SERIE RESEARCH MEMORANDA

DYNAMICS IN LAND USE PATTERNS
SOCIO-ECONOMIC AND ENVIRONMENTAL ASPECTS
OF THE SECOND AGRICULTURAL LAND USE REVOLUTION

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1. Preface

Our economic and environmental system seems to be governed by antagonistic forces, so that current demographic, industrial, social and technological processes exhibit incompatible economic and environmental implications. Environmental, resource and land use policies are fraught with many conflicts that threaten the idea of an ecologically sustainable economic development, advocated inter alia in the Brundtland Report.

The intertwined nature of all processes in an economic-environmental system call for due attention to be given to economic and ecological paradigms from a steady state and/or long-term perspective (see Nijkamp and Soeteman, 1988, and Repetto, 1986). Conventional economic accounting schemes - such as marginal cost or shadow cost principles - often neglect the intriguing problem of environmental externalities and of qualitative shifts in dynamic economic-ecological systems. Long-term strategic considerations (e.g. multigenerational effects, irreversibilities) are thus usually left out in environmental policy analysis (or are at best incorporated in the social rate of discount in cost-benefit calculations; see Gijsbers and Nijkamp, 1988).

Despite the global nature of environmental problems, it is noteworthy that a major problem is caused by the local scale of environmental externalities, in terms of both causes and effects. For example, global problems such as acid rain, sedimentation, desertification, ozonization, eutrofication, ocean pollution and resource extraction are often the result of a great many small-scale and local activities (without being controlled by an environment watchful constituency), while also the far-reaching environmental impacts can be observed most clearly at a local or regional scale. Consequently, the problems of land use (interpreted in a broad sense, including landscape, 'cityscape', soil quality, marine environments) are of central importance in environmental management (cf. Bartelmans, 1986).

Unfortunately, the pluriform nature of dynamic ecological and economic processes can in general hardly be described in a monodisciplinary framework due to differences in precision of measurement, spatial scale, time horizon and adjustment speed of different variables (cf. Braat and Van Lierop, 1987, and Brouwer, 1987). Although the relationship between economic development and ecological sustainability is often regarded to be of a conflicting nature, it is a major task to seek for a

methodology - and a related environmental policy analysis - which emphasizes compatibility instead of antagonism between development and sustainability.

In this context we will introduce in our paper a formal welfare concept as a joint frame of reference for economic development and environmental sustainability (section 2). Based on this paradigm, we will next focus our attention on land use problems. Section 3 will outline the nature of various land use transformations in light of recent economic, agricultural, regional and urban development patterns. In section 4 the position of agricultural land use will be dealt with in more detail from the viewpoint of agricultural growth and related policies in the EC countries. Next, various serious future bottlenecks and threats to environmental development will be spelt out in section 5, in which also a research agenda for strategic land use management will be presented.

2. Development and Sustainability: a Methodological Framework

Economic change and environmental transformation are key aspects of industrialized countries. The performance of these countries is usually measured by means of gross national product (GNP) per capita. However, average GNP does not include social costs outside the market realm, so that environmental externalities are not regarded as components of GNP. Needless to say that this may lead to a biased measurement and perception of actual welfare patterns in our countries. Especially in a long-term perspective, characterized by dramatic (quantitative and qualitative) environmental consequences, the uni-dimensional measuring rod of GNP does not provide meaningful information for strategic policy-making. This shortcoming of conventional welfare indicators has in the past decade led to the popularity of multiple criteria decision methods in environmental policy analysis (see Nijkamp, 1981).

In order to ensure a full account of environmental externalities (including ecological sustainability) in a welfare context, a formal welfare concept is needed. Such a formal welfare concept takes for granted that all elements which are utility constituents (including e.g. toxic material loads, ionizing radiation, deforestation, species diversity, beauty of landscape etc) are to be included as arguments of a social welfare function, no matter whether such elements can be measured in monetary terms or not (provided these elements lead at least to a satisfaction of needs for scarce goods or services). For instance, in a more limited context of agricultural activities the welfare gains from

agriculture should not only be measured by income generated in agriculture, but should also be corrected for negative impacts on landscape, species diversity or eco-stability (cf. Dahlberg, 1986). Clearly, various changes in land use patterns may be due to factors outside the agricultural system itself, e.g. climatic factors (such as a rise in temperature or change in precipitation).

It is evident that a formal welfare concept does not a priori imply a conflict between conventional goods (e.g., a house, a car) and environmental goods (e.g., a forest, clear water): both types may contribute to human welfare.

Admittedly, since there are mutual interactions between the use of conventional and environmental goods, their effects are not by definition mutually supportive (at least not in the short run), so that it is ultimately the trade-off between these types which determines the final welfare change. From a long-term perspective, however, the intriguing question arises whether a trajectory of economic development can be found that is in harmony with ecological sustainability, so that a mutually supportive evolution of both the economic and the environmental systems may arise (see also the concept of 'co-evolutionary development', introduced by Norgaard, 1984). The question whether structural changes (including morphogenetic transformations) in economic and/or environmental systems will enhance 'quantity' without affecting 'quality' (or enhance quality without affecting quantity) is not easy to answer. Especially in case of morphogenetic (i.e., non-linear dynamic) transformations in environmental or economic systems a welfare trade-off is difficult to make.

In this context economic development refers to a situation marked by qualitative shifts in the economy which lead to a positive contribution to welfare. The same applies to ecological sustainability: this refers to a situation which involves a long-term maintenance or improvement of the quality of an eco-system which have a positive welfare impact (cf. Clark and Munn, 1986). Clearly, development and sustainability are concepts which do not automatically take for granted a stable evolution: morphogenetic transformations may imply turbulent system's behaviour in a transition period, caused by cyclical dynamics and complicated feedback relationships. Consequently, economic or environmental policies aiming at a permanent steady state of a dynamic system may threaten the ultimate long-term stability, because its resilience potential may then decline.

