
THE FUTURE OF THE LAND

MOBILISING AND INTEGRATING KNOWLEDGE FOR LAND USE OPTIONS

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- Chapter 9** 'Ground for Choices': A Scenario Study on Perspectives for Rural Areas in the European Community
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CHAPTER 9

'Ground for Choices': A Scenario Study on Perspectives for Rural Areas in the European Community

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INTRODUCTION

European agriculture is going through a period of considerable change. The Common Agricultural Policy (CAP) proved to be very successful. For most agricultural commodities the Community has reached self-sufficiency. In some cases this has even led to substantial surpluses. The rise in productivity may continue at many places as attainable yields are still much higher than actual yields. This implies that the success of the CAP may turn out to be the major reason for a drastic change.

These developments may have a considerable effect on future land use in the EC. Not only surplus production induces changes, but other objectives have been put on the agenda. Social objectives, such as employment and income, economic objectives such as productivity and minimal costs, agricultural objectives such as efficient use of inputs, and environmental objectives such as minimisation of emissions all have consequences for land use. Next to these, forestry and nature conservation also claim land.

As a result, land use may change in the near future, both in size and in quality. How land use will change depends on the possibilities within the agricultural sector and the priority for various goals. Priority setting can be helped if some information is available on the possible options for future changes in land use and its consequences.

The Netherlands Scientific Council for Government Policy executed a study to explore options for land use. A land use allocation model was developed and a number of detailed studies on production potentials were conducted. In this chapter the methodology and some of the results are presented in the first section by Van Latesteijn and Rabbinge. In the second section Van Diepen and De Koning elaborate on one of the building blocks of the study: a qualitative and quantitative land evaluation is described. The chapter is concluded with a statement from the recipients, the policy-makers. Dijsselbloem, Van Zijl and Woltjer explain how they are using the results of the study and demonstrate its usefulness.

POSSIBLE CHANGE IN FUTURE LAND USE IN THE EUROPEAN COMMUNITY

Introduction

Agriculture in the European Community is becoming ever more productive. The combination of better production conditions, improved management and high-yielding varieties has led to a continuing period of growth. Even a greater rise in productivity may be expected in the future as a result of (bio)technological innovations. A positive result of this development is the achievement of food security, the primary objective of the CAP.

However, a dramatic rise in the costs of the agricultural policy conflicts with important trading partners over the subsidised dumping of EC surpluses on the world market; market distortion mainly to the detriment of developing countries; and increasing environmental problems resulting from current production methods. Without change these problems will become intractable.

It is therefore generally recognised that the CAP must be reformed; however, it is not clear in what form. The reforms recently agreed upon have been hailed as a breakthrough (CEC, 1991). This certainly holds for the pricing policy, i.e. a 29% fall in grain prices over three years is considerable and would bring European prices in line with those on the world market. However, the compensation scheme for set-aside land does not address the basic problem, since there was no fundamental debate on the *aims* of the policy, but it was limited to the instruments used. There was inadequate discussion on the extent to which these goals—and/or any adjustments deemed necessary—require a policy review.

Such a discussion would require from the member states of the European Community, and therefore also from the Dutch Government, strategic choices on the future of agricultural areas. In its study 'Ground for Choices', the Netherlands Scientific Council for Government Policy focused attention on the goals of agricultural policy for three reasons (WRR, 1992a):

- (1) the widespread increase in agricultural productivity appears to continue, i.e. growing surpluses are being produced on the land already under cultivation;
- (2) the anticipated growth in the budgetary burden on the Community if policy is not amended;

- (3) the increasing social pressure for attention to aspects other than productivity, such as environmental protection, nature and landscape.

In this chapter we describe the approach adopted to investigate possible future changes in land use and present some of the results.

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 is thus guided by the relative value attached to different policy goals if priority is given to varying policy aims such as 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.

Since the various values attached to goals determine the outcome, this approach allows examination of possible scenarios corresponding to contrasting political philosophies about 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, they also encompass aims relating to socio-economics, 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 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 this scenario agriculture is treated as any 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 the environment. The philosophy represented by 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 separating 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 prevent alien substances from entering the environment. In contrast to scenario NL, the main aim is not to preserve or stimulate certain plant and animal species, but to protect soil, water and air. Natural and agricultural areas are therefore not physically separated but integrated. Farming may take place anywhere, but subject to strict environmental restrictions. This philosophy is in line with the concept of integrated agriculture as developed during the last decade, partly at the instigation of the Council (Van Der Weiden et al., 1984).

Land requirement assessment

The calculations with the GOAL model do not comprise all the problems dealt with in this study. Goals relating to nature and landscape cannot be expressed in figures that the model can interpret. Therefore, maps have been drawn representing the best division of land from the point of view of landscape and nature conservation. The results of the model were assessed on the basis of these maps, so that they may have to be modified 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, hence here we only give an indication of how the model works and what results are obtained.

The model does not produce a forecast. The scenarios explore options of technical possibilities based on a series of well-founded assumptions and presuppositions; however, such factors as price changes, assumptions about the behaviour of actors and institutional obstacles are excluded. Hence, this is not a study of the effects of possible amendments to the CAP, although its results indicate the technical limitations to such changes. 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.).

Policy-making can benefit from this type of information, because the options can be used to determine to what extent current policy can cope with the major developments generated in the scenarios (particularly the continuing rise in productivity and the associated decrease in employment in land-based agriculture). An estimate can, therefore,

be made of the effort required to achieve goals, depending on whether we will have to 'go against the tide' or simply go with it. Hence, the results can serve as guidelines for future policies. If they all point in the same direction, there is clearly conflict between the technical possibilities and policy that aims at 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 possible source of conflict might be the fact that in all four scenarios agricultural land use is much lower than the 127 million hectares currently in use in the EC. Would the great effort needed to maintain the current area of agricultural land in the long term be worth it? Should not other goals be given preference? Such questions arise from simply defining technical possibilities.

The scenarios are designed to promote debate on policy options at various levels. First, they demonstrate the possibilities for achieving the goals considered important in the various philosophies. These are results at European Community level. They also show the areas most suitable for agriculture in the EC, the type of agriculture most effectively pursued in each area (arable farming, livestock, permanent crops or forestry) and the methods that 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 at EC and regional level have consequences for certain countries, they will affect policy at national level as well.

