

Progress Through Partnership: 11 Agriculture, Natural Resources & Environment



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[Preface](#)

EXECUTIVE SUMMARY

Activities in the scope of this Panel make an important contribution to the UK's prosperity and quality of life. Indeed, the industries encompassing agriculture, natural resources and the environment provide a strong and innovative core to much of the UK's science and commerce. The supply and use of technology are crucial to the well being of each of these industries and they draw on ideas and products from other sectors, and from a broad range of fundamental scientific research. Our report reviews how the UK can further develop and apply this strong science and technology base so that the respective industries can make even greater contributions to creating wealth, improving the quality of life and

achieving sustainable development.

Recommendations

Investment is required in the following areas (organisations which we ask to take forward the recommendations are given in parentheses after each recommendation):

Generic areas needing Investment:

- **Animal, microbial and plant biotechnology, and supporting sciences** (Ministry of Agriculture, Fisheries and Food [MAFF], territorial Government departments [for Scotland, Wales and Northern Ireland], Biotechnology and Biological Sciences Research Council [BBSRC]).
- **Robotics, sensors and modelling** to improve monitoring, forecasting, productivity and safety (industry, Natural Environment Research Council [NERC]).
- **More widely integrated environmental research programmes** (Department of the Environment [DoE], MAFF, territorial departments, NERC).
- **Technologies** for site/soil remediation, waste reduction and treatment, and wider use of life cycle evaluation, cleaner technologies and other practices leading to sustainable technologies (Department of Trade and Industry [DTI], DoE, MAFF, territorial departments).
- **Structural changes** to link more closely the whole chain from researcher through producer to consumer, facilitating the flow of technology and linking research and production more closely with consumer preferences (MAFF, DoE, DTI, Office of Science and Technology [OST], territorial departments, Research Councils).
- **Public understanding** of science, engineering and technology, and the **balance of risk and benefit** (OST, Research Councils).
- **Soundly based legislation, training and advice** (all the above Government departments, Health and Safety Executive, Department for Education and Department of Transport).
- A follow up foresight exercise on **Marine Science and Technology** should be carried out to consider this area more fully (OST).

Specific areas of work requiring investment:

- **Food with better keeping and safety qualities while maintaining taste and appearance** (MAFF and territorial departments, Department of Health, BBSRC, industry).
- **Better quality timber and new uses for forest products, and improved systems**

for aquaculture (MAFF, DoE, territorial departments, BBSRC, Forestry Commission, industry).

- **Sustainable resourcing** of construction materials and other natural resources (DTI, DoE, territorial departments).

Key technology needs in relation to the **marine sector** are also identified in Table 2 of the report on Marine Markets Foresight Meetings (Annex A). Detailed recommendations on **global environmental change** and **fisheries R and D** are given in Annexes D and E respectively.

Constraints to achieving these objectives include:

- Supply of trained science, engineering and technology graduates and postgraduates.
- Marketing: better understanding of consumer preferences, and improved co-ordination from researcher to producer, and producer to consumer.
- Financial incentives for investment, particularly for small and medium sized enterprises (SMEs) and new ventures.
- Experts' appreciation of the importance of taking proper account of the public's perception of their work.

It is essential that these constraints are overcome and that the strong science, engineering and technology base in many areas in the Panel's remit is used fully in policy making in the UK, particularly in respect of environmental regulations.

In recent years scientific disciplines have become isolated, although many new products and processes require a multi-disciplinary approach. For example action is needed by funding bodies to ensure that new knowledge from molecular and cell biologies is translated into whole organism, population and ecological studies.

This is particularly important for topics such as sustainability, biotechnology, bioremediation, plant and animal breeding and pathology, and lifetime studies of resources, and will help to ensure that they contribute to national wealth creation and improvements in the quality of life. Other examples are the integration of microengineering with biotechnology and information technology, to provide small 'smart' robots and sensors; and the linking of artificial intelligence and expert systems with monitoring systems to improve forecasting.

