COMMISSION OF THE EUROPEAN COMMUNITIES

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BIOTECHNOLOGY IN THE COMMUNITY

STIMULATING AGRO-INDUSTRIAL DEVELOPMENT

(Discussion Paper of the Commission)

Com 221

CONTENTS

EXECUTIVE SUMMARY

"Biotechnology in the Community: stimulating agro-industrial development

1. The Community has for several years been seeking to promote the development of a competitive and profitable biotechnology industry in Europe. The research and training programme, the concertation activity, and the development of appropriate regulatory regimes for the protection of health and environment, all contribute to this aim.

2. A major advance for the Community's biotechnology industry is the recent Council Decision (25 March 1986) on new sugar and starch regimes, making these materials available at costs closer to those of the world market, thus reinforcing our industry's competitiveness.

3. The use of biotechnology aims to add value to agricultural products, and will maintain, and even accelerate, the growth of agricultural productivity. Given the current situation of agriculture, in Europe as elsewhere in the world, it is clear that progress in biotechnology must be directed mainly towards input and cost reduction in existing activities, and towards enabling new opportunities for the profitable use of agricultural products to be developed, while reducing environmental impacts. Diversification of production and the capture of new industrial markets through advances in plant and animal science or in the processing of agricultural outputs, are aims which will (at least in the medium to long term) both contribute to agricultural policy objectives, and strengthen the foundations of Europe's biotechnology industry.

4. This Discussion Paper announces the intention of the Commission to propose later this year, after further consultation, a substantial programme of pilot and related activities at the agro-industrial interface, as envisaged in the Commission's published guidelines for the Framework Programme of technology, research and development (1987-1991). An indicative list of examples of the types of project to be encouraged is included in section 7. Both in the general analysis and in the specific proposals, potential environmental implications (beneficial or adverse) are discussed.

5. Publicity for this announcement, and possibly a formal "call for expressions of interest", will help to stimulate debate on the ideas here presented, and the submission of specific suggestions for the detailed content of the future programme.

6. This Discussion Paper demonstrates the relationship of biotechnology to agro-industrial development. It supports and complements existing Community policies, e.g. as elaborated in the Green Paper and in COM(85) 750, "A future for European agriculture", and in COM(86)76, "New Directions in Environment Policy". The aim is to encourage innovations aimed at profitable and self-supporting longer-term developments, compatible with the protection of the environment.

1. INTRODUCTION

1.1 In parallel with the "Great Debate" on the future of European agriculture[1] there has been increasing debate about biotechnology: about the promotion, exploitation and management of the recent advances in our understanding and control of living materials and systems; and, at the same time, about the development of appropriate regulatory systems to protect man and the environment from unforeseen dangers. For these advances bring opportunities and threats, challenges pervasive across agriculture, science, technology, industry and environmental protection - challenges, in short, to secure the benefits of the wide-ranging new techniques while at the same time ensuring that any associated risks can be foreseen and contained.

1.2 This document seeks to complement the Green Paper[1] by focussing on the nature of the new opportunities at the interface of agriculture and industry, on how they are to be promoted and expanded in the medium and long terms, and on the actions therefore necessary today to this end, while ensuring the protection of the environment. It announces the intention of the Commission to prepare over the coming months a significant and relevant programme of agro-industrial pilot projects and related preparatory activities; through an extensive process of consultation and discussion with the various interests involved, inviting their suggestions and proposals for such projects, in line with the objectives and the considerations presented below.

Such an initiative should not be seen in isolation. The major principles and actions for the future evolution of the Community's agricultural policy have been outlined elsewhere[1]. Priorities for environmental protection policy have recently been announced[2]. The Community's current research programmes, particularly in agriculture, biotechnology, energy and environment, are well established, and proposals for their future development are included in the Commission's guidelines for the new Framework Programme, 1987-91[3]. This document

(i) is complementary to, and proposes to make use of, existing and proposed research programmes; including in particular the current and envisaged programmes in biotechnology, agricultural research, and food technology;

(ii) is complementary to existing agricultural policy and supportive of the evolution of the agricultural sector;

(iii) does not yet define comprehensively and in detail the particular agro-industrial projects and activities to be supported, but rather

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[1] "Perspectives of the CAP" (Green Paper) COM(85)333, July 1985, and leading up to the communication COM(85)750, "A future for European agriculture", December 1985.