Development of the GOAL model

The GOAL model is a linear programming model that can optimise 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 as objective functions, e.g. maximisation of efficiency of inputs for agriculture, minimisation of regional unemployment in land-based agriculture, and minimisation of the use of pesticides. Political philosophies can be formulated by assigning different preferences to the objectives by restricting the objective functions to a certain domain; for example, the total labour force cannot be less than a minimum level. In this way scenarios can be constructed that show the effects of policy priorities; for example, to maintain the labour force, types of land use will have to be selected with a relatively high input of labour.

The types of land use that the model can select are defined in quantitative terms. Because we want to explore possible long-term options, current agricultural practice in Italy or East Anglia should not be used as a reference, because it reflects current conditions, not those of the future. Therefore, we must define types of land use that might be effectuated in all regions of the EC in the future. For that purpose the concept of best technical means is used, i.e. agriculture takes place according to methods already operational in plant testing stations, experimental farms and many advanced farms. This does not imply predescribed agricultural practice, but gives input-output ratios representing 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 product,
- environment-oriented agriculture, aiming at lowest emissions and immissions per unit area, and
- land use-oriented agriculture, aiming at maximum land use.

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

Crop level

Plant properties, soil properties and climate properties determine the potential crop yield at a given location (Figure 9.1). First, the suitability of the soil for a certain crop is assessed to exclude all units where it cannot be grown (e.g. wheat on steep slopes and maize on clay soils). This can be denoted as qualitative land evaluation. Next, by means of a simulation model, potential yields are calculated for the suitable areas. This can be denoted as quantitative land evaluation (Van Lanen, 1991).

The qualitative land evaluation of the EC is based on the use of a geographical information system (GIS) (Van Diepen et al., 1990), and is executed at the level of land evaluation units (LEUs), representing combinations of soil and climate conditions 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 mechanised farming is assessed.

The quantitative land evaluation is based on the use of the WOFOST crop growth simulation model (Van Keulen and Wolf, 1986), applied to calculate the potential yields of winter wheat, maize, sugarbeet, potato and grass. Required inputs are technical information on regional soil (such as water-holding capacity) and climate properties and relevant crop properties (such as phenological 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, yield potential can be limited by the availability of water at any point during

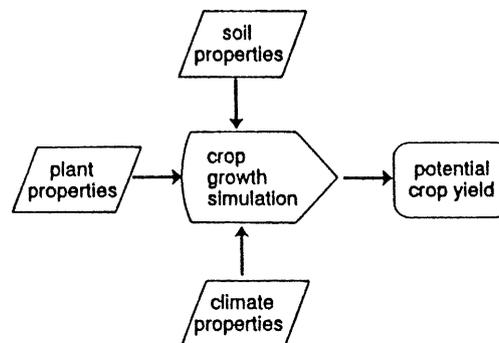


Figure 9.1 The inputs and outputs of the analysis at individual crop level

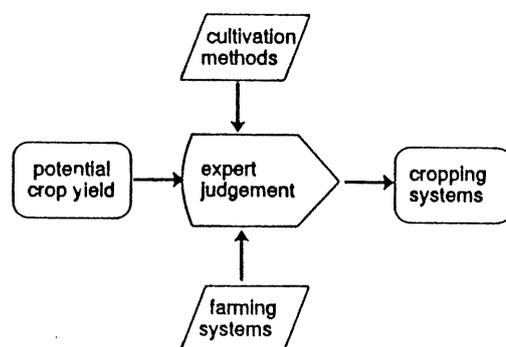


Figure 9.2 The inputs and outputs of the analysis at the level of cropping systems

the growing season. The attainable yields in that situation are referred to as water-limited yields. In the irrigated situation, crop yields are fully determined by climate and properties of the crop. The model results give an indication of the maximum attainable yield at a given location, referred to as potential yield.

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

Cropping system level

To examine land use possibilities in the future, information on individual crops is not sufficient. All crops are grown in a cropping system that defines all inputs and outputs. Moreover, in most cases monocropping is not a sustainable system 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 characterised by a certain rotation scheme, certain management decisions and a certain use of inputs (Figure 9.2). It is striking that at this level the only viable method is expert judgement. From 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 practiced yet, but are available at experimental farms and 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 (De Koning et al., 1992).

Land use level

At the level of land use possibilities, all information is combined. 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 (Figure 9.3).

An IMGP (interactive multiple goal programming) procedure is used to optimise a set of objective functions incorporated in the model. In this procedure restrictions are

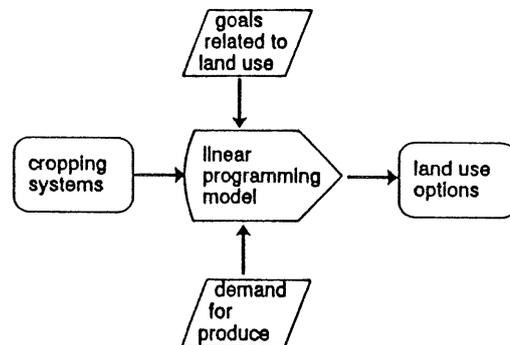


Figure 9.3 The inputs and outputs of the analysis at land use level

put to the objective functions to express preferences in policy goals. Hence, the four different scenarios (FF, RD, NL and EP) are characterised by different restrictions to the objective functions and by varying the demand. A few examples can illustrate this.

In FF the costs of agricultural production are minimised, without other restrictions on the objectives. Moreover, free trade implies that import and export is allowed, so the demand for agricultural produce from within the EC is modified according to expectations regarding new market balances. The model will now select the most cost-efficient types of land use and allocate those to the most productive regions.

In EP again the costs of agricultural production are minimised, but here strict limitations are set to the objective functions representing the use of fertilisers and pesticides, while the demand for agricultural produce represents self-sufficiency. The model will now select types of land use that agree with the imposed restrictions.

Results at the level of the European Community

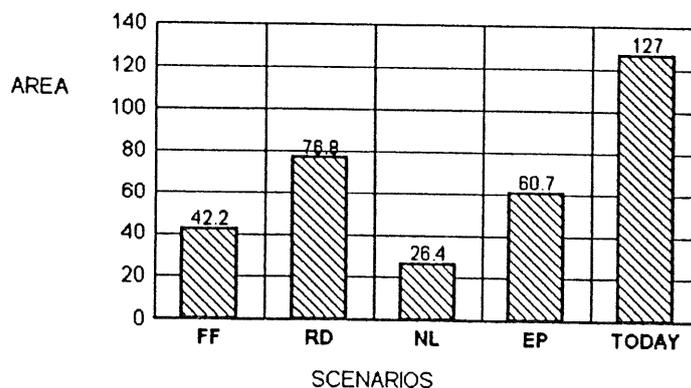
Contrasts among the scenarios

The values of the individual goals differ dramatically among the four scenarios and from one area of policy to another. For land use the highest and lowest values differ threefold. The difference is twofold for land-based agriculture, employment and use of nitrogen (total and per hectare). Highest values for use of crop protection agents per hectare are four times the lowest, while the totals differ by a factor of seven.