One important remark is in order here. In case of (nearly) irreversible processes (e.g., extinction of a rare species) a formal welfare approach should also incorporate the interest of future generations. Such an equity consideration implies that the next generation should not be deprived from the potential of enjoying certain valuable environmental commodities (the so-called bequest value in option theory; see Nijkamp, 1988). This idea of maintaining at least a minimum bequest value in strategic environmental policies was also advocated by Ciriacy-Wantrup (1952, p.253), in particular regarding establishing safe minimum standards of conservation by avoiding critical zones brought on by human activities which make it uneconomical to halt and reverse depletion.

It is evident that with the notions of economic development and ecological sustainability we deal essentially with latent variables, which can only be measured more precisely by using observable indicators. For instance, in economics such indicators might include the evolution of income, the change pattern in income distribution, the composition of the labour force and the evolution of labour force participation. In the context of ecology various other indicators may be used, such as sustainable yield, carrying capacity, multi-functionality and resilience (cf. Brooks, 1986, Cozijn, 1986, and Vincent, 1981). All such measures serve to provide quantitative indicators for judging whether the long-term quality of a dynamic system is affected or not. Clearly, the notions of development and sustainability are not mechanical measures, but refer to the value system (including risk behaviour) of man and society (reflected in a formal welfare approach) (cf. also Kleindorfer and Kunreuther, 1987, and Wynne, 1987).

In light of the above mentioned formal welfare approach, strategic and preventive environmental research (conducted from a social science perspective) should concentrate the attention on the following methodological focal points:

- an investigation of - internal and external - key forces which act as major driving forces for the long-term evolution (including perturbations) of both the economic and the environmental system.
- an exploration of the conditions under which unanticipated surprises (or 'shocks') in the dynamics of both economic and environmental systems may be brought about (both endogenous and exogenous surprise phenomena).
- an identification of long-term feasible (technical, economic, demographic, social, ecological) boundaries within which economic and environmental evolution (including shocks) may take place.

In this context, we may also quote Clark (1986, p.11), who stated:

> ".... we have learned just enough about the planet and its workings to see how far we are from having either the blueprints or the operator's manual that would let us turn that diffuse and stumbling management into the confident captaincy implied by the 'spaceship' school of thought".

Clearly, many attempts have been made in the past decade to model or to replicate the complexity of dynamic economic-environmental systems, but the strategic components (i.e., the above mentioned key forces, surprises and boundaries) were not adequately included, so that these models failed to provide effective and preventive environmental policies (see for a critical review also Braat and Van Lierop, 1987). Consequently, megatrend analysis at a meso level focussing on the qualitative changes and major directions of influence is - from a strategic policy viewpoint - more important than seemingly precise model predictions which are usually bound to fail. This implies that joint expert views (e.g. based on strategic scientific forum analysis) and long-term cross-national comparative studies may often provide more appropriate information than conventional analytical tools. The previous ideas will be elaborated on in subsequent sections which will mainly focus on land use problems.

3. Land Use and Economics: an Orientation

It is interesting to see the shifts in perception of the importance of land use in economic history. For instance, in the early stages of economic theory (in particular by the physiocrats) the production capacity of the natural environment (notably land) was regarded as the main - if not exclusive - source of welfare. Later on the classical economists extended the scope of economic theory by introducing - in addition to land - also capital and labour as complementary production factors for generating commodities (and hence income and welfare). In the latter view the government plays only a minor role: it serves to maintain the institutional and structural conditions within which market decisions can be taken. It is noteworthy that also classical economists mention already the possibility of a stagnant economic development caused by limits on available natural resources, in particular agricultural land.

In later phases of economic theory buildig, especially in the post-war neo-classical thought, it was asserted that the final source of welfare does not rest with nature as such, but with the productive

capacity which is mainly determined by the quality and quantity of labour and capital. This does not imply that in the neo-classical view nature has become irrelevant. Randall and Castle (1985, p.573) clarify this as follows:

> ".... there seemed no reason to accord land any special treatment that would suggest its role is quite distinct from that of the other factors. Land could safely be subsumed under the broader aggregate of capital, since (i) its productivity was clearly responsive to investment and the application of technology, and (ii) the increasing economic importance of non-food-and-fiber commodities together with the increased use of capital inputs in even the food and fiber industries suggested very substantial possibilities for substitution between land and capital".

In contrast to neo-classical thinking, Keynesian economics - with the emphasis on macro-economic equilibrium phenomena - neglected mainly supply limiting (e.g., environmental) factors. In the past decades, however, especially as a result of the 'limits to growth' discussion in the seventies, the role of the natural environment in the process of economic development has again become a focal point in economic research, first starting with non-renewable resources (e.g. oil, materials), but later on also focussing on renewable resources (e.g., fishery, forestry). It was increasingly realized that the natural environment is not only a utility component in a formal welfare approach, but also a production factor in a normal economic-technological system (e.g., a supplier of raw materials, a recipient of waste materials). However, since the market does not provide appropriate signals for a proper allocation of scarce environmental resources, overexploitation seems to be a logical consequence (which reinforces the emergence of social costs in resource exploitation).

In conventional welfare economics such market failures are usually denoted as (negative) externalities. However, it is not an easy task for a government to cope with such externalities in the practice of policy-making, because (i) operational insight into the long-term (structural) relationships between the economic and the environmental system is often lacking, and (ii) the nature and type of public or institutional stimuli (e.g., charges, subsidies, regulations, quote systems, environmental standards) do not often boost congruent responses of the public. A clear exposition on such issues can be found in Hardin's (1968) classical article on the 'tragedy of the commons', where it is claimed that a free

entry to a common agricultural market (i.e., an unpriced or underpriced use of scarce common resources) will inevitably lead to overexploitation, unless certain rules are established (e.g., quota systems, property rights).

In this context, it is interesting to observe that the so-called 'enclosure movement' at the end of the medieval period meant a first major revolution in agricultural land use in Europe with a major impact on environmental quality. It was a logical response to strong competition among farmers who were induced to act as 'free riders' in agricultural resource use. By introducing a system of user and property rights, more care for economic continuity (i.e., economic development) and soil quality (i.e., environmental sustainability) could be ensured.