[2] COM(86)76, "New Directions in Environment Policy".

[3] COM (86) 129, 17 March 1986, "The Scientific and Technological Community: Guidelines for a new Community Framework Programme of technology, research and development, 1987-1991".

(iv) focusses upon the creation of a supportive and encouraging framework, and suggests how biotechnology might help to open up new opportunities, with benefit simultaneously to the Community's agriculture and its bio-industries, while at the same time ensuring adequate protection of the environment.

1.3 Through the creation of a competitive market environment and through its other policies, the Community can promote more effective cooperation between Europe's agriculture, its industry and its science. New patterns are emerging, and Europe's farmers and scientists, technologists and industrialists, have the skills and the assets required to master them.

1.4 The most promising innovations will not typically be identified in the central Ministries and Commission offices ; but the public authorities, and in particular Community policies, can and must create a framework within which there is, on the one hand, incentive (which motivates farmer, technologist and industrialist to work together for objectives meeting the defined needs of the Community, and in particular the needs of the market) and, on the other hand, a responsive regulatory system (which can ensure an adequate degree of protection of man, animals and the environment without discouraging development).

2. THE WORLD CONTEXT

2.1 There is a continuing shift throughout the world towards higher productivity in all branches of agriculture. Food surpluses are emerging in many places, particularly in Western Europe and North America with their nearly static populations, but now including such countries as India and Indonesia, formerly, but no longer major food importers. World supply of grain per head has outpaced population growth (see Figure 1). The search for new outlets for agricultural production, and the need for agro-industrial development, are therefore by no means limited to Europe.

2.2. In global competitive terms, the United States occupies the world's most favoured position for leading an agro-industrial revolution. It combines an abundance of unused or under-used land, strengths in all the relevant industrial fields and underlying sciences, a coherent and relatively strict environmental policy (although their grain production has been at some cost to the environment) and a large home market. The 1984 OTA report[4] affirms this position and predicts that already by 1990 35 million tonnes of maize, equivalent to 21 million tonnes of starch, will be used in the US to produce chemicals. If this does happen substantial additional amounts of corn gluten products will be coproduced and add further to the pressure on world animal feed markets, which have already had to absorb the corn gluten products associated with US isoglucose production.

2.3 In contrast, Japan is short of land, must find raw material suppliers to complement its strong industrial and research capabilities if it is to compete effectively in the developing revolution, and has a smaller home market than Europe.

2.4 The Community has some big advantages in agro-industrial development. It has much more land than the Japanese, and the continued increase of productivity gradually allows more of this to be made available for new uses. It has a strong agricultural base, thanks to its agricultural

[4] Commercial Biotechnology: An International Analysis, Jan. 1984, Office of Technology Assessment, Library of Congress Catalog Card No. 84-601000 p.6

policy, which has made possible the achievement of the highest yields of grain per hectare of any in the world (see Figure 2); although excessive inputs of some agrochemicals and certain farming practices have led to environmental problems.

2.5 It has a powerful chemical industry, bigger than those of the United States and Japan, that is strongly innovative in the biological field, holding, for example, three quarters of the world market in industrial enzymes. It has a strong and innovative pharmaceutical industry.

These industrial strengths rest on an equally powerful and diverse pure and applied research base in the natural sciences that has produced many of the world's recent Nobel prize winners in these fields.

Europe is also the world's largest trading bloc, based on a large internal market.

2.6 We in Europe must therefore use and develop all our strengths if we are to play a leading role in agro-industrial development. We must find profitable ways to link agriculture to industry in order to avoid becoming dependent on the efforts of others for an increasing proportion of our biologically-based industrial products.

2.7 Moreover it needs to be borne in mind that, if Europe were to reduce significantly its dependence upon imports of agricultural raw materials, this would undoubtedly have serious impacts on agriculture and the economies (and, hence, possible land use and environmental developments) in developing countries. It is therefore necessary (in parallel with our own evolution towards the new agro-industrial phase of our own development) to continue and reinforce existing Community efforts to assist these countries to improve their agriculture and to secure environmentally sustainable rural development. Biotechnology may well be able to contribute substantially to these aims.

