well-known quantitative data (demand for agricultural products, technologies, possible use of land, etc.).

Policymaking can benefit from this type of information, because the options can be used to determine to what extent current policy can cope with the developments which occur to a significant extent in the scenarios (this is particularly the case with the continuing rise in productivity, and the decrease in employment in land-based agriculture linked to this). An estimation can therefore be made of the effort required to achieve goals, depending on the question of whether we will have to 'go against the tide' or simply go with it. In this way the outcomes produced by GOAL can serve as *guidelines for future policies*. If they all point in the same direction, there is clearly conflict between the technical possibilities

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3 *Bouwstenen voor een geïntegreerde landbouw* (Building blocks for an integrated agriculture - in Dutch) by W.J. van der Weiden, H. van der Wal, H.J. de Graaf et al., WRR Preliminary and background studies no. V44, The Hague, Staatsuitgeverij, 1984.

and a policy which seeks to achieve something else. Variations in the results can point to unsuspected potential in certain areas. They can also show extra possibilities by indicating when certain developments can be substituted for others.

One source of the kind of conflict mentioned above could lie in the fact that all four scenarios show much less agricultural land use than the 127 million hectares currently in use in the EC. Great effort would be needed to maintain the current area of agricultural land in the long term. Would this be worth doing? Should not other goals be given preference? Simply defining technical possibilities gives rise to such questions.

The scenarios are designed to promote debate on policy options at various levels. Firstly, they demonstrate the possibilities for achieving the goals to which the various philosophies attach importance. These are results at *European Community level.* They also show which areas are most suitable for agriculture in the EC, what type of agriculture can most effectively be pursued in each area (arable, livestock, permanent cultures or forestry) and what methods should be used (geared towards highest production efficiency, environmental protection or maximum use of land). These results have an effect at *regional level.* If the results on EC- and regional level have consequences for certain countries, they will affect policy at *national level* as well.

In the following sections the development and main results of the model are summarized.

THE DEVELOPMENT OF THE GOAL MODEL

The GOAL model (General Optimal Allocation of Land Use) is a linear programming model that can optimize land use to meet a policy goal, given a limitative set of types of land use and an exogenously defined demand for agricultural and forestry products. A number of policy goals are coupled to types of land use in the form of objective functions, e.g. maximization of efficiency of inputs needed for agriculture, minimization of regional unemployment in land based agriculture and minimization of the use of pesticides. Political philosophies can be fed into the model by assigning different preferences to the objectives. Within the GOAL model this is done by restricting the objective functions to a certain domain, e.g.: the total labor force can not be less than a minimum level. In this way scenarios can be constructed that show the effects of policy priorities, e.g.: to maintain the labor force the model will have to select types of land use with a relatively high input of labor.

The types of land use that the model can choose from are defined in quantitative terms. Because we want to explore possible long term options, current agricultural practice in use in Italy or East-Anglia should not be used as a reference, because it reflects the capabilities and regional differences of this moment, not those of the future. Therefore we must define types of land use that are envisaged over a longer period of

time. The concept of *best technical means* is used to obtain such types of land use, i.e. agriculture is takes place according to methods that are already operational in plant testing stations, experimental farms and many advanced farms at this moment. This does not imply a well defined way of agriculture in the sense of prescriptions, but gives input-output ratios that presume the highest possible efficiency under the prevailing biophysical conditions. Basically three types of production techniques are distinguished:

- Yield Oriented Agriculture aiming at maximum efficiency of inputs per unit of product,
- Environment Oriented Agriculture aiming at lowest emissions and immissions per unit of area, and
- Land Use Oriented Agriculture aiming at maximal land use.

These forerunners are used as a reference for future developments. In that way the results of the model calculations are consistent across all member states of the EC. Three levels of analysis were necessary to construct the GOAL model.

Crop level

In figure 1 the inputs and outputs for the analysis at the individual crop level are visualized. Plant properties, soil properties and climate properties determine the potential crop yield at a given location. To calculate this potential crop yield the suitability of the soil for a certain crop is assessed to exclude all units where that crop can not be grown (e.g. wheat on steep slopes and maize on clay soils). This can be denoted as a qualitative land evaluation. Next, by means of a simulation model, potential yields are calculated for the suitable areas. This can be denoted as a quantitative land evaluation[4].

The qualitative land evaluation of the EC is accomplished through the use of a Geographical Information System (GIS) [5]. The evaluation is executed at the level of Land Evaluation Units (LEUs), a combination of soil and climate conditions that is considered to be homogeneous (22.000 units to cover the EC). By looking at factors like steepness, salinity, and stoniness of the soil the suitability for mechanized farming is assessed.

The quantitative land evaluation is accomplished through the use of the WOFOST crop growth simulation model [6]. For the areas that are suitable the potential yields of winter wheat, maize, sugarbeet, potato, and grass are assessed. The simulation model uses as its inputs: technical information on regional soil (such as water holding capacity) and climate properties and relevant properties of the crop (such as phenologi-

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4 H.A.J. van Lanen, Qualitative and quantitative physical land evaluation: an operational approach (Thesis) Wageningen Agricultural University, Wageningen, 1990.