It is interesting to observe that in the past centuries agricultural land use has not shown revolutionary or even significant changes in terms of land use institutions, despite the large-scale introduction of mechanisation, automation, high-tech and modern biotechnology and despite changes in settlement and urbanisation patterns. However, in the past decade, various qualitative (i.e. structural) changes which we will describe in the next section, have led to an agricultural land use which is a direct and large-scale threat for ecological sustainability all over Europe. In our opinion, we are now facing the eve of a second agricultural revolution (the first one being the enclosure movement), which will be induced by the unacceptable social costs (in the form of environmental externalities) of modern farming activities. This will be further discussed in the next section.

4. Agricultural Land Use and the Environment

In the present section we will make an attempt at providing a more coherent framework for connecting the two key concepts of 'economic development' and 'ecological sustainability' by introducing two intermediate auxiliary terms, viz. 'environmental potential' and 'utilisation form'. The environmental potential refers to the capacity of the natural environment to offer a structural contribution to (socio) economic development without affecting environmental components that would reduce ecological sustainability. In addition to this Pareto-optimality concept, the utilisation form refers to the extent to which production or consumption in an economic system does absorb components of the environmental system (i.e., the degree at which production and/or consumption exert a claim on the environmental potential). Thus environmental potential and utilisation forms are not independent of each

other, as a high level of environmental potential is often accompanied by a low level of socio-economic functions, and vice versa (see also Figure 1).

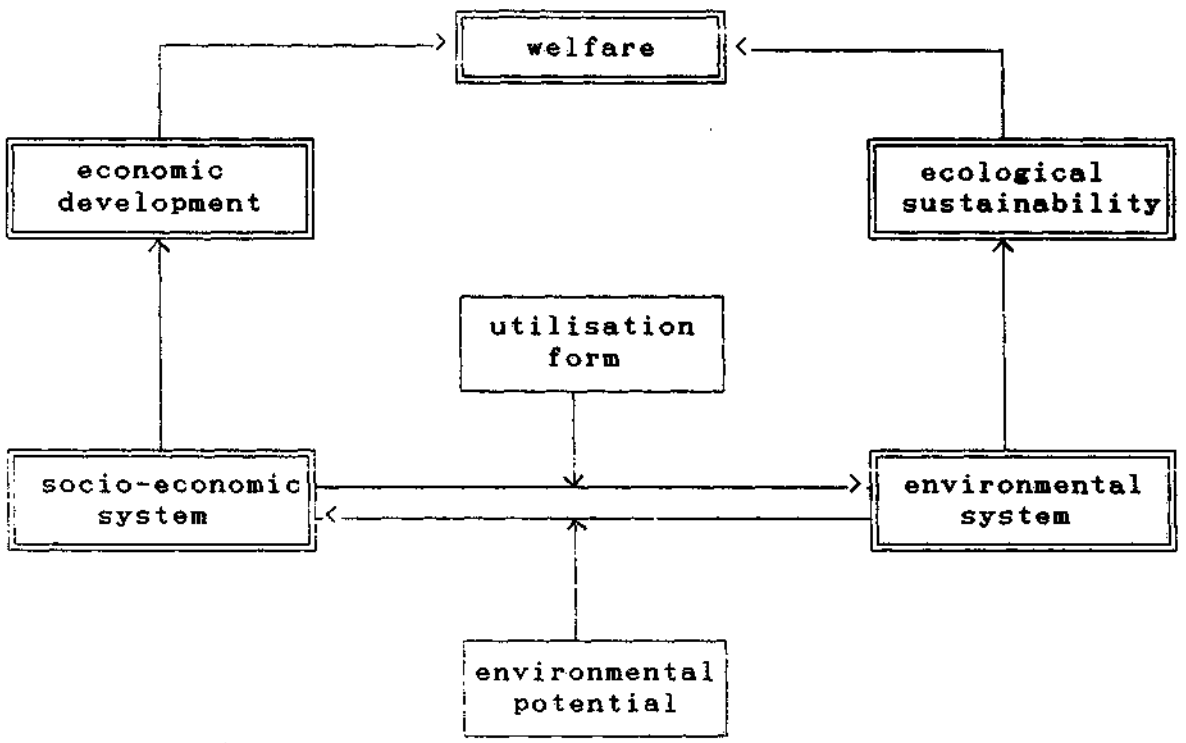

Figure 1. The formal welfare-theoretic framework of economic development and ecological sustainability.

For instance, the transition from a nomadic culture towards an industrialized society has meant a transformation of landscapes from natural toward man-made landscapes (see also Wilkinson, 1973). Agricultural key factors acting as driving forces in this context are inter alia modernisation, economies of scale (notably concentration), and specialisation in mono-cultures. Clearly, the upper limits of agricultural production (or productivity) may still be shifted upwards (cf. de Wit et al., 1987), but such a rise would no doubt affect the environmental potential (or the sustainability) in the long run, as a further increase in soil productivity tends to lead to a lack of resilience caused by soil degradation. Seen from this perspective, the environmental potential may also- beyond a critical limit - become a key

force for further socio-economic development. In fact, when the soil productivity has reached its limits, we may speak of marginal land (cf. Brouwer, 1988). These limits may stem from various bottlenecks:

- physical : caused by climatic, physiographic or soil conditions in a certain area (e.g., a situation of soil erosion or desertification after deforestation).
- social : caused by lack of necessary skills, traditional family patterns, demographic processes and the like in an agricultural society. Of course, the latter type of limits may be removed in the long run, as is shown by the history of agriculture in Europe.
- technological: caused by lack of appropriate tools in agriculture, e.g. environment-friendly pesticides or other toxic chemicals.
- economic : caused by efficiency motives taking for granted the necessity that marginal costs of production may not exceed marginal benefits (especially in cases of a fully operating market mechanism).

The recent history of agricultural land use has demonstrated that considerable parts of European agriculture have reached (or are about to reach) one or more of the above mentioned limits, which means that environmental potential and utilisation forms tend to become conflicting matters.