3. PRODUCTIVITY GROWTH: FROM PROBLEMS TO OPPORTUNITIES

3.1 The growth of productivity in agriculture is the result of many advances in farming practice, based on technological and biological progress. Biotechnology, based on recent and continuing breakthroughs in basic biological science, will maintain or even accelerate the increase of productivity. It might therefore appear inevitable that it will lead to ever greater problems.

3.2 However, such problems result not only from technology. By modifying the economic context, and by developing, exploring and demonstrating the potential of the new technologies, the problems may gradually be transformed into opportunities.

3.3 Thus the growth of productivity - to increase outputs, or perhaps more importantly, to reduce inputs - will be fully acceptable and indeed essential, so long as it is addressed to products for which there exist market opportunities, and generates environmental benefits. The policy framework must enable technological innovation gains to be managed for the benefit of the farmer and society.

3.4 The Community is still the largest importer in the world of agricultural and forest products. The Commission has already indicated, in the Green Paper, the need to encourage research for the development of new uses for agricultural products (particularly in non-food sectors) and alternative

production activities for products in which the Community is still in deficit. Biotechnology can also contribute to a greater differentiation of product qualities in all areas, in response to user requirements, particularly the demands of industry. Finally, it can help agriculture to take fuller account of the needs of environmental protection.

3.5. Each of these aspects - diversification of agricultural production, the needs of manufacturing industry, and environmental protection - is further discussed in sections 4 and 5 below.

4. IMPORTANT FIELDS FOR DEVELOPMENT: RAW MATERIALS FOR INDUSTRY, QUALITY IMPROVEMENT AND IMPORT SUBSTITUTION

4.1 In its Green Paper and the document "A future for European agriculture"[1], the Commission has already indicated the results of its preliminary reflections on new uses for agricultural products, alternative production activities and the needs of environmental protection in the course of agricultural practices. At the same time, it expressed its view on the opportunities and limitations regarding the realisation of new openings, given the evolution of agricultural revenue and public expenditures. It is clearly stated that the profitability of production, obtained primarily through reduction of costs and without further commitment of public funds for market support should be the principal objective to promote the competitiveness of agricultural and industrial products on both Community and external markets. It is appropriate to make maximum use of the possibilities offered by biotechnology for the realisation of these objectives. Europe, with its first-rate skills in the biological sciences and its powerful industry (food, animal feed, chemical, pharmaceutical, forest products....) has an outstanding opportunity to make use of an emerging domestic asset. But it will require a medium to long term effort, jointly conducted by science, industry and agriculture, environmentalists and consumers, to discover and to develop to full scale the potential new opportunities.

4.2 The scale of the potential opportunity in import substitution is theoretically vast: Europe imports over 20 m. tonnes p.a. of animal feed, over 4 m. tonnes p.a. of vegetable oils and fats, and 120 m. cubic metres p.a. of forest products. About 80 m. tonnes of oil equivalent are used annually as chemical feedstock - most of it imported. But the extent to which such opportunities for substitution might ultimately be realized will depend on the economic factors and constraints noted above, not to mention considerations of the Community's commercial policy.

4.3 In the food and feed industries much more attention to what can be sold on the market is already being given by farmers and manufacturers in response to increased consumer awareness and sophistication.

Further technical efforts will certainly be made to improve the quality of the crops used. Obvious objectives that could be more actively pursued with existing technology include progress towards the development of nutritionally superior plants, e.g. lupin, or varieties of barley and maize and many other species that are rich in essential amino acids, while still maintaining yield, particularly for use in animal feed.

New industrial processes will also be developed to add value to agricultural products, for example by converting them into new and better-balanced high-protein foods.

4.4 In forestry there is an apparent (but by no means easy) opportunity to reduce the Community's imports of wood, and products made from wood and wood fibre, which amount to about 50% of total use and cost well over 15,000 million ECU, by susbstituting domestic production. The Commission has recently stated its aims and intentions in this sector[5].

4.5 In the chemical industry there is a considerable technical potential to expand the use of agricultural feedstocks. Over the last decade the incentive to use agricultural crops for industrial purposes has increased as fossil hydrocarbons have become dearer relative to agricultural products. The recent collapse of the oil price does not alter the economic and strategic logic of reducing dependence on fossil resources, and replacing it by greater use of renewable materials. At the same time, our ability to respond to this incentive has begun to increase through improvements in plant breeding and industrial technology, which are making it possible to breed plants more suited for industry, and to make better industrial use of them.