5 C.A. van Diepen, G.H.J. de Koning, G.J. Reinds, J. D. Bulens, H.A.J. van Lanen, "Regional analysis of physical potential of crop production in the European Community"; in: *The greenhouse effect and primary productivity in European agro-ecosystems.* J. Goudriaan, H. van Keulen and H. H. Van Laar (eds.), Pudoc, Wageningen, 1990.

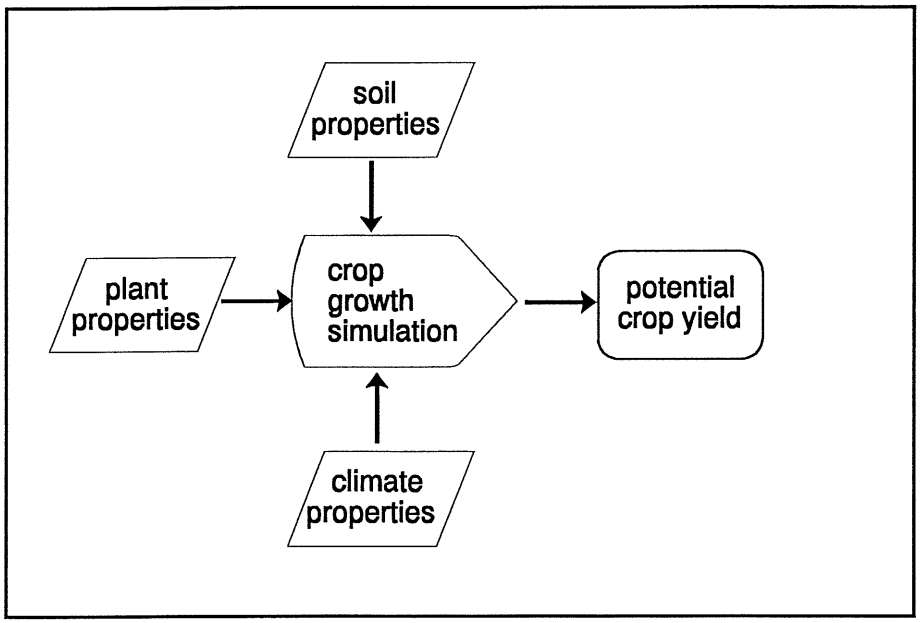
6 H. van Keulen, J. Wolf, *Modelling of agricultural production: weather, soils and crops* Simulation Monographs. Pudoc, Wageningen, 1986.

cal development, light interception, assimilation, respiration, partitioning of dry-matter increase over plant organs and transpiration).

Two degrees of water availability are distinguished: rainfed and irrigated. In the rainfed situation maximum yields can be limited by the availability of water at any point during the growing season. In that case the model simulation gives an indication of the attainable yields when no irrigation is applied. This is referred to as water limited yield. In the irrigated situation there are no limitations to crop growth other than those impeded by climate and soil conditions and properties of the crop. In that case the model simulation gives an indication of the maximum attainable yield at a given location. This is referred to as potential yield.

The water-limited and potential yields are used as input at the next level of analysis.

Figure 1 **The inputs and outputs of the analysis at individual crop level**

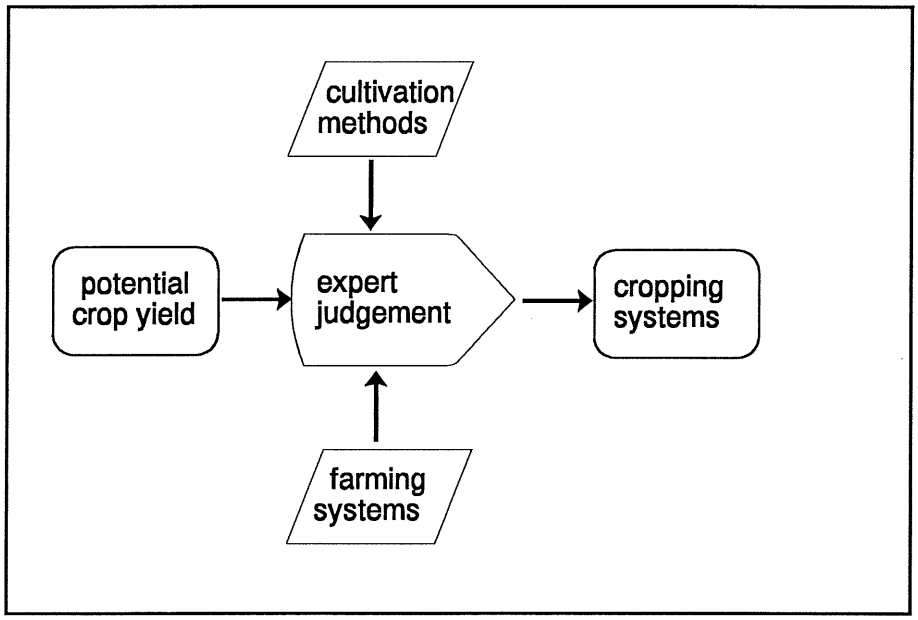


Cropping system level

If one wants to find out land use possibilities in the future, information on individual crops will not be sufficient. All crops are grown in a cropping system that defines all inputs and outputs. Moreover, in most cases monocropping does not provide sustainable agriculture and only a limited number of crop combinations can be used in practical cropping systems. Therefore potential yields of indicator crops are translated into cropping systems that comprise a certain rotation scheme, certain management decisions and a certain use of inputs. In figure 2 the inputs and outputs at this level of analysis are given. It is striking that at this level the only viable method is expert judgement. From his experience, both in practice and in experiments, the expert can deduce input and output coefficients of cropping systems. Yield levels are different from the potential level and maximum efficiency depends on soil and location.