Our recommendations are reinforced by similar ones from other Sector Panels (on Chemicals; Communications; Construction; Energy; Food and Drink; Health and Life Sciences; IT and Electronics; Manufacturing, Production and Business Processes; Materials; Retail and Distribution; and Transport). This broad support reflects the extensive range of industry that is underpinned by the activities reviewed by the Panel.

Pressures for Change

In all of the areas considered by the Panel, there are major pressures for change. Examples

include the following:

Agriculture. Increasing international competition; use of land for non-food crops and for conservation, development and access; growing resistance to productivity gains at the expense of environmental losses (e.g. pollution, loss of habitat); threat to plant and animal health from removal of trade barriers; public acceptability of systems of animal-based food production; and decreasing financial support from the Common Agricultural Policy.

Marine. Increased use for leisure; protection from pollution of the sea, and of food derived from it; improved management of fish stocks; and increasing culture of fish, shellfish and algae.

Oil and gas. Improved recovery from mature fields; recovery from marginal fields or more hostile environments (e.g. deeper water); and decommissioning and dealing with post-production pollution.

Industrial and construction materials. Pressures for reuse and modernisation rather than new build in the developed world and enormous growth in demand in the developing world, as a result of increasing population and rural/urban migration.

Environmental issues at both global and local levels pervade all of the above activities. The environment provides both an opportunity and a constraint. It can be viewed as a stock of natural capital whose sustainable use is the foundation for wealth creation and an acceptable quality of life. Increased pressure on the environment will result from population growth and redistribution, increased scale of economic activities, demand for potable water and changes in attitude and lifestyle. There will be increasing pressure on resources (e.g. raw materials, energy stocks) and sinks (waste assimilation capacity of environmental media), leading to possible global climatic changes; loss of biodiversity; pressure on waste management systems; increasing severity of pollution problems; increasing concern over the unsustainability of present human activities; and divergence between expert and public perception of environmental risks.

Likely events in the next 20 years are difficult to predict because of major uncertainties over the effects of long-term influences on technology (e.g. CAP, GATT, environmental policies, research funding). Nonetheless, over the next 20 years the UK agricultural sector is likely to be greatly influenced by imports of basic foodstuffs from ever widening geographical and horticultural sources. Our farmers will need to concentrate on crops and livestock which can be most efficiently produced in this country, probably on an acreage which continues to decrease. Farm incomes and rural land use, however, will be characterised by increasing diversity - new crops grown for industrial or other non-food purposes, and new recreational, conservation and amenity services for the community. The exploitation of other natural resources will be increasingly influenced by considerations of environmental protection and sustainability. The need to protect and use our environment in a sustainable way has already spawned an effectively new industrial sector, ranging from treatment and monitoring equipment to a wider range of specialist services in activities such as environmental impact assessment, monitoring, environmental audit and pollution control. The market for these 'environmental' goods and services will continue to expand worldwide. The UK must invest in and harness its scientific, engineering and technological capabilities not only to seize these opportunities, but also to assist agriculture and other natural resource-based industries to respond to widening competition and to the need for environmental protection,

while at the same time maintaining their contribution to wealth creation.

Background

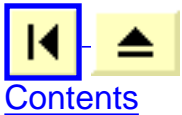
The UK Technology Foresight Programme is a systematic process for assessing those scientific and technological developments which could have a strong impact on industrial competitiveness, wealth creation and quality of life in the next 10 to 20 years. The aim of the UK Technology Foresight Programme is to recommend priority areas for research and development funding, and for related education and training. This information would be used by Government in determining policy, and by the Research Councils and others responsible for the allocation of research funds in the public and private sectors.

The programme began in 1993 when the Steering Group on Technology Foresight was established under the chairmanship of Sir William Stewart, the Chief Scientific Adviser to the Government. In Spring 1994, the Steering Group established 15 Sector Panels of experts to carry forward detailed technology foresight work on defined sectors covering the whole UK science base. The Panel on Agriculture, Natural Resources and Environment (ANRE) was one of these.