4.6 New techniques in plant genetics now promise to increase still further the plant breeder's control of crop quality following rapid recent advances in R&D, particularly within the last two years ; and partly as a result of work carried out within the Commission's Biomolecular Engineering Programme (1982-1986).

A major effort is now being made, worldwide, with private and public finance, to develop plant breeding using the newly available methods. To facilitate the integration of these new methods with the traditional - and still essential - skills of the plant breeder, significant structural changes are taking place; creating new alliances to bring together seed companies and companies with strengths in molecular biology, basic science and biotechnology - e.g. manufacturers of herbicides, fertilisers, pharmaceuticals, energy products and processed foods.

4.7 The progressive achievement in agriculture of greater control over the quality of products and the corresponding tendency for product value to become more related to quality than to quantity precisely echoes a similar trend in industry, towards greater value per tonne of output, through "informatisation" and "dematerialisation" as described in reports by the Community's FAST programme[6].

4.8 Plant breeders are becoming more ambitious, although the traditional skills of classical breeding remain fully relevant. But the new sciences will powerfully amplify these. For example, genetic engineers are now targetting commodity oilseed crops such as soybean and rapeseed (colza), to produce high-value specialty oils, containing an abundance of C_{10}, C_{12} and C_{14} fatty acid residues instead of mainly C_{16} or greater. Such speciality oils, typically extracted from coconut and palm kernel, are almost exclusively imported from tropical areas. They are valued for the C_{12} and C_{14} residues needed for detergent manufacture and the C_{10} for plasticisers. If current efforts are successful the cost of oil used in the manufacture of detergents may be reduced by half, perhaps moving the balance of advantage decisively away from fossil hydrocarbons

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[5] COM (85) 792 final - 14.01.86. Forestry.

[6] Forecasting and Assessment in Science and Technology. The report on the first programme (1978-83) is available in English: "Eurofutures: the challenges of innovation", Butterworths, London, 1984, and in French: "Europe 1995: mutations technologiques & enjeux sociaux", Futuribles, Paris, 1983.

to commodity oilseeds as the favoured feedstock for detergent manufacture; for even in 1980 45% of the world's detergents were made from natural oils and fats (Table 1)[7]

Table 1: Natural oils and fats as a raw material for chemicals (percent)

Share in raw materials	1980	1990
Coatings	40	80
Detergents	45	70
Plasticisers	15	30
Adhesives	1	5
Agrochemicals	10	25
Thermoplastics	2	4
Lubricants	20	30

4.9 In principle many organic chemicals now derived from fossil hydrocarbons could be made from agricultural sources. The European Council of Chemical Manufacturers' Federation (CEFIC) recently indicated[8] that industrial use of oils and fats is of about 3,0 million tons to produce a wide range of products. A large part of the current EC production of oils and fats does not correspond to quality requirements because of their distributions of chain lengths, their degree of saturation, and functional properties. The Community has therefore an interest in developing a programme for oil-producing plants capable of being grown under climatic conditions existing within the Community.

There is also a need to develop in the long term research on plants more productive of sugars, and starches in molecular forms better corresponding to the requirements of the chemical industry (see paragraph 6.3)

4.10 The best opportunities for expansion exist for the manufacture of higher-priced products, the "specialty chemicals" to which the industry is already turning in the face of new competition in bulk chemicals from the Middle East and elsewhere. However, bulk products such as bio-ethanol or others should not be excluded from consideration, provided that developments offer a prospect of meeting the same economic criteria and constraints as are indicated in 4.1, and which apply to all the developments discussed in this document.

4.11 In all these areas, the developments needed will also stimulate technological capabilities of relevance to the Community's competitive strength in world markets, for agricultural and industrial goods and services. The aim of the initiatives proposed in this document is to stimulate these developments, and the exploitation of the opportunities discussed above.

[7] Table 1 is taken from: "Chemistry and Biology - an interface in oils", by Thomas Thomas of Unilever, Chemistry and Industry pp 484-489 (1982).

[8] "Use of Agricultural Raw Materials in the European Chemical Industry", CEFIC, March 1985

4.12 To gain the maximum value from these trends a closer partnership between agriculture, industry and science is needed. Crops must be designed for market needs ; chosen and developed with a view to product quality, and taking account of the land and the climatic zones most suited to them and of environmental factors. Agriculture and industrial practice will both be helped to improve their production techniques.