These systems are not widely used yet, are available at experimental farms and put into practice at some advanced farms throughout the EC. This element in the analysis is crucial yet open to debate due to the subjective choices that are involved. To enable the discussion at this point a report of the necessary choices has been published [7].

Figure 2 **The inputs and outputs of the analysis at the level of cropping systems**



Land use level

At the level of land use possibilities for the EC all information is brought together. Requirements for various goals related to land use together with alternative cropping systems and a demand for agricultural produce are fed into the GOAL model to generate scenarios of different options for land use at the level of NUTS-1 regions within the EC.. The cropping systems are fed into the model through input-output tables that differ for the various local production circumstances (soil and climate). This is illustrated in figure 3.

An IMGP (Interactive Multiple Goal Programming) procedure is used to optimize a set of objective functions that is incorporated in the model. In this procedure restrictions are put to the objective functions to model preferences in policy goals. The four different scenarios (FF, RD, NL and EP) are expressed in the GOAL model by setting different restrictions to the objective functions and by varying the demand. A few examples can illustrate this.

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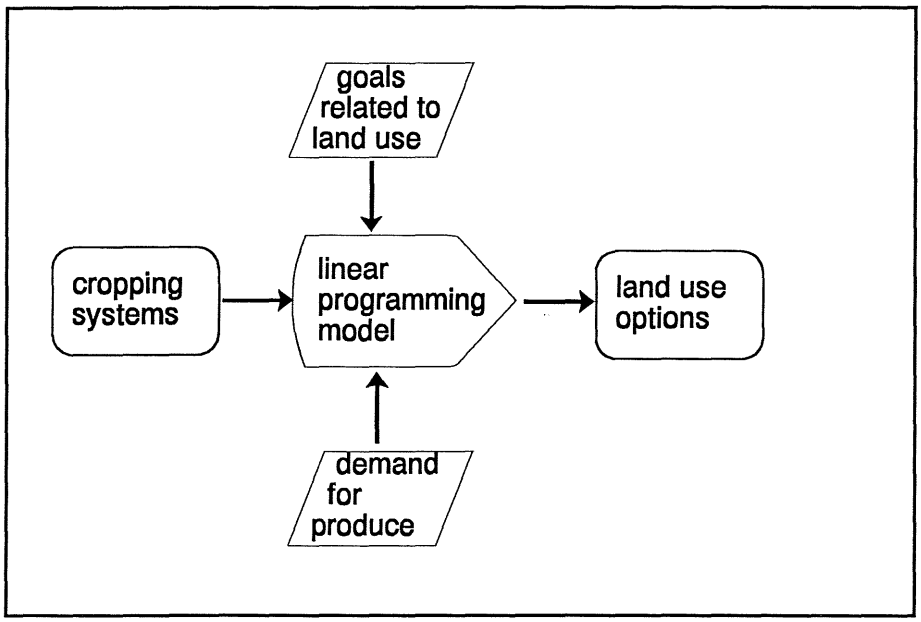
[7] G.H.J. de Koning, H. Janssen, H van Keulen,*Input and output coefficients of various cropping and livestock systems in the European Communities.* Working Documents W 62, Netherlands Scientific Council for Government Policy, The Hague, The Netherlands. 1992.

In FF (free trade and free market) the costs of agricultural production are minimized and no other restrictions are put to the objectives. Moreover, free trade implies that import and export is allowed, so the demand for agriculture produce from within the EC is modified according to expectations regarding new market balances. The model will now choose the most cost-efficient types of land use and allocate them in the most productive regions.

In EP (environmental protection) again the costs of agricultural production are minimized, but here strict limitations are put to the objective functions that represent the use of fertilizers and pesticides. Next to that the demand for agricultural produce is fitted to self-sufficiency. The model will now choose for types of land use that agree with the imposed restrictions.

Figure 3 **The inputs and outputs of the analysis at land use level**



RESULTS AT THE LEVEL OF THE EUROPEAN COMMUNITY

Contrasts between the scenarios

The model calculations point to dramatic differences between the four scenarios. The values of the individual goals differ from scenario to scenario and from one area of policy to another. When it comes to land use the highest value is some three times higher than the lowest. The difference is twofold as far as land-based agriculture, employment and use of nitrogen (total and per hectare) are concerned. Highest values for use of crop protection agents per hectare are 4 times the lowest, while the totals differ by a factor of 7.