The ambit of the Panel embraced land-based agriculture (including food and non-food products); horticulture; forestry; aquaculture; fossil fuel and mineral extraction; and all aspects of environmental protection (terrestrial, freshwater, marine and atmospheric). In addition to the major direct contribution to GDP by the ANRE sector, it also underpins such major sectors as the food industry, the provision of fresh water, the construction and energy industries, and addresses environmental issues ranging from biodiversity to long-term concerns about the impact of global warming.

The Panel comprised 20 experts drawn from these diverse fields, supplemented by four Sub-Groups where additional expertise was represented. Views of the Panel were augmented by a questionnaire survey of some 50 other experts; a Delphi survey - over 600 experts from industry, research institutes and academe were consulted; many workshops and seminars were conducted throughout the UK; and written submissions were received from numerous individuals and organisations. All of these inputs contributed to our final recommendations. Moreover, in considering our recommendations, we recognised that it would not be possible to use conventional measure of wealth creation in comparing issues concerning the environment and quality of life with direct market opportunities (such as new products and processes). Issues such as the responsible husbandry of finite resources, sustainability, environmental impact, and animal health and welfare dictate that prioritisation involves political dimensions as well.





Progress Through Partnership: 11 Agriculture, Natural Resources & Environment



1. GENERAL INTRODUCTION

1.1 Plans for the UK's future prosperity have been linked by Government with the importance of science, engineering and technology for wealth creation, growth and quality of life. All of the latter depend on investment in research and development, education and training, and public understanding of science. The basis of the argument was presented in the White Paper Realising our Potential; A Strategy for Science, Engineering and Technology [1]. A major objective identified in the Paper was the need to develop a long-term vision of technologies and markets. This is the focus the UK Technology Foresight Programme and hence of our report, which has been produced after widespread consultations between experts from academia, industry, commerce, Government and special interest groups. These consultations also provided a strong foundation for developing wider networks of contacts, a key aim of the UK Programme.

1.2 Many other countries have already set up Foresight Programmes - most notably Japan where the Science and Technology Agency produces five-yearly technology forecasts for 30 years ahead. Germany has recently carried out two foresight studies: one that directly compared its technological capability with that of Japan, and another which focused on technologies critical to Germany in the next ten years. The USA's foresight exercise began in 1989, and has a similar objective to that in the Netherlands of evaluating and identifying emerging technologies that have a broad range of potential applications in the nation's industry. France, Australia, New Zealand and South Africa are also instigating foresight processes, as is the Commission of the European Union.

1.3 The UK programme began in 1993 when the Steering Group on Technology Foresight (SGTF) was established under the chairmanship of Sir William Stewart, the Chief Scientific Adviser to the Government. The SGTF formed 15 panels of experts to carry forward detailed technology foresight work on defined sectors covering the UK science base. The Sector Panel on Agriculture, Natural Resources and Environment (ANRE) was formed in Spring 1994. Every element considered by our Panel impinges on the life of each man, woman and child in these islands and within the wider European Union. Furthermore, the industries embraced by the remit of the Panel contribute considerably more than three per cent to the Gross Domestic Product (GDP) of the UK and form the base for the success of numerous other industries.

Every aspect considered by the Agriculture, Natural Resources and Environment Panel impinges on the life of each man, woman and child in these islands and within the wider European Union.

1.4 The ANRE Panel immediately recognised a problem of heterogeneity within its extensive remit. Our work covered many areas where there is a pressing need to develop strategic approaches because new technologies, opportunities, markets and constraints are

likely to emerge over the next 10 to 20 years. Vigorous attempts have been made to overcome this apparent obstacle and to identify those aspects where attention to overlaps and common interests would provide added value to the work of the Panel. This demanded the formation of four syndicateSub-Groups (Agriculture, Natural Resources, Environment and Marine Technology) to help focus our work on primary areas. Unexpectedly, distinct advantages have emerged from the interdisciplinary nature of the Panel - there were constructive interactions that address the prospects of wealth creation and improvements in the quality of life within ANRE.