Thus the question of feasibility of further land use claims in the light of ecological sustainability and economic development is an intricate one, which by no means has been studied satisfactorily in the European countries. In fact, the situation is even more complicated, as spatial substitution effects - in the form of a geographical transfer of negative externalities - may occur. For instance, part of the environmental potential of region A may be used for an expansion of utilisation forms in region B. An example of the latter situation is the regional environmental potential for the production of tapiocca in Thailand for intensive cattle breeding and milk production in the Netherlands: the indirect land use needs for this sector in foreign countries are approximately twice as much as the total direct agricultural land use claims in the Netherlands! Analogous examples can be found inter alia in the production and spatial distribution of drinking water and in the international pattern of acid depositions.

It is noteworthy here that to some extent this spatial substitution effect for land use is comparable to the 'bubble' concept in industrial environmental policies, although in the case of transfer of externalities connected with the environmental potential and utilisation form no explicit policy has been adopted so far among European countries. But the previous observations also show that such transfer processes are so far reaching that the environmental issues which often emerge at local scales really become visible at a world-wide scale. This conclusion can also be found in the Brundtland Report on "Our Common Future", in which it is convincingly demonstrated that the geographically interwoven pattern of environmental potentials and utilisation forms leads to global resource problems reflected inter alia in desertification, deforestation, soil erosion, acid rain and so forth. But in terms of strategic and preventive policies the notion of 'think globally while acting locally' has not yet reached any stage of maturity!

Clearly, in a way analogous to environmental policies for the industrial sector governments might be willing to impose maximum limits on agricultural production which comply with environmental standards, but even such a seemingly simple policy choice would include various disadvantages from an environmental viewpoint:

- even strict norms lead seldom to no-effect levels of environmental degradation.
- agricultural production standards are more oriented towards market interests than to preventive environmental protection measures.
- production limits adopted in only one country do not solve transborder environmental effects.
- the spatial distribution of environmental externalities and related social costs may be quite uneven in case of a system of uniform production limits.

The previous observations demonstrate in any case clearly that operational and policy-oriented research is badly needed in the area of integrated agricultural land use planning and environmental management. Also from an economic viewpoint we are facing an unfavourable situation of lack of insight into social costs of various forms of land use and into the social benefits of alternative environment-friendly land use policies. For example, the estimated social costs of acidification in the Netherlands range from 150 to 3000 million Dutch guilders per annum. On the other hand, the total management costs for public policy actions by the Dutch government in this area amount to 557 million Dutch guilders in 1988.

There is of course a main problem in the field of land use policy, viz. the interference of agricultural policy with environmental policy. Agriculture has - via its land use - a direct and indirect impact on the quality of the environment: there is no other sector which is so much dependent for its inputs on the environmental potential (an observation also made in Malthus' Essay on the Principles of Population). Unfortunately, agricultural utilisation forms are often not in agreement with the environmental potential in a certain area.

According to Odum (1969) one may regard agricultural development as a transformation process of the ecosystem, in which the number of species diminishes, the efficiency of food recycling gradually declines, the production increases but the vulnerability of the production also increases, the biomass is reduced. The post-war developments in the agricultural sector have shown in clear transformation from natural equilibrium mechanisms toward man-induced equilibrium mechanisms, which have affected the diversity and stability of ecosystem. An agriculturally advanced country such as the Netherlands forms a clear illustration of the above mentioned points, as Dutch agriculture is increasingly turning into a high tech sector.

Taking the Dutch case as a representative example, we may list the following factors which have acted as main driving forces for the recent evolution in the agricultural sector:

- concentration tendencies caused by economies of scale. For instance, the number of Dutch farms specialized in milk production declines in the period 1973-1985 from 99,000 to 61,000 (i.e., approx. 60%), while the average number of cows per farm increased from 22.8 to 39.8 and the production of milk increased from 9 mln to 12.5 mln tons. Similar observations can be made regarding related industrial sectors (e.g., food processing). Thus, the agricultural sector has followed the pathway of the industrial sector toward large-scale activities, and for the moment there is no reason to assume that this development will soon come to an end.
- modernisation and intensification. The capital intensity, as well as the share of intermediate deliveries for agricultural production has increased significantly in the recent past, a situation strongly induced by the emergence of the high-tech sector (notably bio-technology). In various subsectors of agriculture the soil productivity has almost been doubled in the past 15 to 20 years. Without a clear environmental concern, this may of course lead to a

serious soil degradation, not only because of exhaustion of fertile soil but also because of the use of heavy machines.

- lack of diversification. The diversity of spatial and environmental structures is increasingly affected by new cultivation methods and far reaching physical planning in agricultural areas. Also the rise of big 'agribusiness-complexes' contributes to a uniformity of the agricultural landscape (see Post et al, 1987). This trend towards a levelling out of traditional environmental variety in rural areas is of course closely connected with the above mentioned specialisation (induced by automation and mechanisation).
- socialisation. Social backgrounds, notably drastic changes in the socio-economic position and image of farmers' families, have exerted a deep impact on the life style and attitude of farmers, which in turn has had a thorough impact on environmental conditions. In the Netherlands, around 1930 approx. 20 percent of the labour force was agriculturally oriented, whereas at present this figure is approx. 4 percent. The gap between rural and urban life styles has diminished at the same time: the agricultural community has - from a social-cultural viewpoint - developed toward an urban-oriented community. This emancipation of the agricultural community has caused an abandonment of traditional family patterns, and has stimulated a modern attitude toward risk taking in business. Consequently, farmers have become innovative entrepreneurs of the Schumpeterian type. The strong competition on a national and international market has led to a rationalisation process, in which environmental concerns are subordinate to survival strategies. The resulting soil degradation (notably compact soil structures, erosion, toxification, exhaustion and salinification) implies a loss of environmental potential, which in the long run may become a serious threat for both the future economic perspectives (i.e., the development option) and the future quality of the environment (i.e., the sustainability option).