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

Land use

In all four scenarios agricultural land use is considerably lower than at present (Figure 9.4). The highest land productivity is achieved in scenario NL, where the area of agricultural land is smallest. The discrepancy between the area of land currently in use



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

Figure 9.4 Land use in the different scenarios compared with current land use in the EC (in million hectares). Source: WRR

and the area technically necessary for food production shows that the present set-aside schemes can only be the very beginning of structural changes.

The second conclusion is that there is little scope for a policy aiming at maintaining all current agricultural land in use.

Employment

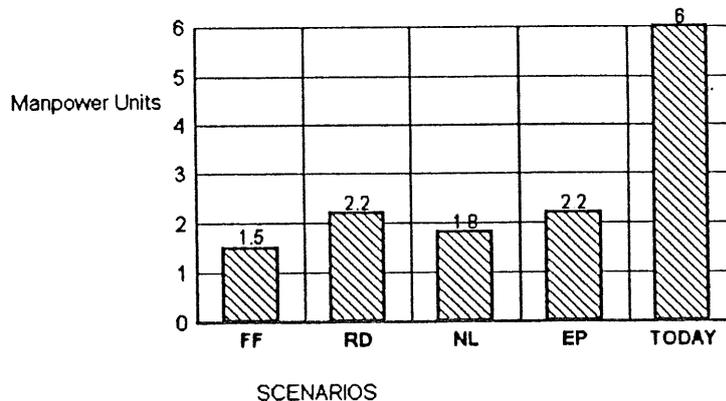
In all scenarios agricultural employment is much lower than the current level (Figure 9.5). Even in scenario RD, where the objective is to keep as many people as possible employed in land-based agriculture without subsidies, employment declines, i.e. from 6 million to 2.2 million manpower units (MPUs, 1988/89). These results indicate that preserving the current level of employment means maintaining hidden unemployment (in some regions up to 50%) at high costs. Moreover, the current loss of jobs in the agricultural sector of 2-3% per year will result in a decline of about 40% in 15 years time, despite all the measures taken.

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

Environment

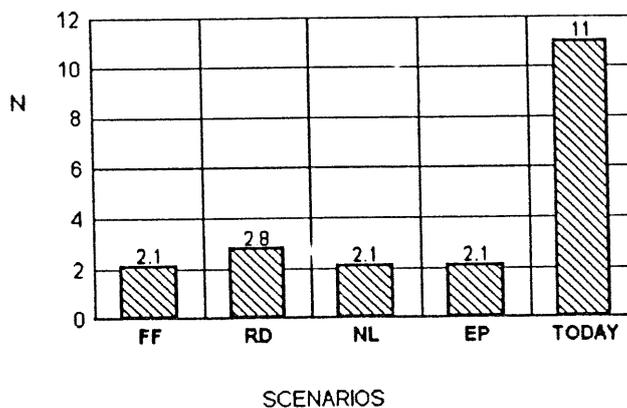
The impact of agriculture on the environment is affected mainly by the use of crop protection agents and artificial (nitrogen) fertiliser. It is technically possible to significantly reduce the use of both without adversely affecting production (Figures 9.6 and 9.7). In particular, crop protection offers considerable scope.

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

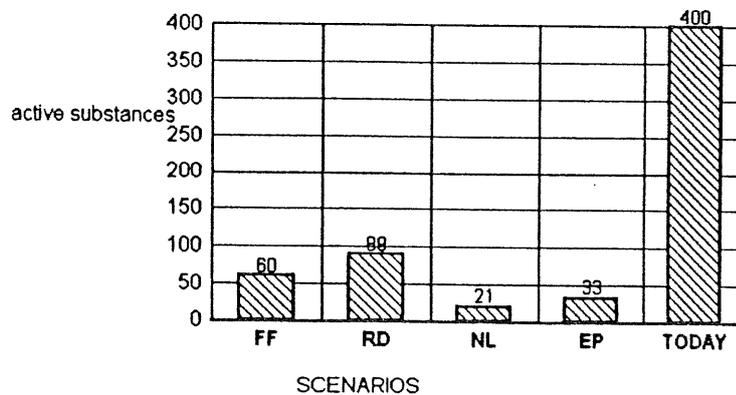
Figure 9.5 Employment in the different scenarios compared with current employment in the EC (in millions of manpower units). Source: WRR



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

Figure 9.6 Surplus of nitrogen fertiliser in the different scenarios compared with current surpluses in the EC (in million tons). Source: WRR

A reduction in the use of fertilisers and pesticides is considered in current European policy as a service that 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 results of the scenarios show that the surplus of nitrogen and the use of crop protection



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

Figure 9.7 Crop protection. Source: WRR

agents can be sharply reduced without loss of production. Generally speaking, therefore, there is no need for compensation. None the less, considerable regional differences exist with respect to the environment. In the north-western corner of Europe in particular, where the use of pesticides and nutrients is highest (overuse, from the standpoint of rational and efficient management), application can be reduced without necessarily leading to a lower level of production. These results show that taking general policy measures with regard to a highly differentiated, regional activity such as agriculture is precarious.

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

Results at the level of individual regions

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

In scenario FF agriculture is confined mainly to the north-west of the EC; in scenario RD agricultural activities are distributed fairly evenly throughout the EC; in scenario NL many agricultural activities shift to the southern regions; in scenario EP agricultural activities are fairly evenly spread over the EC, with the exception of the Benelux and Ireland. These differences in spatial distribution of agricultural activities are connected to differences in policy goals. 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). From the weak regions in scenario FF, only Ireland retains a substantial share of employment in arable farming (in this scenario the creation of labour is relatively expensive in the southern regions). In scenario NL, Spain and Italy retain 40% and 34% of the current employment, respectively, and Portugal only 14%. (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.)

The significant differences among 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 minimise the area of agricultural land in favour of large nature areas, land-based agricultural activities virtually disappear in a number of regions with 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 the relative value of the term 'weak' and the importance of policy objectives for the future of rural areas in the EC. 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 relatively uniform distribution of land use over the EC. In scenario RD this is a result of the condition that maximum employment must be retained in all regions, which results in 29% of the current level of employment in all regions. Since the same percentage of employment is maintained in all regions, those with a high level of employment at present (such as the Mediterranean regions) enjoy a relative advantage. 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. Restrictions other than costs in these two scenarios result in a shift of agricultural activities to southern Europe (provided the necessary irrigation development takes place).