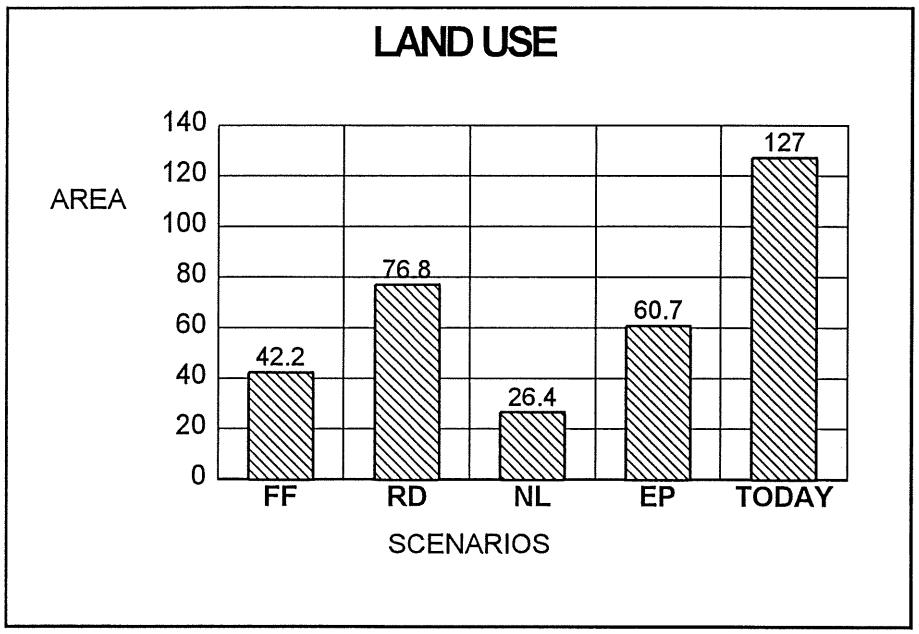
The first conclusion which can be drawn from these significant differences is that there is scope for a clear policy to be pursued.

Land use

The highest and lowest values for land use do vary widely, but all four scenarios lead to a considerable reduction in agricultural land. This is illustrated in figure 4 which compares the land required under the four scenarios with the current amount of land under cultivation. The highest land productivity is achieved in scenario NL, where the area of agricultural land is smallest. Of the 127 million hectares of agricultural land now in use, 26.4 million hectares remain in scenario NL. The other scenarios also lead to a sharp fall in the area of land required: 42 million hectares in FF, 76 million hectares in RD, and 60 million hectares in EP. The discrepancy between the area of land currently in use and the area that is technically necessary for food production shows that the present set-aside schemes can only be the very beginning.

The second conclusion is that there is little scope for a policy geared to keeping all current agricultural land in use.

Figure 4 **Land use in the different scenarios compared with current land use in the EC (in mill. ha)**



Scenario FF - Free market and free trade
Scenario RD - Regional development
Scenario NL - Nature and landscape
Scenario EP - Environmental protection

Source: WRR

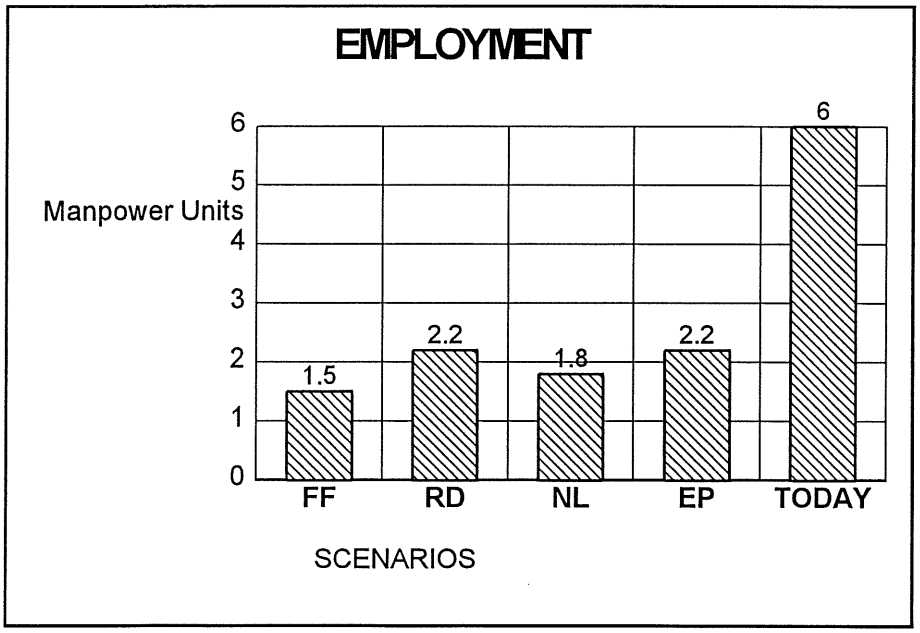
Employment

All the scenarios show a further reduction in agricultural employment (see fig. 5). The current level of employment in agriculture cannot be continued. Even in scenario RD, in which an attempt is made to keep as many people as possible employed in land-based agriculture in the EC without subsidies,

employment declines. Of the 6 million manpower units (MPUs) today (1988/89), no more than 2.8 million remain. It can be concluded from the scenarios that preserving the current level of employment amounts to maintaining hidden unemployment (in some regions up to 50 %), and costs a great deal of money. Moreover the loss of jobs in the agricultural sector already amounts to 2 to 3 % a year. If this trend continues, in 15 years' time employment will be about 40 % lower than today, despite all the measures taken.