1.5 This report reviews the many sectors in the Panel's scope as they are now and the forces for change, which are considerable in many cases (Chapter 3). The text then provides essential detail about how we addressed these forces - including a major consultation exercise, work on benchmarking and a review of available scenarios (in Chapters 4 and 5). These extensive activities formed the foundations of the Panel's review of opportunities, needs, strategic targets, barriers to progress and priority issues (Chapter 6) which led to our recommendations (Chapter 7). Before reporting our work, we feel it is important to provide some background information on wealth creation, quality of life and sustainability, in Chapter 2. Wealth creation and improved quality of life are the main objectives of the UK Technology Foresight Programme. They are closely linked to sustainable development (sustainability) because technological developments should be viewed in their socio-economic, political and environmental frameworks. Thus the Panel has reviewed wealth creation, quality of life and sustainability - these concepts were central to developing our recommendations from the extensive ranges of ideas, views and information that are presented in the later parts of this report.

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Progress Through Partnership: Preface

The Technology Foresight Programme is a major initiative which was announced in the 1993 White Paper 'Realising Our Potential'. The Programme brings together industry, academia and Government to consider how the UK can best take advantage of opportunities to promote wealth creation and enhance our quality of life. The Programme has been driven forward with great energy and enthusiasm by the 15 independent Technology Foresight panels. The Programme has reached out to over 10,000 people.



I believe that the current findings from the Technology Foresight Programme will prove invaluable. They will help businesses, academic institutions and policy makers to **Progress Through Partnership**. I know that, encouraged by the Office of Science and Technology, several other organisations are embarking on the Foresight approach. Only by bringing together science and business more effectively will we secure the economic performance necessary to maintain our competitiveness.

The Foresight panels have generated visions of the future which will lead to more informed decision-making in both the public and private sectors. I would like to thank them for their wholehearted devotion to this important mission. We now look forward to a busy and exciting period as the results of Foresight are drawn together and the Foresight process moves forward.

The Rt Hon David Hunt MBE, MP Cabinet Minister for Science and Chancellor of the Duchy of Lancaster



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Progress Through Partnership: 11 Agriculture, Natural Resources & Environment



FOREWORD

During the period May 1994 to February 1995 the Resources and Environment Sector Panel completed its foresight work in an international sector embracing a broad range of industries and topics that underpin the well being of the UK (e.g. agriculture; horticulture; biotechnology; animal and plant breeding; veterinary science; forestry; marine technologies; fossil fuel and mineral extraction; renewable energy sources; environmental protection, monitoring and management; and the water and waste industries).

Panel membership reflected the diverse remit, and included experts from the public sector, small and medium-sized enterprises, and multinationals. Consultation and appraisal consisted of analysis of the published literature, Panel and Sub-Group meetings, extensive Delphi exercises, regional workshops, Lectures, broadcasts, correspondence, and preparation of this report.

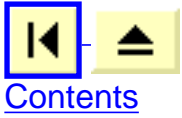
Special attention was given to assessing wealth creation, quality of life and sustainability as the basis for our priority issues, specific recommendations and practical steps to address markets, goals and opportunities crucial for the UK.

I am grateful for the co-operation of Panel members and those consulted, and for the efforts of Drs D. H. Watson and D. H. Brooks, in a high velocity, unique programme wholly dependent on goodwill and foresightedness, and designed to help shape future areas of science, engineering and technology.