In conclusion, the environmental potential of the soil and the utilisation forms are interconnected phenomena which may be in conflict in the short term. In the long term, however, it should be stressed that a meaningful compromise between these elements has to be reached in order to support both economic development and ecological sustainability in the agricultural sector. Whether or not this is a feasible strategy in a European setting, will not only depend on the entrepreneurial decisions in the agricultural sector, but also on public policy decisions

taken at the level of the European Community. The question whether the international political arena in Brussels will act as a key force (or constraint) for a sound and balanced agricultural development will be discussed in the next section.

5. Overproduction in the Agricultural Sector: An International Perspective

In the previous sections no explicit attention has been given to a major determinant of changes in agricultural land use and production, viz. the supranational policies pursued at the level of the Commission of the Europeam Communities (EC). In this context, the paradoxical problem of unacceptable environmental degradation on the one hand and over-production in the agricultural sector on the other hand deserves closer attention, with a particular view on shifts in land use patterns. In this section we will again take agriculture in the Netherlands as a frame of reference, as this sector is most clearly reflecting the problems caused by the strictly regulated common agricultural policy of the EC.

We will start here with some statistical information on the labour force, the production volume, the land use and the investments in the agricultural sector in the Netherlands, the EC and (partly) the USA and Japan (see Annex 1). Despite the decline in employment in agriculture in the Netherlands, this sector is still providing a significant contribution to national income. This is due mainly to the strong rise in soil productivity of agriculture in the Netherlands, as is also reflected in Table 1. This table shows that the average agricultural soil productivity in the Netherlands is approx. four times as high as the EC average, while the Dutch agricultural labour productivity is approx. three times as high as the EC average.

It should be added, however, that these figures provide a biased picture, as they neglect the fact that the Netherlands is strongly dependent for its agricultural sector on imports of intermediate products from abroad (see section 4). But as far as the domestic land use development in the Netherlands is concerned, we see invariably a continuing trend toward a decrease in agricultural labour force, a decline in agricultural land use (and farm units) accompanied by a significant rise in production (reflected in an average annual growth of soil productivity in the period 1961-1981 of 4.3 percent in the Netherlands).

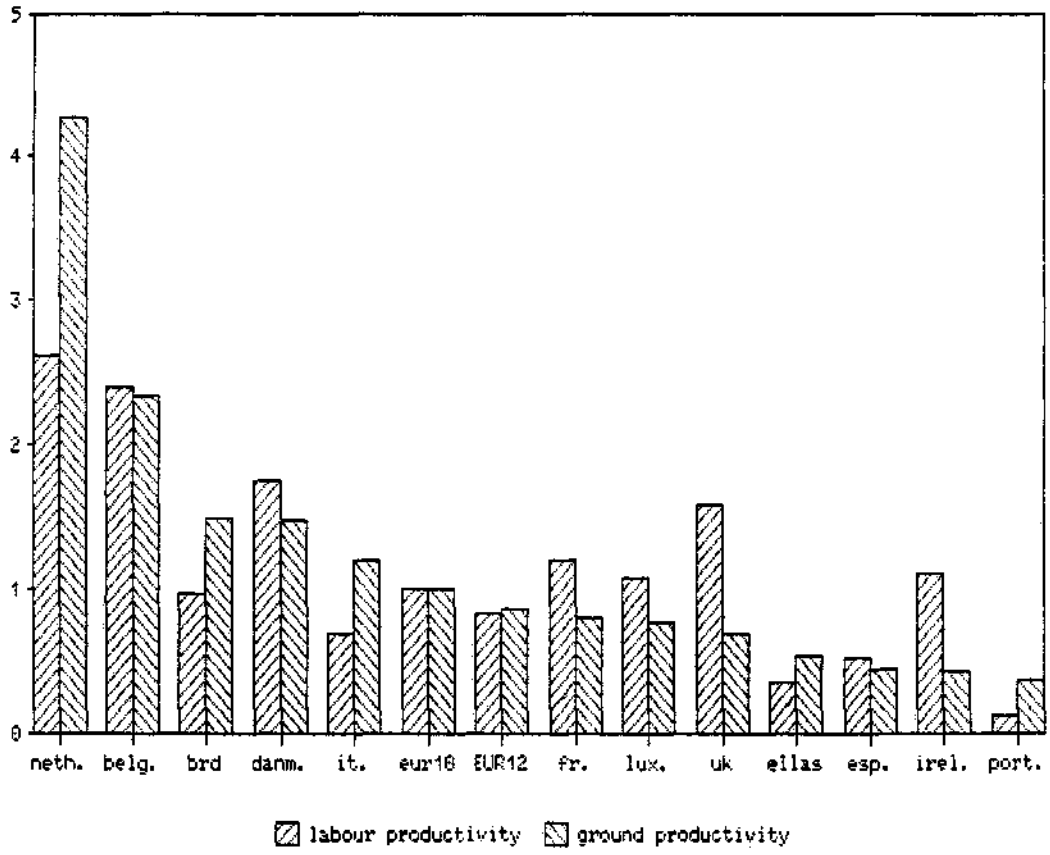

Table 1: Labour productivity and ground productivity
for EC-member countries, 1985. Eur10 = 1
(source: Commission of the European Community, 1987)

For the EC as a whole the average growth rate of production for the period 1961-1981 was 2.3 percent. Since agricultural land use is gradually declining, the actual growth rate per hectare is even higher. The Netherlands has - as mentioned before - the highest growth rate per hectare mainly because of its advanced organisation of research, education, information and technology in the agricultural sector, as well as by its well established marketing, logistical and distributional strategies, a situation which was mainly due to the strong and efficient societal support for this sec support for this sector. For the next 20 years, there have been estimates for the Netherlands that the annual growth of production will be about 2 percent, the decrease of labour

force will be about 2.5 percent, while the growth of the labour productivity is estimated to be about 4 percent. The surplus of cultivated land may rise to 25 percent of the present acreage use.

In recent years, the position of the agricultural sector has increasingly been questioned for two reasons:

- the enormous (domestic and EC)subsidies given to this sector
- the environmental degradation caused by this sector (just in a period where pollution by the industry is increasingly being controlled).

Thus both the environmental potential and the utilisation forms of agriculture are becoming a source of intriguing and controversial debates in the Netherlands. In this framework, the wisdom of the current EC agricultural policy is more and more questioned.