For the strong regions, mostly situated in the north-western part of the EC, 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 allowed in any scenario), 18% in arable and livestock farming in the south, 26% in the west, and 36% in the north. In scenario RD, 29% of employment is retained in all regions; a condition imposed in this scenario. In scenario NL, land-based agriculture disappears from the Netherlands almost completely; the remaining 5% employment is provided by forestry and some livestock farming in the south. In scenario EP, the same picture emerges: 5% employment remains in arable farming in the north, east and south and in forestry in the west. Similar effects occur in Denmark, Germany, Belgium and Luxembourg. These results show that 'strong' is also a relative term.

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 executed aiming at devising an 'ecological network' for the EC (Bischoff and Jongman, 1993), based on ecological principles and the current state of protection of different areas throughout the EC. The results show that roughly 36% of the total area 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 tentative, therefore we have chosen the acronym TEMS (Tentative Ecological Main Structure) to denote the 'necessary area' for nature.

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

With respect to the costs of agriculture, a difference of 20 billion ECU exists 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 converting large areas into protected nature areas (minus acquisition and development costs; it should be borne in mind that the additional costs in NL are moderated by the benefits arising from increased employment and reduced 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. However, the uniform distribution of employment required in RD offsets the lower use of nitrogen in EP. Even 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 analysis shows that the direction and pace of change is influenced by policy measures. Improvements in production conditions, price guarantees, research, information campaigns and education promote technological development. Adjustments can be made by modifying production conditions and product requirements as will be outlined below.

Use of rural areas

At EC level an integrated policy for physical planning 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, indicating what areas should be used, is therefore required. Such indications could serve as a frame of reference for decisions on grant requests for European funds to stimulate structural improvements in production conditions (irrigation, rural development projects or other infrastructural works).

There seems to be scope also for a nature development policy at EC level (but has not (yet) been utilised). European landscapes and nature parks are few in number at

present. Concerted action by European and national authorities and nature conservation groups may get things moving.

Setting aside agricultural land for alternative use

Under the present set-aside scheme there is not yet much scope for setting aside productive agricultural land as it must be kept for agricultural purposes, and the scheme assumes that productivity increases will be halted or even reversed. The results of 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 the possibilities for reduced production capacity through alternative use of agricultural land such as nature development and recreation. There is also scope for agrification, where preference must be given to activities requiring extensive areas, such as energy recovery. Scope exists at European level, but it is not yet very attractive economically. However, a study by the Netherlands Energy and Environment Company (NOVEM) confirms the results of earlier studies that energy recovery on arable land has perspectives in the long term, provided the energy is refined (electricity, gasification, etc.) (NOVEM, 1992).

Regional development and employment

As already stated, in all scenarios employment in land-based agriculture is much lower than at present. European policy attempts to counteract the loss of jobs by improving the structure of agriculture. An evaluation of the impact of the structural funds intended for this purpose has shown that even now their effects are absent or even counter-productive (Van Der Stelt-Scheele, 1989). 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 support. If, for social reasons, supplementing farmers' incomes is considered, various ways exist. 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 that hampers land mobility. By granting a support for land put to alternative 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 current study required a considerable research effort. In developing the methodology and formulating the GOAL model, problems were encountered that are of sufficient interest to be referred to again here to facilitate similar studies in the future.

The analysis focused on the 12 EC member states, and can be extended in two directions. First, the study included only the territory of the EC before the unification of Germany. If countries with a large agricultural potential, such as most of central and eastern Europe, join the Community, the need for a review of the objectives of European agricultural policy becomes even more pressing. The GOAL model can be used to examine the consequences of such developments. Second, follow-up studies at regional level may provide information on the prospects for specific regions within the conditions set by the scenarios. Greater attention can then be devoted to other economic sectors.

One of the key assumptions in the model is that agriculture throughout the EC takes place with the best available techniques and without wastage. The best regional specification, permitted by current knowledge has been applied. A more detailed description of production techniques differentiated to specific regional conditions may be worthwhile.

The study does not deal with the financing of policy on rural areas. Only the total costs of agriculture are considered, which already show substantial differences between scenarios. The partitioning of costs between producers and 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 not been considered either. An attempt to distinguish between different forms of nature management with the aim to safeguard the various ecological values at minimum cost has not led to directly applicable results (Creemer, 1990). 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 results of the scenarios, it requires further development if it is to be used as a basis for a future European nature conservation policy. That would have to be an all-EC effort, since the necessary criteria must be agreed. In addition, regional input is needed to indicate areas suitable for inclusion in a network of protected areas.

Policy agenda

The results of this study suggest a clear policy agenda. They indicate that radical changes in the rural areas in the EC are possible. EC policy in this field is developing rapidly. National governments can use the scenarios as a guide in their contribution to this policy. Some general conclusions regarding future policies can be drawn from the scenarios.

The objectives should form the starting point in all proposals, surveys and analyses on reorganisation of European agricultural policy. The GOAL model could be used for this purpose. Policy goals must dictate the choice of instruments. Discussion on these goals must be conducted explicitly, not through policy instruments. The selected goals must serve as the background for policy formulation. Although other considerations will undoubtedly play an important role in the negotiating process, a situation should be avoided where the combination of goals and instruments leads to conflicting instruments, as is now often the case.

All the land use options in the 12 EC member states studied, show considerable surpluses of agricultural land, though their size and regional distribution vary among scenarios. This means that a policy aimed at maintaining the use of land for agricultural purposes in the long term (either directly through extensification, for example, or indirectly through 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 environmental goals).

All the options studied show that far fewer jobs are required in agriculture than at present. Even today a high level of hidden unemployment exists 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.

The environmental impact of agriculture in many areas of the EC is very serious, especially in the Netherlands. This study indicates great technical potential for tackling this problem, and policy could be formulated to realise this potential, as suggested in earlier reports: levies on pesticides; promoting research and information campaigns on 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, etc. (WRR, 1992b). 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.

Possibilities for an active European nature conservation policy certainly exist in view of land use 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.