The third conclusion is that in all cases considerable effort is required to accommodate the wastage of labor from agriculture.

Figure 5 **Employment in the different scenarios compared with current employment in the EC (in mill. MPUs)**



Scenario FF - Free market and free trade
Scenario RD - Regional development
Scenario NL - Nature and landscape
Scenario EP - Environmental protection

Source: WRR.

Environment

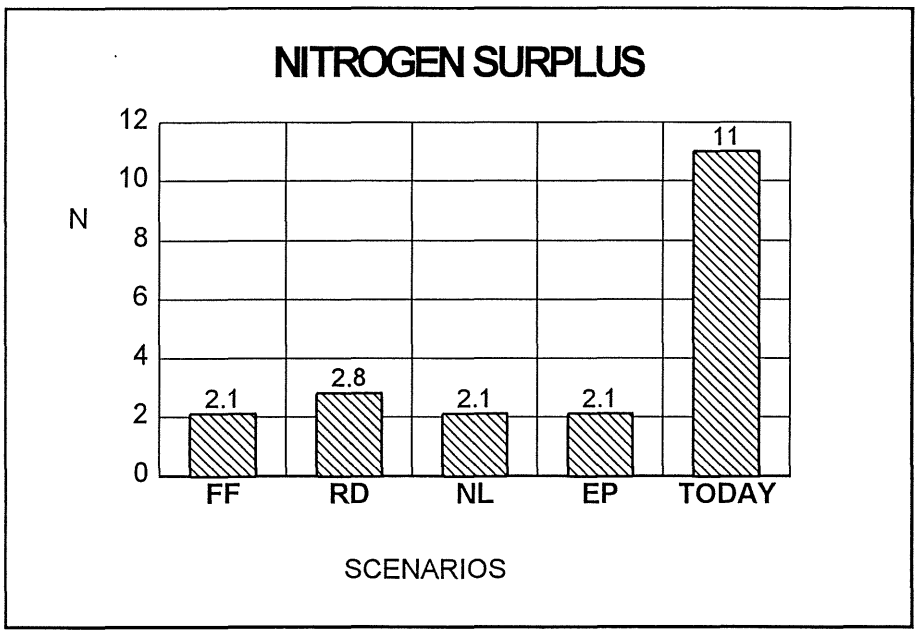
The quality of the environment is affected mainly by the use of crop protection agents and artificial fertilizer. It is technically possible to significantly reduce the use of both nitrogen fertilizer and crop protection agents without adversely affecting production. This is shown in figures 6 and 7. In particular crop protection offers a great deal of scope.

A reduction in the use of fertilizers and pesticides is seen in current European policy as a service which farmers render to society. It is assumed that as a result they will suffer a loss of income and must therefore receive compensation. However, the scenarios show that the surplus of nitrogen and the use of

crop protection agents can be sharply reduced without loss of production. Generally speaking, there is therefore no need for compensation. This does not alter the fact that there are considerable regional differences as far as the environment is concerned. In the northwestern corner of Europe in particular, where the use of pesticides and nutrients is highest (from the standpoint of rational and efficient management, it is out of hand), a reduction in use can take place without necessarily leading to a lower level of production. In this regard, the scenarios show that taking general policy measures with regard to a highly differentiated, regional activity such as agriculture is a precarious matter.

The fourth conclusion is that policy measures can successfully promote more environmentally friendly production methods by limiting the use of nitrogen fertilizer and above all by reducing the large-scale use of crop protection agents.

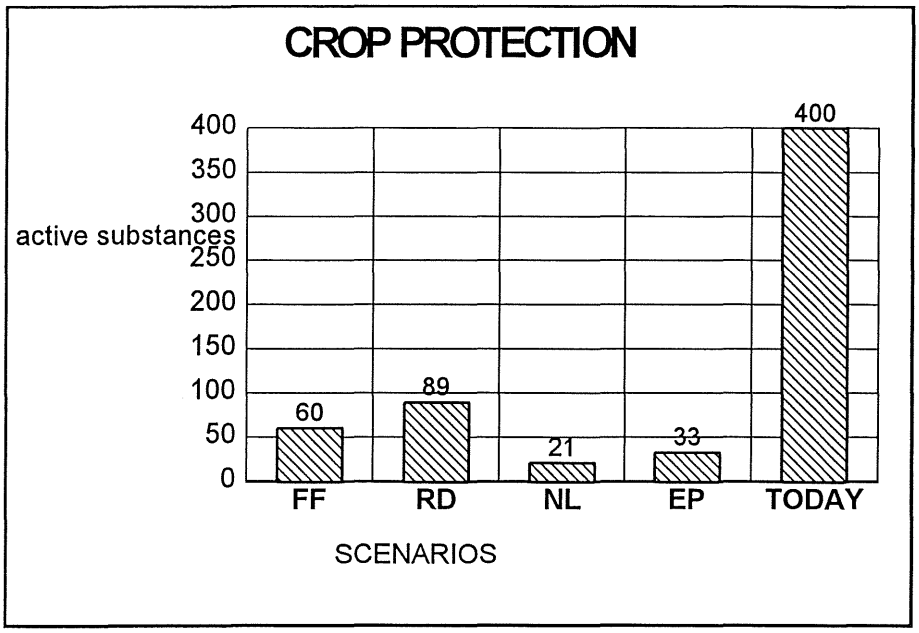
Figure 6 **Surplus of nitrogen fertilizer in the different scenarios compared with current surpluses in the EC (in mill. tons)**