The common agricultural policy of the EC has various objectives e.g.:

- increase in agricultural productivity
- maintenance of agricultural income at an acceptable level
- stabilisation of agricultural markets
- safeguarding of the provision with agricultural products
- a reasonable price level for consumers

Such a diversity of objectives would require a broad spectrum of instruments. However, surprisingly enough, in practice the EC has only one major instrument, viz. a price policy. It is also noteworthy that some of the above mentioned objectives (e.g., the rise in productivity) have been realized even without the use of specific EC instruments. Clearly, certain regions in the Community may be lagging behind in terms of productivity. Analogously, the self-provision rate is not evenly spaced over the member countries but the need for agricultural products can be covered for almost 100 percent by internal production inside the Community. Besides, a stable price level of agricultural products has never been a serious problem in the Community. Nevertheless, there are some severe tensions in the common agricultural policy in the EC, which also have serious implications for land use in the Community.

First, the EC has the dual aim of using price policies for achieving a situation of both stable markets for agricultural products and of acceptable income levels for farmers (i.e., comparable to non-agricultural income). However, since the economic development in the EC member states does not run parallel, but instead shows significant discrepancies, a complicated system of compensating monetary transfers was designed in order to meet the income target. But the latter policy

measure implied that a uniform price policy became illusory, a situation which was more recently coped with by introducing an indirect system of income subsidies via a reduction in value added tax in several countries. Clearly, this situation of artificial low prices may stimulate agricultural overproduction with all negative implications for environmental quality in rural areas. Thus instead of incorporating social costs of environmental externalities, the agricultural market is even further destroyed by indirect price subsidies.

A second problem concerns the aim of stable markets for agricultural products. Equilibrium on such markets can in principle only be reached if prices become flexible so as to meet a balance between demand and supply (which would most probably affect the income objective) or if supply would be strictly regulated. But the latter policy is problematic, as it introduces a planned submarket in an otherwise free market system, while it does not ensure a maintenance of acceptable income levels for the agricultural sector.

The current situation of a market disequilibrium is mainly caused by the strong rise in agricultural productivity. Despite the very moderate increase in the demand for agricultural products in the EC (approx. 0.5 per year) and despite the gradual decline in real prices of agricultural products (approx. 2.0-2.5% per year), the supply of agricultural products in the Community has risen with approx. 2.0-2.5% per year. As a consequence, there is hardly any shortage of any agricultural products in the EC, as is also indicated in Table 2. The markets for agricultural products are apparently saturated, the internal demand does not increase and the supply on the world market of agricultural products from outside the EC is even increasing mainly due to lack of purchasing power in Third World countries. Consequently, stock control and supply control are challenging but extremely difficult tasks for the Community.

A third problem emerges from the significant differences in agricultural income between the member states of the EC. The average net agricultural income per capita shows a large variation and ranges from 22,000 ECU in the Netherlands to 3,400 in Portugal. The latter situation indicates that agriculture in various countries is often a (sub-)-marginal activity, which needs complementary income earned in other (often informal) sectors.

Finally, in recent years the financing of agricultural subsidies has become a source of many tensions. The growth in these expenditures

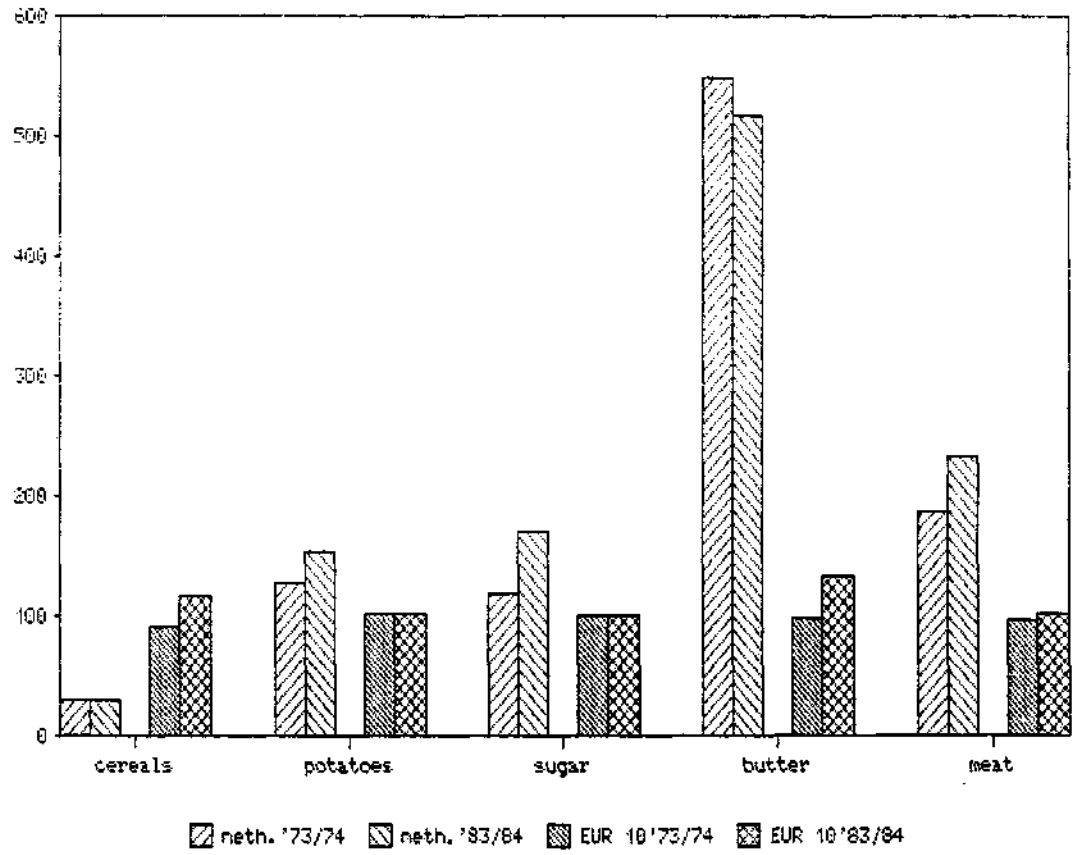

Table 2: Internal Supply of some Important Products (percentage)
(Source: Commmission of the European Community, 1987)

has been outrageous and has caused severe political frictions. The EC agricultural expenditures (agricultural subsidies, import duties etc) have increased from 10,828 mln ECU in 1982 to 20,619 mln ECU in 1987, although it has to be added that the EC revenues (import taxes, value added taxes etc) products have increased from 21,240 mln ECU in 1982 to 35,672 mln ECU in 1987[1].