QUALITATIVE AND QUANTITATIVE LAND EVALUATION IN THE EUROPEAN COMMUNITY

Introduction

In 1989 the Netherlands Scientific Council for Government Policy (WRR) requested the DLO-Winand Staring Centre (SC-DLO) to make an assessment of the crop production potential of the regions of the European Community (EC) for various kinds of land use. The aim was to estimate the scope for growth in agricultural production in the future, by quantifying the biological production ceilings that could be reached under continuing technological development, and by indicating the distribution of this yield potential over the regions. As yield potential depends also on yield variability, this implied that effects of heterogeneity of the crop growing environment in space and in time had to be taken into account.

The study should provide unbiased information for quantifying regional production volumes per land allocation scenario and should indicate regional differences in yield potential under well-defined production situations. The Netherlands Scientific Council

for Government Policy stipulated that the method should be scientifically sound and objective, that its results were reproducible and consistent, and that the study would explore the biophysical possibilities for regional crop yield potentials.

The working hypothesis was that throughout the EC the same high technological level would prevail, so that regional differences in crop production potential could be attributed solely to differences in agro-ecological conditions, disregarding current comparative advantages of some regions with a favourable socio-economic production structure.

The crop production potential was to be characterised by a theoretically attainable yield level for a number of indicator crops, including the annual field crops winter wheat, grain maize and silage maize, oilseed rape, potato, sugar beet, and also grass, forests and fruit trees, in each of the EC regions. For a given location this yield level depends on crop properties, weather and soil conditions, and its assessment is achieved by applying a land evaluation procedure. The choice of a procedure depends on the information requirements of the user of the evaluation results. The methodological options available range from qualitative based heavily on judgement to quantitative based on crop growth simulation (Van Diepen et al., 1989). This section starts with the breakdown of the EC land area into small land units, serving as geographical unit areas for evaluation, before focusing on the choice of land evaluation procedures for the assessment of regional crop yield potential across the European Community. Alternative methods will be presented and discussed with emphasis on the relation between analytical complexity and discriminative power of the various methods, in view of their relevance for supporting policy formulation.

Methods and data

Approach

The assessment has a geographical and an analytical aspect and involved the agro-ecological zoning and the evaluation of the production potential per zone. This required the use of a GIS and land evaluation models.

It is difficult to study spatial and temporal variability simultaneously, therefore, they were dealt with separately in the present study. Spatial variability was characterised using static data, e.g. climate zones are distinguished using long-term mean values, and temporal variability was studied within a spatially homogeneous zone using dynamic data, e.g. time series of monthly weather were used to generate time series of annual yields per land unit. Consequently, within this study there are no dynamic processes crossing spatial boundaries.

Zoning and the role of the GIS

Spatial variability was taken into account by the identification of geographically homogeneous zones, serving as discrete unit areas for land evaluation—the so-called land evaluation units (LEUs). A LEU is a land unit defined as a unique combination of soil unit, agro-climate unit and administrative unit. The soil and climate unit together

form an agro-ecologic unit, and the administrative unit is needed to allow comparison with official regional production statistics. The LEUs were identified with a GIS by overlaying the EC soil map (CEC, 1985), an agro-climatic map (Thran and Broekhuizen, 1965) and a map of EC-administrative regions at NUTS-1 level (Nomenclature des Unites Territoriales Statistiques). The LEU map counted some 4200 different units, distributed over some 22 000 map polygons.

The production potential for each land evaluation unit is determined in an analytical procedure using attribute data of the LEU. In the geographical sense, this evaluation is a point analysis. The overall regional potential is obtained by aggregation of yield data from LEU-level over agro-climatic regions or over NUTS-1 regions. The use of a computerised GIS is a quantitative method and it is the only way to handle accurately large quantities of geographic data. Its qualitative alternative of estimating areas by eyeballing has never been considered seriously.

Attribute data per zone

A climatic zone was characterised with monthly weather data of a weather station that was considered as representative because it was selected from the list of stations of which the data had been used for the compilation of the agro-climatic regions. Long-term average data were available for all 109 weather stations, and, in addition, for 81 of these stations, 26 years of monthly temperature and rainfall data. The information on the 546 units of the EC soil map consists of the name of the dominant soil unit, its texture and slope class. The soil name expresses the soil's genesis and morphology. In addition a soil phase (e.g. gravelly) may be indicated on the soil map. Other soil data needed in the land evaluation procedure had to be derived through subjective interpretation of soil unit definitions. This includes the estimation of the groundwater influence, effective rooting depth, and water-holding capacity.

Choice of evaluation procedures: quantitative or qualitative

Option of quantitative crop-growth simulation model

It was assumed that the best way to comply with the wishes of the Netherlands Scientific Council for Government Policy was through application of dynamic crop growth simulation models. This assumption was founded on the idea that a simulation model is the only tool to determine quantitatively the effect of variability in weather and soil conditions during a growing season and over a series of years.

The WOFOST model, a universal model for annual field crops and grass, was used to calculate the potential and water-limited yield levels for all relevant land units and an estimate was made of the crop nutrient requirements needed to obtain these theoretical yield levels.

The WOFOST crop growth model integrates the effects on crop growth of all relevant environmental factors such as radiation, temperature, rainfall, evaporation and soil moisture conditions during the complete growth cycle of the crop from a knowledge of the growth process. If the processes are correctly described, the model can be applied to environments other than that for which it was originally developed.

Option of qualitative methods

A completely different approach is the application of purely qualitative evaluation methods, i.e. methods relying on judgement, with or without computer aid. Such procedures are proposed in the 'Framework for Land Evaluation' (FAO, 1976).

The only existing land evaluation study at EC level was a qualitative one carried out by Lee (1986) on 10 EC countries and focused on the identification of the most suited areas for crop production. The evaluation followed the usual procedure to classify the suitability of a zone by combining separate climate and soil suitability ratings into one overall suitability rating. The soil limitations considered were drought, wetness/tilth, topography and rockiness. In the evaluation by Lee, topography and rocks marked the separation between suitable and unsuitable soils, and the three factors, drought, wetness/tilth and topography, lead to a differentiation in three grades of soil suitability.

After combining with the climate grading, the final results are obtained. The yield projections for various crops are made on the basis of the observed current yield level in the best areas and extrapolated as a time trend until the year 2000.

*Methods applied for land evaluation of the European Community**A mixed qualitative/quantitative approach for annual crops*

We followed a mixed qualitative/quantitative approach for annual crops (Van Lanen, 1991) consisting of two steps. The first qualitative step consists of sieving all LEUs for their suitability for a given crop. All obviously unsuitable LEUs are excluded from the second quantitative step.