PROFESSOR JOHN R HILLMAN, Chairman, UK Technology Foresight Panel on Agriculture, natural Resources and Environment

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2. DEVELOPING THE BASIS FOR REVIEW: WEALTH CREATION, QUALITY OF LIFE AND SUSTAINABLE DEVELOPMENT

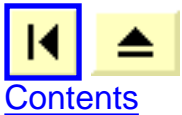
2.1 Wealth creation, quality of life and sustainable development are not mutually exclusive. As the major creators of wealth, agriculture and other industries can impact on the environment through resource depletion, emissions and waste. It is in the interests of industry to increase the efficiency with which it uses resources. Agriculture and other industries have a responsibility to improve the quality of the environment through new techniques and better design, new management practices, and improved energy efficiency. If we diminish the productivity of the four great eco systems on which our economies are still highly dependent - grasslands, arable croplands, forests and oceans - through over exploitation and pollution, we erode the foundations on which wealth is created. Science, engineering and technology have an important role in assisting industry to meet the challenges.

2.2 The purpose of **sustainable development** is to meet the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development does not mean the preservation of the environment at all costs. Nor does it imply that development must always have priority because of its importance for wealth and job creation. Much economic activity will have an impact on the environment. This will not necessarily be harmful - in some cases it will be beneficial. It is important to establish precisely what environmental impacts arise from the development of the economy, and what problems they cause.

2.3 Environmental pricing, valuation and accounting. There is much interest in developing and evaluating economic instruments as a means to ensure sustainable development. The principle of the landfill levy, announced in the 1994 Budget, is an example of an economic instrument for waste management. More detailed work on environmental pricing, valuation and accounting is necessary. The Government's Panel on Sustainable Development suggested in their January 1995 report that further work should relate to the following: depletion of non renewable resources, and finding replacements or substitutes for them; keeping renewable resources renewable; and protecting the capacity of natural systems to absorb pollution.

2.4 The above concepts are explored further in Annex A and references 2 to 8.





Progress Through Partnership: 11 Agriculture, Natural Resources & Environment



3. AGRICULTURE, NATURAL RESOURCES AND ENVIRONMENTAL MANAGEMENT: MAIN CHARACTERISTICS AND FORCES FOR CHANGE

3.1 Although the various components of the Panel's remit are considered separately in this Chapter, in life there is no clear distinction between them: environmental aspects in particular pervade all of the components and indeed the topics of all 15 Foresight Panels. Activities in the Panel's remit make an important contribution to the UK's prosperity and Quality of life. Although the industries in the remit of this Panel directly contribute about three per cent to the UK's GDP, in cash terms this is a huge sum - e.g. agriculture, forestry and fishing, including the effects of support and protection, contribute about £10 billion to GDP. However there is a debate about the adequacy of GDP/gross national 'income' indicators as measures of welfare, since they are limited to market-based activities and do not fully encompass depreciation of natural capital (including natural resource and environmental systems). Concern over environmental impacts of the increasing scale of economic activity, and support for the objective of sustainable economic development, have generated considerable interest (in both developed and developing economies) in environmentally adjusted indicators of macroeconomic performance.

Environmental aspects pervade the topics reviewed by all 15 Foresight Panels.

3.2 Exploitation of natural resources makes an essential contribution to UK industry and exports - for example to the construction industry, which contributes about three times the above percentage to GDP [9]. Reflecting its geographical position, the UK has a richness of natural resources from both land and sea. In the longterm, the wealth-creation process must be underpinned by the sustainable utilisation of natural resources and systems. Effective environmental management is a prerequisite in all of the areas in the Panel's remit, and many others of national importance. Management of the environment must be guided by economic, sustainability and precautionary criteria. Indeed the UK environmental equipment and services industry is making a major contribution to a growing global market currently valued in excess of 00 billion [10].

The UK has a richness of natural resources from both land and sea. UK industry is making a successful contribution to global markets in natural resources and the associated environmental equipment and services markets.

3.3 There are several foci for the considerable scientific, technological and social science research that is carried out in the UK on agriculture, natural resources and environment. Work is carried out and funding is provided by Government departments (including the Department of the Environment; the Ministry of Agriculture, Fisheries and Food; the Department of Trade and Industry; the Scottish Office; the Northern Ireland Office and the Welsh Office), Research Councils (BBSRC, ESRC, NERC and others), agencies, industry and others. The science, engineering and technology thus produced is sometimes taken up

quickly- for example, it has been submitted [11] that farmers, in general, are keen to grasp and take up new ideas and technologies quickly.