5. ENVIRONMENTAL ASPECTS

5.1 The central feature of Community environmental policy, as restated in the Commission's recent Communication to the Council, "New Directions in Environmental Policy"[2], is the preventive approach to potential environmental problems - an approach which, by prior assessment and action, seeks to avoid adverse impacts arising. The European Council has stressed that environmental protection policy can contribute to improved economic growth and job creation, and has affirmed its intention to give it the dimension of an essential component of the economic, industrial, agricultural and social policies implemented by the Community and by its Member States.

Against this background it is essential that, especially in relation to a new development such as that discussed in this Discussion Paper, measures to ensure the protection of the environment must be fully integrated in the action foreseen, from the outset.

5.2 It is already clear that biotechnology, applied in the field of agriculture, has the potential for both adverse and beneficial consequences for the environment. Both agriculture and the environment can benefit from solutions offered to problems which at present are intractable; e.g. new uses for wastes or by-products; more efficient use of fertilisers and improved possibilities to fix atmospheric nitrogen; the development of pest-resistant crops and animals; and the continued development of low-volume, non-persistent, biodegradable pesticides (such as the synthetic pyrethrins). The resultant opening up of new markets and enterprises through biotechnology should be such as to provide an economic incentive to the farmer to maintain and enhance the rural fabric.

It is too soon to judge the potential effects on patterns of land-use of the agro-industrial developments discussed in this Discussion Paper but, if they led to a wider and more diversified agriculture (which is conceivable), that too could be environmentally beneficial.

5.3 On the other hand, other major impacts, of direct relevance to environmental policy, are that there could be

1) changes in farm structure and employment;

2) increased pressure for industries to buy and operate farmlands for the production of specialized raw materials for their industrial operations (with associated questions of soil quality and erosion);

3) a possible tendency in some regions towards monocultures centered on industrial needs, that is, large areas of single-crop production, no fallow lands, and ensuing implications for the use of agricultural chemicals;

4) unforeseen consequences:

- those linked to the deliberate or accidental release of modified organisms into the environment, (for the assessment of which the Community's new research action programme in biotechnology (1985-89) contains a number of relevant projects);

- water and air pollution dangers and waste management requirements;

- impacts on wildlife, habitats and ecological diversity.

5.4 It is important that the investigation and evaluation of these potential environmental impacts should be vigorously pursued, so that appropriate policies to protect the environment can be developed and implemented.

6. BIOTECHNOLOGY AND AGRO-INDUSTRIAL DEVELOPMENT IN EUROPE

6.1. The Community actions outlined in the Commission's 1983 Communication[9] to the Council, on "Biotechnology in the Community", contain elements supportive of the action proposed. The elements of this plan are as follows:

- research and training
- concertation
- access to raw materials of agricultural origin
- regulatory regimes
- intellectual property rights in biotechnology
- demonstration projects.

6.2 Significant action is already being undertaken on the first five of these. In research and training and in concertation, a Biotechnology Research Action Programme has been established for the period 1985-89, with an initial budget of 55 million ECU. A significant proportion of its research elements are relevant to the agro-food sector, while its concertation action is helping promote the broad interdirectorate and international collaboration needed to bring about agro-industrial development.

At the time this programme was decided upon, Council stated that it would be reviewed during 1986; and the Commission will shortly be proposing an increase in its resources, in line with the new Framework Programme. For although this present document concerns demonstration projects, it must not be forgotten that in this knowledge-based, multi-disciplinary technology with such widespread applications, the strength of our research and training activities and the effectiveness of our concertation, both at Community level and with our Member States, are fundamental to our competitive strength. An increased programme will be justified both in terms of the proven successes of our Biomolecular Engineering Programme, and in terms of the growing future needs, e.g. for concertation, contextual measures and infrastructure in all their aspects - including data-banks, information systems and associated developments, where the scale of need is just coming into focus.

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[9] COM (83) 672/2 and ANNEX, 4 October 1983.

6.3 The Commission has proposed[10] new regimes for sugar and starch that would make these raw materials of agricultural origin available for non-food industrial use in the Community at prices closer to those enjoyed by the industry's main competitors. These changes are essential to make investment within the Community attractive in those industrial projects of most interest to agriculture, namely projects that demand large inputs of starch and sugar. It was therefore a major step forward for European biotechnology, and for Europe's agriculture and industry, when the Council on 25 March 1986 adopted new regimes.