The exclusion criteria are quite trivial: steepness, rockiness, stoniness, gravelly soils, salinity, heavy clay texture and poor drainage conditions. However, drought was not considered, as its effects would be evaluated quantitatively. The exclusion criteria are land use specific, and increasingly severe criteria were applied to grass, cereals and root crops.

To the remaining suitable soils the crop simulation model is applied to quantify the effects of some limitations on yield. The effects of temperature, sunshine and latitude are accounted for in the model by a description of the growth processes: light interception, CO₂ assimilation, assimilate partitioning and respiration. The effects of drought and of wetness are quantified by tracking the soil moisture condition and by accounting for its effect on evapotranspiration and hence on growth rate, the effects of tilth by delaying the date of sowing, and the effects of topography by assuming less complete water infiltration into soils on sloping terrain.

This resulted, for each suitable LEU, in a series of simulated yields over 26 years, of which the mean served as indicator for the yield potential.

A qualitative approach for forests

For the evaluation of the production potential of forest the quantitative method could not be applied because tree growth models are not available. Therefore, a computer-aided qualitative procedure was applied. The advantage of a computer-aided procedure

is, apart from working speed, that the evaluation procedure must be formalised, implying that the evaluation procedure uses specified input data and specified interpretation rules and factor ratings. Traditional qualitative land evaluations are, in practice, often loosely applied, and may even use information not included in the formal land database.

Results

The results of the land evaluation study were delivered as maps and tables of area extent and yield levels per region. The results of the qualitative assessment are given as the extent of areas excluded for mechanised cultivation of cereals and root crops respectively. There is a striking agreement between this assessment and the results given by Lee (1987) concerning suitability classes for cultivation (S3 = moderately/poorly suited and U = unsuited). Table 9.1 gives the area extent aggregated by country for both qualitative assessments.

Tables 9.2 and 9.3 allow a comparison of the estimates of the yield potential by region according to the qualitative method by Lee and the crop simulation model, for the crops winter wheat, grain maize, sugar beet and potato. The combined rating of soil and climate conditions by Lee has resulted in concentrating the projected production on the most suited land in a few regions and consequently in discarding many other regions as being less favourable, without yield estimate. Some regions seem to have no potential at all for any crop. It appeared that the most suited regions for temperate crops were in northern France, Belgium, the Netherlands and England, and for more heat-requiring crops the Po Valley emerged as the best region. The projected yield level under high management in the year 2000 does not vary over the regions labelled as most suitable. On the other hand, the crop simulation model gives results for a wide range of soil and

Table 9.1 Extent of land (% of total area) unsuited (U) and poorly suited (S3) for mechanised arable farming according to Lee and excluded land for cereal growing (cer) and for root crop cultivation (root) in WRR study

	U (%)	S3 (%)	Land excluded for	
			cer (%)	root (%)
West Germany	4	53	48	57
France	22	35	43	61
Italy	45	32	73	88
Netherlands	9	33	18	38
Belgium	3	35	36	42
Luxembourg	8	77	69	85
United Kingdom	54	22	66	72
Ireland	59	13	53	53
Denmark	3	0	10	11
Greece	75	14	87	92
Spain			58	88
Portugal			67	84

Source: De Koning and Van Diepen (1992) and Lee (1987).

Table 9.2 Projected yield (ton/ha harvested weight) at high management level in the most suited areas (on well-suited soils under favourable climate) in the year 2000 according to Lee for some crops in some selected regions in the EC

	Winter wheat	Grain maize	Sugarbeet	Potato
Niedersachsen	8.5-10.9	nil	nil	nil
Bayern	nil	nil	nil	nil
Bassin Parisien	8.5-10.9	8.5-11.0	73-92	55-73
Sud-Ouest France	nil	8.5-11.0	nil	nil
Emilia Romagna	nil	8.5-11.0	73-92	nil
It south of Roma	nil	nil	nil	nil
Vlaams gewest	8.5-10.9	nil	73-92	55-73
East Anglia	8.5-10.9	nil	nil	55-73
Scotland	8.5-10.9	nil	nil	55-73
Ireland	8.5-10.9	nil	nil	55-73
Denmark	8.5-10.9	nil	nil	nil
Greece (North)	nil	8.5-11.0	73-92	nil

Source: Lee (1987).

Table 9.3 Simulated water-limited yield (ton/ha dry matter)^a averaged over all suited soils for some crops in some selected regions in the EC

	Winter wheat	Grain maize	Sugarbeet	Potato
Niedersachsen	6.62	nil	14.1	11.9
Bayern	7.48	11.15	17.5	12.3
Bassin Parisien	6.80	8.18	14.5	10.3
Sud-Ouest France	7.70	8.34	13.4	9.8
Emilia Romagna	6.14	6.81	11.3	8.9
Abbruzi	5.29	2.93	7.1	5.9
Vlaams gewest	6.99	nil	14.8	12.3
East Anglia	7.37	nil	12.8	10.2
Scotland	7.83	nil	11.1	12.8
Ireland	8.45	nil	13.9	11.8
Denmark	5.81	nil	12.3	9.6
Greece (North)	5.13	3.55	8.9	8.1

^aNormal moisture contents: wheat, 16%; grain maize, 14%; sugar beet, 80%; potatoes, 78%.

Source: De Koning and Van Diepen (1992).

climate units and indicates small differences in regional yield potential in terms of average water-limited yield. All these differences can be related to differences in weather and soil conditions during the growth cycle.

Discussion

Qualitative methods

Qualitative land evaluation allows us to make a rather consistent selection of suited soils on the basis of simple soil criteria. But the claim by some proponents of this approach that qualitative procedures lead to a more balanced view of the complexity of the real

world than computer models does not hold. Qualitative methods go awry when a multitude of factors play a role in varying intensity over large areas. Instead of clarifying, they obscure the complexities. The maximum yield levels were a mixture of observed yields and extrapolated trends in yields, without a relationship to varying environmental factors. The results did not meet the information requirements of the Netherlands Scientific Council for Government Policy.

The case of drought limitation may serve as a simple illustration of the problem of intuitive multifactor analysis. As a general rule, sandy soils have some drought limitation. In qualitative land evaluations they are therefore rated as moderately suitable for cropping. However, the severity of the problem depends also on the climatic water balance and groundwater influence. Under humid climates soil sandiness may be no problem at all; under dry climates it may be a severe problem. The estimation of the yield effect of the drought limitation over a range of climatic zones and groundwater conditions is impossible to solve with qualitative methods. It becomes even more difficult when the effects of drought must be combined with those of limited opportunities for soil tillage.