Scenario FF - Free market and free trade
Scenario RD - Regional development
Scenario NL - Nature and landscape
Scenario EP - Environmental protection

Source: WRR.

Figure 7 **Use of crop protection agents in the different scenarios compared with current use in the EC (in mill. kg)**



Scenario FF - Free market and free trade
Scenario RD - Regional development
Scenario NL - Nature and landscape
Scenario EP - Environmental protection

Source : WRR.

RESULTS AT THE LEVEL OF INDIVIDUAL REGIONS

In addition to information on objectives at European Community level, the scenarios also provide information on the partitioning over the individual regions in the EC. Each scenario shows a different regional land use pattern.

In scenario FF (free market and free trade) agriculture is confined mainly to the northwest of the EC. In scenario RD (regional development) agricultural activities are distributed fairly evenly throughout the EC. In scenario NL (nature and landscape) many agricultural activities shift to the southern regions. Scenario EP (environmental protection), like RD, results in a fairly even spread of agricultural activities over the whole of the EC, with the exception of the Benelux and Ireland. The difference in the location of agricultural activities in the different scenarios is naturally also connected to differences in land use objectives. For instance, in scenarios FF and NL the distribution of employment over the regions is extremely uneven.

It is interesting to compare these results with the existing distinction between strong and weak regions in the EC (weak regions are those with a low score in terms of production, productivity and employment rate). As far as weak regions are concerned, in scenario FF only Ireland retains a substantial share of

employment in arable farming [8]. In scenario NL Spain and Italy retain 40 and 34 % of current employment respectively and Portugal only 14 %[9].

The significant differences between the scenarios show that regions have different potentials for productivity increases. Weak regions in scenario FF are strong in scenario NL. In the latter scenario, which seeks to minimize the area of agricultural land in favor of large nature areas, virtually no land-based agricultural activities remain in a number of regions which enjoy a strong position at present. In this scenario production on a limited area of land is given preference over production at minimum costs. This shows not only how relative the term 'weak' is, but also how important policy objectives are for the future of rural areas in the EC. The development of highly productive, irrigated agriculture in southern Europe may cause land use and agricultural employment problems in the northern member states.

Scenarios RD and EP give a more uniform distribution of land use among the 12 EC member states. In scenario RD this is a result of the condition that maximum employment must be retained in all the regions. Model calculations show that it is possible to maintain 29 % of the current level of employment in all the regions. Since the same percentage of employment is maintained in all the regions, those with a high level of employment at present enjoy a relative advantage. This applies especially to the Mediterranean regions. In scenario EP 50 % of the present level of employment is retained in Spain, 14 % in southern Italy, 11 % in Greece, and 10 % in Portugal. The imposition of restrictions other than costs in these two scenarios results in a shift of agricultural activities to southern Europe (provided the necessary irrigation takes place).

As far as strong regions are concerned (which are mostly situated in the northwestern part of the EC) the example of the Netherlands is representative. In scenario FF only 5 % of employment in land-based agriculture is retained in the east of the Netherlands (the minimum figure allowed in all the scenarios). 18 % of employment in arable and livestock farming is retained in the south of the Netherlands, 26 % in the west, and 36 % in the north. In scenario RD, 29 % of employment is retained in all the regions because this is one of the conditions in this scenario. In scenario NL land-based agriculture disappears from the Netherlands almost completely; the remaining 5 % employment is provided by forestry and a certain amount of livestock farming in the south. In scenario EP little land-based agriculture remains: 5 % employment in arable farming in the north, east and south of the Netherlands and in forestry in the west of the country. Similar effects occur in Denmark, Germany, Belgium and Luxembourg. These results show that 'strong' is also a relative term.

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[8] In this scenario the creation of labor is relatively expensive in the southern regions.

[9] In scenario NL it is assumed that agriculture takes place on the smallest possible area of land and therefore gives the highest productivity. In this scenario the creation of jobs is relatively expensive in Greece and Ireland.

Regional shifts also occur when the scope is examined for using agricultural land which can no longer be exploited profitably for creating a network of protected areas in the EC. To that end a separate study was aimed at devising an 'ecological network' for the EC [10]. Ecological principles and the current state of protection of different areas throughout the EC are used to select nature expansion areas. The study shows that roughly 36 % of the total area of the EC must be reserved for nature protection to safeguard a healthy natural environment. Compared to the current 2 % this would require a major expansion in nature conservation areas. However, these results are only based on one attempt to come up with usable data. Therefore we have chosen the acronym TEMS (which stand for Tentative Ecological Main Structure) to denote the 'necessary area' for nature areas.