3.4 The supply and use of technology are crucial to the well being of each of the industries in the Panel's area of review. Although the industries draw on ideas and products from other sectors of industry, and from a broad range of fundamental scientific research, there is considerable innovation within UK agriculture, and the nation's natural resources and environmental industries. Indeed, various of these industries provide a strong core to much of the UK's scientific and commercial life. However, the industries making up this major sector of national activity have developed along divergent paths.

Agriculture and Horticulture

3.5 Agriculture, and horticulture, have always been beset by uncertainty because of fluctuations in weather, unpredictable behaviour of market prices, changing forms of governmental intervention, and the unexpected outbreak of diseases and pests during the changing seasons. Recent years have seen new pressures on farmers. These include policy itself (including support and environmentally related policies), the activities of environmentalist groups, consumers suspicious about the safety of food, animal welfare groups concerned over intensive methods of livestock production, developers who seek the release of land no longer required for agriculture, ramblers and motorists who press the claims of recreation, and those who begrudge subsidies and financial protection for farmers and landowners. Yet the UK agricultural industry and its main customers, the food processing and retail sectors, are among the most concentrated and production efficient in the world (11, 12). Agriculture and horticulture have excellent records in responding quickly to new opportunities afforded by breakthroughs in technology. This is due in most part to the skills of individual practitioners who are among the most knowledgeable of any industry in the UK.

The UK agricultural industry and its main customers, the food processing and retail sectors, are among the most concentrated and most production-efficient sectors in the world. Agriculture and horticulture have excellent records in their ability to respond quickly to new opportunities afforded by technology

3.6 The Agriculture Sector: what is happening to it? The demand for food security after the Second World War and the policies that were set in place thereafter resulted in a rise in productivity per hectare and per animal, with growth rates of about two or three per cent per annum (p.a.). Between 1946 and 1994, wheat yields grew at 2.3 per cent p.a. and milk yields by 1.8 per cent p.a. The productivity of all factors involved in production in the past two decades has grown on average by about 1.5 per cent. This came from an explosive mix of technological advances, diffusion of innovation, Government policies, farm support and investment. The result has been a reduction in producers' prices of up to about four to five per cent p.a., after correction for changes in the value of money. The implicit price of gross output, including support, deflated by the Retail Price Index, has fallen by an average of around 1.75 per cent p.a. since the War and 2.5 per cent since 1973. It is a point of contention whether yield productivity will continue to increase at two to three per cent p.a., or by a reduced rate, or in certain sectors by a higher rate.

3.7 Another distinctive feature has been the continuing tendency for farms to become larger and fewer, thereby reducing fixed costs in an attempt to compensate for any 'squeeze' on

farm incomes. For example, the number of specific-enterprise, cereal-grower holdings in the UK fell from 172,000 in 1967 to 75,500 in 1993; potato-grower holdings from 105,000 to 22,100; and dairy-herd holdings from 132,000 to 41,500 [13]. The rate of decrease has diminished in the last five years. The survival of small producers has also been threatened but they have by no means disappeared.

3.8 Of all the changes that have occurred in the agriculture sector the decline in the number of farm workers has been the most pronounced, primarily as a result of mechanisation. Together with yield improvements there has therefore been a significant improvement in the output per person employed and a commensurate improvement in the status of farm workers, though they still remain near the foot of the national wages ladder. By the year 2000 the total agricultural labour force is expected to be 15 per cent smaller than at present (622,000 in 1993 and 616,000 provisionally for 1994, compared with an average of 699,000 in 1982-84). Present and future diversification of farm activities, however, will make these figures more difficult to quantify. The number of people presently involved in the agriculturally-related industries is approximately 14 per cent of the population, with agriculture itself accounting for about 2.1 per cent of the workforce in recognised employment.