Yet, many authors take it for granted that only qualitative methods are applied for evaluation of the productive capacity of land resources at the scale of large countries or continents. Such evaluations use strongly generalised data. In this respect they are opposite to the paradigm of De Wit and Van Keulen (1987), who propose to use undistorted input data, and 'to calculate first, average later'.

Quantitative methods: strengths and weaknesses of simulation models

The crop model produces yield estimates and simulated yield variability can be related to variability in observed environmental factors. However, the model is conceived as a closed, controlled system, while in reality a crop may be exposed to factors not included in the model. Even if the model results are plausible, the question remains how good is the model in predicting the regional yield potentials.

The purpose of the modelling is to obtain insight into a well-defined part of reality, to quantify effects on yield and to keep control of analytical complexity. To achieve this the model is deliberately designed as a schematisation in terms of uniform field conditions and by distinguishing the hierarchy in potential, water-limited and nutrient-limited production situations. The model does not include influences of weed competition, pests and diseases.

Yet, the model, and physical quantitative methods in general, cannot completely fulfil their purposes because of a number of limitations inherent to the model and to the data needed by the model. To mention a few:

- the modelled processes may be more complicated than described in the model, e.g. interactions between processes and feedback mechanisms;
- schematisation in terms of soil layers (one layer soil) and time step (one day) is too coarse for some processes;
- parameterisation of the model is not perfect, because not well known, e.g. maintenance respiration;

- the model contains too many variables for statistical validation;
- there is no correct description of the environment, e.g. the air temperature and crop temperature may vary quite independently;
- many site-specific model input data are not available and have to be guessed;
- the mechanisms of recovery of the crop after serious stress are not known;
- there may be errors in the weather, soil or crop data.

There is continuous debate, and need for research, on how to tackle these problems of the inadequacy of models: either by simplifying or refining the model or by introducing stochastic elements in the model or by using more generalised or more detailed data.

Expert judgement

It has become fashionable to speak about expert systems in the context of land evaluation and it is good to make a distinction between various aspects of expert judgement in land evaluation. On the one hand, expert judgement may be called in to add quality to quantitative procedures; on the other hand, expert judgement may replace quantitative procedures. In combination with the use of simulation models, expert judgement is needed to arrive at a meaningful zonation, to select zones for further quantitative analysis, to fill gaps in the required input data (e.g. by formulating so-called pedotransfer functions), and to judge the validity and consistency of input data. After model application it is necessary to interpret the model output and to combine it with agronomic and environmental information not taken into account in the model. This is the general working procedure in integrative land evaluation research. We try to answer a question by combining available information from many sources and fill the information gaps with intelligent guesses.

The application of purely qualitative methods may be justified if they are applied to solve routine problems. When the questions address new problems we may well try to speculate on the possible solutions, but we should avoid treating first approximations, hampered by lack of knowledge and data, as experts' judgements. The danger in the application of qualitative methods is that it tends to confirm the status quo of knowledge and to follow the consensus of public opinion, thereby blocking the development of ideas that the world may be different from that.

IMPLICATIONS FOR RURAL POLICY IN THE EUROPEAN COMMUNITY

The European Common Agricultural Policy has been readjusted many times over the last decade. Following attainment of the policy goals, set in 1958, agriculture in the EC arrived at a situation of structural production surpluses, accompanied by high budgetary costs and unacceptable claims on environment and nature. This situation still continues and urgently calls for a discussion on the future of Europe's rural areas. All policy adjustments so far have lacked the necessary reflection on the new function of the rural space.

This also holds for the latest, most far-reaching policy reform—the MacSharry Reform. In the discussion paper accompanying these measures, the Agricultural Commissioner emphasised the importance of efficient agriculture integrated with the other functions of the rural areas, such as forestry, tourism, nature, landscape and recreation. Unfortunately, the time pressure on the Council of Ministers of Agriculture restricted the discussions to policy instruments only. A missed opportunity, because despite justified criticism of the ideas of Commissioner MacSharry, his ideas deserved substantial attention.

But not everyone lets opportunities go by. In 1988 this challenge was taken on by the Netherlands Scientific Council for Government Policy in its study on the future of the rural areas in the European Community in the concrete form of a model-scenario study. Four scenarios were formulated, based on four coherent visions of rural and agricultural policy (for land-based agriculture and forestry in the EC) to approximately the year 2015.

The results of the study indicate how land in rural areas can best be used following different policy objectives, thus explicitising the consequences of political choices. Even more importantly, the results point out to politicians and policy-makers the need and the possible scope for choices.

These political choices will not be objectively, rationally the best choices. Policy is, and shall always be, a compromise between different interests: the interests of member states, agricultural lobbies, industrial lobbies, nature and environment lobbies. Moreover, we must be careful not to overestimate the intervention possibilities in the reality of today's society, albeit difficult to accept for social democrats.

The main conclusion drawn by the Council in its report is that in all four scenarios a surplus of cultivated land arises. Therefore: 'a general European policy, which indicates what areas should be used for what purpose, is required.' This is certainly no sinecure: in the Netherlands, governments have had to resign over land policy. Nevertheless, the Council's recommendation stands. If, because of 'Ground for Choices', the surplus of cultivated land will remain prominently on the policy agenda, the study will have rendered its service.

A politically important question is at which level of administration this new land policy should take form. Is the bureaucracy in Brussels able to formulate such a policy and, following a decision by the Council of Ministers, to implement this policy from a centralised level? A reasonable doubt seems justified.

In different regions of the Community different scenarios may have to be implemented. For example, for the north of the Netherlands the Regional Development scenario (RD) is very plausible and for the south the Environmental Protection scenario seems obvious. The Council hints at this possibility in the epilogue of 'Ground for Choices', when it suggests diverging developments of agriculture in the Community: 'on a relatively small area highly productive agriculture with the best technical means, satisfying the major demands for food. On the remaining area an extensive form of agriculture can take place with emphasis on nature and landscape.'

Therefore, broad agreement at the Community level on the choice of strategy in combination with more detailed choices at regional level would be more realistic. This

would also be in line with the principle of subsidiarity: the Community should concentrate on issues that the member states themselves cannot deal with.

Taking on new challenges, first of all a well-balanced sustainable development of the rural areas in the different regions of the Community is no longer possible by developing one big package of European guidelines. This observation will be even more valid when the Community expands from 12 to 16 and later possibly 24 member states.

Within a rough and sometimes prescriptive framework, regions—possibly coinciding with states—can opt for a development fit for their specific situation. At Community level the framework comprises market and price policies as well as supplementary income policy.