In all four scenarios sufficient land is in principle available in most of the regions to allow a significant area to be used for this purpose as well as for arable farming and forestry. Scenarios FF and NL are particularly attractive for nature development. It is, however, surprising that the 'surplus areas' are mainly found in the central part of the EC rather than in the Mediterranean areas, where low productivity, an ageing population and emigration result in a great deal of land being taken out of cultivation. The scenarios therefore indicate the scope for a different type of development in the Mediterranean area.

As far as the costs of agriculture are concerned, there is a difference of 20 billion ECU between scenarios FF and NL, in both of which agricultural products may be imported from outside the EC. This difference can be seen as the price to be paid for making large areas of land into protected nature areas (minus acquisition and development costs; in this regard it should be borne in mind that the additional costs in NL are moderated by the benefits arising from increased employment and less use of crop protection agents; production on a smaller area will also affect costs). The difference in costs between RD and EP is difficult to attribute to a single factor. It should be noted, however, that the uniform distribution of employment required in RD offsets the lower use of nitrogen in EP. Maximum distribution of employment or a relatively low level of environmental pollution can be achieved at comparable cost.

SCOPE FOR OTHER POLICIES

The driving force behind change in land use and land productivity is technological progress. The scenarios show that this force can be strengthened or weakened by policy measures. Improvements in production conditions, price guarantees, research, information campaigns and education promote technological development. Adjustments can be made by altering production conditions and product requirements. The scope for this exists, and several possibilities will be outlined below.

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10 N.T. Bischoff and R.H.G. Jongman, *Development of rural areas in Europe: the claim for nature*; WRR Preliminary and background studies no. V79, The Hague, Sdu Uitgeverij, 1993.

Use of rural areas

At EC level a policy in which the different physical planning aspects are viewed as a whole does not (yet) exist; physical planning policy in rural areas is mainly indirect, incorporated in agricultural policy, regional policy or environmental policy. The scenarios show that, in the absence of an integrated policy, regional conflicts will increase rather than decrease. Growing incompatibility among European, national and regional policy seems unavoidable. A general European policy, which indicates what areas should be used, is therefore required. Such indications could act as a frame of reference for assessment of whether to grant requests for European funds to stimulate structural improvements in production conditions (irrigation, rural development projects or other infrastructural works).

There would also seem to be scope for nature development policy at EC level. European landscapes and nature parks are few in number at present. The scope for such initiatives exists, but has not (yet) been utilized. Concerted action by European and national authorities and nature conservation groups may get things moving.

Setting aside agricultural land by putting it to different use

There is not yet much scope for setting aside productive agricultural land. Under the present set-aside scheme land must be kept for agricultural purposes, and the extensification scheme assumes that productivity increases will be nullified and that even a decrease is possible. The scenarios in this study show the contrary. If productivity steadily increases, a set-aside scheme becomes extremely expensive. It seems improbable that this will receive much political support, especially since land and income supports and other measures will also make demands on European funds.

Our calculations indicate how production capacity can be reduced by putting agricultural land to different use. Nature development has already been mentioned. Another possibility is recreation. There is also scope for agrification, where preference must be given to activities requiring a great deal of space, such as energy recovery. There is scope for this at European level, but it is not yet very attractive economically. However, a study conducted by the Netherlands Energy and Environment Company (NOVEM) clearly shows that energy recovery on arable land faces promising prospects in the long term, provided the energy is refined (electricity, gasification etc.)[11]. This confirms the results of earlier studies in this field.

Regional development and employment

As already stated, in all scenarios employment in land-based agriculture is much lower than it is at present. European policy attempts to counteract the loss of jobs by improving the structure of agriculture. An evaluation of the structural funds intended for this purpose has shown that even now much of the

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11 Netherlands Energy and Environment Company (NOVEM), *De haalbaarheid van de produktie van biomassa voor de Nederlandse energiehuishouding. Eindrapport*, Utrecht, March 1992.

money used has no impact or is even counterproductive[12]. A policy that takes account of changes resulting from technical progress could make better use of the funds and alleviate the adverse effects.

The same applies to some degree to income supports. If, for social reasons, supplementing farmers' incomes is considered, there are various ways of doing so. If support is linked to individuals, it amounts to a Community assistance scheme. If it is linked to land, it cannot be confined to agricultural land only, since this hinders land mobility. By granting a land support for land which is put to different use, a basic financing system will be created for other purposes, such as nature conservation. Such ideas require further consideration. The scenarios show that current plans, involving the use of structure funds, amount to carrying coals to Newcastle.

CONCLUSIONS

Research agenda

The preparation of this study required a considerable research effort. In developing the methodology and producing the GOAL model we encountered a number of problems. Several of these are of sufficient interest to be referred to again here. Further research on these matters may facilitate similar studies in the future.

The survey focused on the 12 EC member states, and can be extended in two directions. First, the study examines only the territory of the European Community before the unification of Germany. If countries with a large agricultural potential (which applies to most of central and eastern Europe) join the Community, it will only serve to make the need for a review of the objectives of European agricultural policy even more pressing. The GOAL model can be used to examine the consequences of the accession to the EC of central and eastern European countries. Second, follow-up studies at regional level can help to provide greater information on the prospects for regions within the conditions set by the scenarios. Greater attention can then be devoted to other economic sectors.