Of all the changes that have occurred in the agriculture sector the decline in the number of farm workers has been the most pronounced, primarily as a result of mechanisation.

3.9 Most farm land is still owned by private individuals or families. Owner occupation has been on the increase for the last 70 years at the expense of tenant farmers, but this has become an expensive affair for those with large loans to repay and a reduced farm income. However, the future pattern of land tenure shows little evidence of an immediate or drastic erosion and tenancy seems likely to continue. The total area of land in holdings declined by 1.5 per cent between 1981 and 1993, the tillage area declined by ten per cent (showing the effect of set-aside), and there were declines in the numbers of cattle and calves (11 per cent), pigs (0.9 per cent) and poultry (1.6 per cent). In contrast, the number of sheep and lambs increased by 37 per cent [13].

3.10 These statistics need to be viewed against population growth in the UK which is expected to be no more than about four per cent between now and 2015. Studies estimate that the demand for food at the farm gate will be virtually static per head of population but choices about what food to buy will be increasingly influenced by how it is produced, its safety, taste, nutritional properties, appearance and cost, the latter being the outstanding determinant of choice and purchase.

3.11 Four pressure points are worthy of special note:

- Many of the changes that can be observed currently are the result of the farmers' response to various pressures on their income. It is anticipated that in the timescale reviewed in this Foresight exercise, there will be reductions in price support for farmers.
- It is now generally accepted that for UK markets it no longer makes sense to retain as much land as possible in current methods and types of food production. This

raises questions about the rapid development of crops for industrial use, extensification and the provision of new areas for conservation, access, and development.

- International competition for internal and export markets will grow.
- The productivity gains have been to some extent offset by a set of negative environmental factors, including water pollution, habitat loss and degradation, and concern over pesticides residues and other chemical contaminants in the food chain.

3.12 Agriculture's role in wealth creation. Agriculture produces many goods, both food and non-food, which are sold in the market place. In principle, it should be possible to assess its wealth-creating potential in terms of whether society could achieve more, less or equal value using these resources differently. The target might be said to have been reached when the value of resource in any one use was equal to its value in all other potential uses. For this purpose it is essential to consider all markets for all sorts of resource. Thus, an assessment of world markets for all potential uses of these resources is essential.

3.13 Because policies exist, it is not possible to move directly from observed costs, and returns, to an assessment of agriculture's potential. In a perfect market, factor prices would indicate the value of land, labour and capital in all other uses, and product prices would reflect the worth society attached to the outcomes. There would be no reason to respond differently according to the source of the products, whether they were home-produced or imported. The Common Agricultural Policy (CAP) implies that, in the eyes of policy makers, markets cannot provide a satisfactory basis for assessing wealth-creating potential within the European Union. Essentially, the CAP raises the price of imported goods artificially in relation to those which are home-produced and raises the price of all agricultural products in relation to non-agricultural products.

3.14 To identify how far observed prices correspond to social values it is necessary to examine the basis of the policies involved. There exists, for example, a wide body of opinion which thinks that the socio-economic values embodied in the CAP are defective in terms of the level of production, impact on world trade, effects on research and development, consequences for the environment, and sustainability in the long-term. Policy makers will have to grapple with a 'sustainability balance', i.e. how best to reduce the trade-off between adequate financial returns to farmers, productivity increases, and minimising environmental impact.

3.15 If we take a narrower view, estimating what might maximise the benefit to 'UK plc', then it may be sensible to treat the CAP as a 'given'. One aspect of this Foresight exercise is to estimate in its assessments how changes in the CAP are likely to influence developments of new technologies and markets at various time horizons, in much the same way as estimates of future market scenarios are implicit in conventional analyses of priorities for investment in research and development, and in plant and equipment. Another aspect has been to consider the impact of probable future agricultural policy developments, including further reform of the CAP leading to less farmed land, lower prices for products, alternative uses for land (including industrial crops), more environment legislation, and different models of production.