A choice for a more market-oriented agriculture must be accompanied by an active restructuring of agriculture. The reformed CAP and EC structure funds have so far only tried to slow down such a process.

We make the political choice of maintaining agricultural production in all regions of the EC. This implies that regions will have to comply with production-control targets in a structural way. For this purpose, a scenario study of regional level can be an apt instrument. Regions must be enabled to take cultivated land out of production for purposes such as nature development, forestry, recreation, etc. By doing this the present inefficient method of individual set-aside can be abandoned.

There are more advantages to be gained by a strong regional policy component. The main advantage will be a higher efficiency and social acceptance of rural policy, on a level closer to the issues and the people involved.

Also, a regionally oriented policy may prevent the fate of most European agreements: more *ad hoc* solutions offering something to everyone.

This plea for regionalising the CAP within a Community framework does not answer the question of the future of rural areas and their populations. We should offer agriculture a future again: a future as supplier of food, raw materials for industry, of nature and landscapes. Such a development requires an economically viable agriculture that earns an income from fulfilling all these social and economic needs. Such an income will be composed of two elements: an economically fair price for the raw materials and an income supplement linked to the production of public goods. During the process of restructuring, direct income support should temporarily be given in addition to the two main components.

This is not a plea for re-nationalising agricultural policy but a plea for a policy based on smaller socio-geographical and administrative units; units that may cross state borders. The Community and its regions will have to invest in the future of their rural areas. Opportunities will have to be created at regional strong points. The strength of the European Community is its diversity, and that strength should be exploited much more.

Finally, it seems appropriate to quote from a letter that Sicco Mansholt, the founder of the European agricultural policy, recently wrote to the scientists responsible for 'Ground for Choices':

This study is of major importance for the future development of the agricultural policy. Its strength lies in its presentation: Whatever scenario one chooses, the consequences are grave. Politicians can no longer postpone making choices, as that will lead to chaos. When I recall the sixties, when I had to make political choices, how I wished I would have had at that time 'Ground for Choices'.

REFERENCES

- Bischoff, N. T. and Jongman, R. H. G., 1993. *Development of Rural Areas in Europe: The Claim for Nature*. WRR Preliminary and Background Studies no. V79, Sdu Uitgeverij, The Hague, The Netherlands.
- CEC (Commission of the European Communities), 1985. *Soil map of the European Communities, 1:1,000,000*. Commission of the European Communities, Luxemburg.
- CEC (Commission of the European Communities), 1991. The development and future of the Common Agricultural Policy. Proposals of the Commission; COM(91) 258 final, Brussels, 11 July. CEC, Brussels, Belgium.
- Creemer, M., 1990. *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). The Hague, report on a period of practical training. Netherlands Scientific Council for Government Policy, The Hague, The Netherlands (in Dutch).
- De Koning, G. H. J. and Van Diepen, C. A., 1992. *Crop production potential of rural areas within the European communities. IV: Potential, water-limited and actual crop production*. Working Document W68, Netherlands Scientific Council for Government Policy, The Hague, The Netherlands.
- De Koning, G. H. J., Janssen, H. and Van Keulen, H., 1992. *Input and output coefficients of various cropping and livestock systems in the European Communities*. Working Document W62, Netherlands Scientific Council for Government Policy, The Hague, The Netherlands.
- De Wit, C. T. and Van Keulen, H., 1987. Modelling production of field crops and its requirements. *Geoderma* 40: 253-265.
- FAO, 1976. *A Framework for Land Evaluation*. FAO Soils Bulletin 32, FAO, Rome.
- Lee, J., 1986. *The impact of technology on the alternative uses for land*. FAST Occasional Paper FOP 85, CEC-DG XII Science, Research, Development, Brussels, Belgium.
- Lee, J., 1987. European land use and resources. An analysis of future EEC demands. *Land Use Policy* 4: 179-199.
- NOVEM (Netherlands Energy and Environment Company), 1992. *De haalbaarheid van de productie van biomassa voor de Nederlandse energiehuishouding*. Eindrapport, NOVEM, Utrecht, The Netherlands.
- Thran, P. and Broekhuizen, S., 1965. *Agro-climatic Atlas of Europe. Vol. 1: Agro-ecological Atlas of Cereal Growing in Europe*. Elsevier, Amsterdam.
- Van Der Stelt-Scheele, D. D., 1989. *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). Working Documents no. W46, Netherlands Scientific Council for Government Policy, The Hague, The Netherlands (in Dutch).
- Van Der Weiden, W. J., Van Der Wal, H., De Graaf, H. J., Van Brussel, N. A. and Ter Keurs, W. J., 1984. *Bouwstenen voor een geïntegreerde landbouw* (Building blocks for an integrated agriculture). WRR Preliminary and background studies no. V44, Staatsuitgeverij, The Hague, The Netherlands (in Dutch).
- Van Diepen, C. A., Wolf, J., Van Keulen H. and Rappoldt, C., 1989. WOFOST: a simulation model of crop production. *Soil Use and Management* 5: 16-24.
- Van Diepen, C. A., De Koning, G. H. J., Reinds, G. J., Bulens, J. D., Van Lanen, H. A. J., 1990. Regional analysis of physical potential of crop production in the European Community. In: Goudriaan, J., Van Keulen, H. and Van Laar, H. H. (eds), *The Greenhouse Effect and Primary Productivity in European Agro-ecosystems*. Pudoc, Wageningen.
- Van Keulen, H. and Wolf J., 1986. *Modelling of Agricultural Production: Weather, Soils and Crops*. Simulation Monographs, Pudoc, Wageningen.
- Van Lanen, H. A. J. 1991. *Qualitative and quantitative physical land evaluation: an operational approach*. Doctoral thesis, Wageningen Agricultural University, Wageningen.

- WRR (Netherlands Scientific Council for Government Policy), 1991. *Technologie en overheid. Enkele sectoren nader beschouwd* (Technology and government. A close inspection of some sectors). Report to the Government no. 39. Sdu Uitgeverij, The Hague, The Netherlands (in Dutch).
- WRR (Netherlands Scientific Council for Government Policy), 1992a. *Ground for choices. Four perspectives for the rural areas in the European Community*. Report to the Government no. 42, Sdu Uitgeverij, The Hague, The Netherlands.
- WRR (Netherlands Scientific Council for Government Policy), 1992b. *Environmental policy: strategy, instruments and enforcement*. Report to the Government no. 41, Sdu Uitgeverij, The Hague, The Netherlands.