For the future it is plausible that the following issues in agricultural policy will gain importance:

- export restitutions may tend to increase due to the weak position of the dollar and the high level of autarky of the Community.
- a decline in the world market price of agricultural products will increase the net deficit between import taxes and export subsidies.
- a tendency toward a more uniform Community policy for the agricultural sector (including Spain and Portugal) will necessitate the

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1 draft budget.

development of a more structurally-oriented and strategic agricultural policy.

- price compensation, quota systems and related policy measures, may tend to become practice for most agricultural products, if productivity increases are not ground to a halt.
- in a stagnating economy, the growth in value added tax will not run parallel to agricultural expenditures in the EC, so that international, intersectoral and intrasectoral conflicts for the agricultural sector may become sharper.
- the increasing practice of fraud in agricultural subsidies may lead to structural shifts in policy.

In view of the saturation levels for almost all agricultural products, it is evident that a continuation of current trends would be a major failure from an economic viewpoint, while the negative externalities of a further rise of the agricultural sector would also become excessively high. Consequently, the European agricultural sector badly needs a structural re-orientation. Some selected issues related to the latter point will be discussed in the next section.

6. Strategic and Scientific Options for Co-evolutionary Development

The previous sections have demonstrated that agricultural land use is facing many severely conflicting angles. In view of the serious socio-economic and environmental frictions inherent in agricultural overproduction, various strategic options may be considered. We will sketch here three different options:

- modern (i.e., high-tech oriented) agriculture. This option takes for granted the necessity of the use of modern technology in order to remain competitive by reducing production costs (and eventually also by coping with environmental degradation).
- traditional agriculture. This strategy would imply a gradual development of this sector, but would require price compensating measures in order to comply with the income target.
- 'green' agriculture. In this way the environmental repercussions of agricultural activities would be minimized, inter alia by establishing a more soil-extensive cultivation mode.

In the latter option a non-transferable and land related quota system or a forced extensification of agricultural land use would be plausible in order to cope with the overproduction in this sector, especially because the alternative, viz. a transition towards a market

mechanism might lead to price reductions and hence would stimulate more competitive behaviour (including large scale concentration, mechanisation and intensification). However, it is also often claimed that the first mentioned option - a quota system - does not necessarily lead to an extensification of agricultural land use, but may also cause a further intensification (and hence even more environmental threats) in case of strong competition. Furthermore, both options may lead to serious price and market distortions, so that then an equilibrium on a European scale is even more difficult to attain. Compensating policy measures (e.g., price measures, individual income subsidies) may be necessary and they also have many socio-economic and financial disadvantages. One thing is clear: the EC budget cannot bear any more the burden of huge transfers to the agricultural sector, so that in the near future a 'forced' solution for agricultural overproduction based on a closer market orientation seems to be inevitable. This option may benefit the modern agricultural production sectors. No doubt this will lead to a new problem: excess supply of rural land. On the basis of ongoing technological development and a more market oriented policy, the surplus of cultivated land may even be 25% for the next 20 years in the Netherlands. This seems to be an option which is in agreement with environmental interests, but it involves a great many social and financial problems. Moreover, the modern agricultural sector - if it will survive - will use the economically best practical technological means to cope with lower prices, and this will in general not be in agreement with environmental objectives. Traditional agriculture may then be another meaningful choice option, but here serious income problems (inducing again unlimited competition) may emerge and preclude a balanced solution.

Hence, it seems that a greater emphasis on the market mechanism accompanied by satisfactory policy measures regarding ecological sustainability is the only way left. This implies that the modern technological evolution (e.g., bio-technology, energy technology, information technology, genetic manipulation, robotisation) in the agricultural sector would continue, provided it would also be more oriented towards safeguarding long-term environmental interests. Thus here high-tech agricultural technology would have to find a compromise with environmental technology.

Finally, the question as to what to do with vacant agricultural land is an intriguing one. This problem of so-called <u>area management</u> has received increasing attention in the past years. Of course, a part of

the available land can be used for new urbanisation, industrialisation and infrastructure plans, a part for recreational and leisure purposes and another part for extensification of agricultural uses induced by lower land prices. But even then a large stock of vacant land may remain. A new potential use would naturally be a reconversion into 'environmental capital' (e.g., via reforestation), but the financial and management implications of such far reaching policy decisions may be excessive. Even at the moderate scale this leads already to major problems in the Netherlands.

Clearly, in the case of such tendencies towards area management, much information and research would be needed in order to get more precise insights into the potential reconciliation of agricultural economic development and ecological sustainability. Whether or not utilisation forms will then be more in harmony with environmental potential is still an open but intriguing question. Hence this new research field of a co-evolutionary development of a modern and sound agricultural sector and of an ecologically sustainable environment deserves a serious multidisciplinary and cross-comparative analysis in various European countries. Some relevant items on such an ambitious research agenda would be:

- the identification of environmental components which in the long run are critical for a balanced land use development;
- the analysis of economic consequences of changes in environmental potential (e.g., caused by changes in multifunctionality);
- the assessment of long-term land use implications of shifts in environmental potential;
- the analysis of the changing role of agriculture with respect to the changing quantitative and qualitative needs of the public regarding both the type and the mode of agricultural production;
- the compatibility of changes in land use with other societal objectives (e.g., the use of vacant agricultural land for bio-energy purposes);
- the socio-economic analysis of both efficiency and equity questions emerging from policy choices regarding environmental sustainability in the framework of agricultural policy;
- the study of the role of modern technology (e.g., bio-technology) in enhancing the environmental potential of agricultural land use;
- the investigation of possible strategic EC options regarding agricultural utilisation forms which - given economic objectives

for this sector - would ensure a long-term sustainable land use at a European scale.