One of the key assumptions on which the model is based is that agriculture throughout the EC takes place with the best available techniques and without wastage. The different production techniques could be specified in greater detail. The best regional specification permitted by current knowledge has been given. A more detailed adaptation of production techniques to specific regional conditions may be worthwhile.

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12 D.D. van der Stelt-Scheele, *Regionaal beleid voor de landelijke gebieden van de Europese Gemeenschap; inventarisatie en evaluatie* (Regional policy for the rural areas of the European Community: inventory and evaluation - in Dutch); Working Documents no. W46, The Hague, WRR, 1989.

The study does not deal with the financing of policy on rural areas. Only the total costs of agriculture are given in the scenarios. Even at this level, there are major differences between them. The share of costs to be borne by the producers and the authorities was not examined, nor were the consequences for European taxpayers. This information is essential if policy alternatives are to be developed further.

The financing structure of nature conservation policy has also been left out of account. An attempt to distinguish between different forms of nature management has not led to directly applicable results[13]. The purpose of this distinction was to safeguard the various ecological values at minimum cost. The positive response of nature conservation groups to this first attempt warrants further effort in this direction.

To make the study more specific, a tentative network of protected areas in the EC has been developed. Although this approach proved very useful in interpreting the scenarios, it is no more than a first attempt, and requires further development if it is to be used to assess a future European nature conservation policy. Such an approach would have to be taken by the EC as a whole, since the necessary criteria must be agreed. In addition, the regions need to do more to indicate which areas are eligible for inclusion in a network of protected areas.

Policy agenda

The scenarios in this study suggest a clear policy agenda. They indicate that the rural areas in the EC may see very radical changes in the coming decades. EC policy in this field is developing rapidly. National governments can use the scenarios as a guide in their contribution to this policy. A number of general conclusions regarding future policies can be drawn from the scenarios.

The intended objectives should be used as a starting point in all proposals, surveys and analyses concerning the reorganization of European agricultural policy. The GOAL model could be used for this purpose. Policy goals must determine the choice of instruments. Discussion on these goals must be conducted openly, not through policy instruments. Once the goals have been chosen, they must serve as the background for the elaboration of policy. Although other considerations will undoubtedly play an important role in the negotiating process, they should not be accorded too much significance. A situation where the combination of goals and instruments leads to some instruments conflicting with others, as is now generally the case, must be avoided.

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13 M. Creemer, *Natuurbeheer in Europa, een inventarisatie van doelstellingen, methoden en kosten van inrichting en beheer in beschermde gebieden in de landen van de EG*(Nature conservation in Europe. An inventory of aims, methods and costs of arrangement and management of protected areas in the member states of the European Community - in Dutch); The Hague, report on a period of practical training, 1990.

In all the land use options in the 12 EC member states which the Council has studied, there are considerable surpluses of agricultural land. Their size and regional distribution differ from one scenario to another, but the general picture is clear. This means that a policy designed to maintain the use of land for agricultural purposes in the long term (either directly by means of extensification, for example, or indirectly by means of set-aside schemes) will meet increasing resistance. The costs of such a policy may rise sharply and the eventual results will sometimes be incompatible with other goals (e.g. nature conservation, and also environmental goals).

All the options studied by the Council show that far fewer jobs are required in agriculture than at present. Even today there is a high level of latent unemployment in many regions of the EC, and this level will rise sharply if the present number of jobs is maintained. Measures can be devised to mitigate the adverse consequences of this loss of jobs, but the artificial maintenance of maximum employment in agriculture is unaffordable and impracticable. It would be better for policy to manage this drop in employment.

The environmental impact of agriculture in many areas of the EC is very serious, especially in the Netherlands. As this study shows, there is great technical potential for tackling this problem, and policy could be designed to realize this potential. The council has specified possible measures in earlier reports: levies on pesticides; promoting research and information campaigns in the field of integrated cultivation systems; improving production conditions in areas intended for agriculture; training; certificates for workers in the crop protection sector; deposit systems for plant nutrients, etcetera[14]. None of these proposals are new. However, they should be introduced at European level, and the fact that this will benefit both the environment and production should be an incentive to do so.

The possibility of conducting an active European nature conservation policy certainly exists, as far as land use is concerned, and there seems to be little conflict with agriculture. At European level the Netherlands could encourage the further development of a network of protected areas. A precondition is that a financing structure must be established for European nature conservation policy. A combination of government funds and private financing ('bonds for nature') is an obvious choice.

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14 Netherlands Scientific Council for Government Policy (WRR), *Technologie en overheid. Enkele sectoren nader beschouwd* (Technology and government. A close inspection of some sectors - in Dutch); Reports to the Government no. 39, Sdu Uitgeverij, The Hague, 1991. Netherlands Scientific Council for Government Policy (WRR), *Environmental policy: strategy, instruments and enforcement*; Reports to the Government no. 41, The Hague, Sdu Uitgeverij, 1992.