In conclusion, it seems that the second agricultural revolution has not only induced a great many environmental issues (e.g., regarding sustainability), but it also seems to offer an option for a redirection of socio-economic and environmental goals. Sustainable agricultural development may even be possible within the limits of the environmental potentials. But this requires a comprehensive view on the utilisation form of land. Dynamics always offer opportunities. It is a challenge for scientists and policy makers to select the sustainable ones.

Annex 1

1. List of geographical abbreviations

EUR 6 : BAD, France, Italy, the Netherlands, Belgium, Luxembourg
EUR 9 : idem + England, Ireland, Denmark (1980)
EUR 10 : idem + Greece (1981)
EUR 12 : idem + Spain and Portugal (1986)

2. Development of employment in the agricultural sector in The Netherlands, EUR 10, EUR 12, USA and Japan.
(% of total workforce) (Source: Eurostat, several years).

year	neth.	EUR 12	EUR 10	USA	japan
1960	9.8	21.1	18.4	8.5	30.2
1970	6.3	13.8	11.4	4.5	17.4
1973	6	11.9	10	4.2	13.4
1980	4.9	9.6	8	3.6	10.4
1982	5	9.1	7.6	3.6	9.7
1983	5	9.1	7.6	3.5	9.3
1984	5	8.9	7.4	3.3	8.9
1985	4.9	8.6	7.2	3.1	8.8

3. Number of farms (Source: Eurostat, several years)

year	neth.	index	EUR 6	index
1966-1967	341.7	100.0	10110.3	100.0
1975	253.7	74.2	6415.5	63.5
1983	243.4	71.2	5124.7	50.7

4. Average ha cultivated land (Source: Eurostat, several years)

year	neth.	index	EUR 6	index
1966-1967	247	100.0	6404.9	100.0
1975	162.6	65.8	5194.1	81.1
1983	138.5	56.1	4975.3	77.7

5. Area of cultivated land in The Netherlands (1900 - 1983)
(Source: Agricultural Institute of the Netherlands, several years)

(*1000 ha)

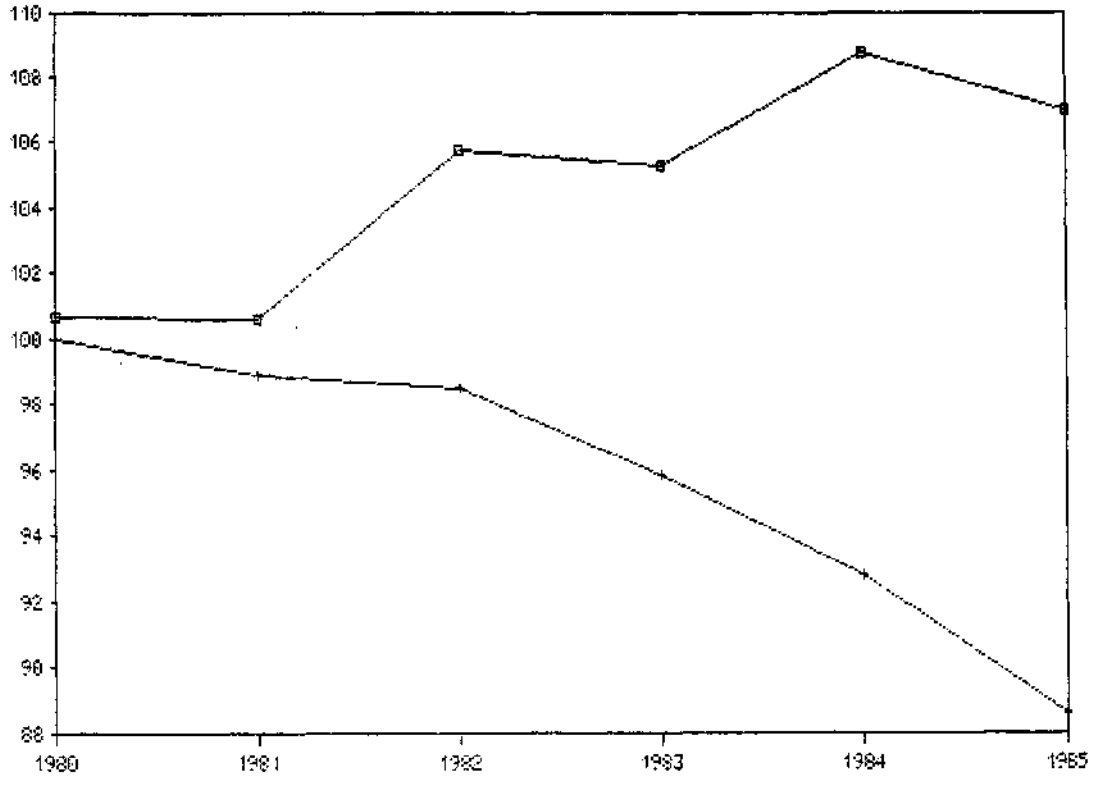
	1900	1920	1940	1960	1977	1983.
total area (a)	3255	3265	3335	3613	3719	3729
area cultivated (b)	2085	2184	2324	2314	2060	2008
% b/a	64.1%	66.9%	69.7%	64.0%	55.4%	53.8%

6. **Gross investments in real assets in the agricultural sector (1973 - 1985) (Source: Eurostat)**

(1980=100)

	1973	1981	1984	1985
Netherland	54.7	82.5	102	95
Belgium	76.7	80.3	109.4	115.9
Denmark	54.3	68.4	74.1	97.5
BRD	67.3	92.3	117.2	104.8
France	60.2	104.2	138	129.4

7 **Development of production (constant prices) and product prices (after correction of inflation), EUR 10.**
The average of the years 1979, 1980 and 1981 has been set equal to 100. (Source: Eurostat)



□ production + price level

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