6.4 The Commission services are developing a common approach to regulatory regimes for biotechnology which will both enable agro-industrial development to be based on the whole Community market, and at the same time ensure adequate protection of man, animals and the environment. It is intended that proposals for a regulatory framework will be brought forward shortly; and that initiatives should be taken to promote harmonisation at the international level as well.

The regulations and procedures to be developed will relate to the use of organisms, to processes, normal discharges and wastes, and to accidents.

With regard to intellectual property, biotechnology now raises more pressingly the question of the patentability of higher organisms and, as far as new plant varieties are concerned, overlap with other forms of protection, notably plant breeders rights. Important policy issues are involved and are being examined by the Commission.

6.5 Only in the case of demonstration projects (or rather, mainly pilot and exploratory activities, at this stage), the sixth element of the Commission's biotechnology plan, has substantial action been delayed. The Commission now intends to prepare proposals for their implementation.

7. THE NEED FOR PILOT PROJECTS, AND RELATED PREPARATORY ACTIVITIES, TO SHOW THE WAY FOR AGRO-INDUSTRIAL DEVELOPMENT

7.1 Several factors now make it appropriate to resume consideration of pilot projects, and for related preparatory activities, in biotechnology. Amongst these factors may be cited:

- the need to demonstrate new possibilities and new directions for the evolution of european agriculture ;

- the recognition by investors and industrialists of the long time-scales and the uncertainties associated with some types of biotechnological innovations;

- the need, declared by the European Council, to give environmental protection policy the dimension of an essential component of the economic, industrial, agricultural and social policies implemented by the Community and by its Member States;

- the need to provide a basis for accurate economic assessment of investment options;

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[10] COM (85) 433 final,
COM (85) 344 final.

- the need to demonstrate that, provided that due account is taken of the above factors, a "New deal" for European biotechnology is possible, as a result of the progress of research and the initiatives being launched by the Community to improve the contextual conditions.

7.2 The word "pilot" is used for convenience: the projects are foreseen as a direct follow-up of research results already achieved, and now ready or nearly so (subject to suitable health and environmental precautions being taken) for testing or confirming in realistic agricultural and industrial conditions. The activities envisaged may include:

- strictly "demonstration" projects which (in the well-established usage of the Community's existing programme of energy demonstration projects) follow successful R&D (including pilot plants), and immediately precede commercialization; responding to specific needs such as testing at industrial scale, and assessing the prospects for economic viability;

- trial projects for testing and improvement of results prior to general application. Hence these projects could also be of a "feasibility testing" or "exploratory" character.

Preparatory actions must include appropriate prior assessment of the potential environmental impacts of such projects, including cost-benefit analysis procedures which take account also of environmental damage costs.

7.3 The following are <u>examples</u> of areas in which the projects could be encouraged:

. greenhouse and field trials of candidate crops at the research stage, particularly of crops developed in whole or in part by novel techniques of gene transfer and through somaclonal variation, and of plants with new properties conferred by new associations with mycorrhizae, or plants developed for low input requirements, in order to test their suitability for larger scale trials or industrial processing;

. trial at farm level of such candidate crops, that have already shown promise in trial plots, to test agronomic performance, pest resistance, suitability for industrial processing, etc. under different practical and least cost conditions;

. resource surveys of land quality in the Community by climatic zone to assess its suitability for alternative crops (developing and using the new soil map produced by the agricultural research programme, and the FAST Studies of the long-term use of renewable natural resource systems, "SYRENA");

. studies to ascertain the scope for the application of information technology to all aspects of farming, including (but not limited to) the improvement of profitability;

. trials of whole-crop harvesting, fractionation and refinery systems at farm and district level to develop methods for recovering all the botanical elements of crops and of agricultural wastes and converting them into forms suitable for downstream use, for example the recovery of low-grade wood and other cellulosic fractions and their pretreatment to render them suitable for hydrolysis;

. trials of new systems capable of using agricultural products and wastes throughout the year, for example multi-purpose fermentation and downstream processing systems that can operate on a variety of feedstocks, and produce a variety of products;

. trials of new biotechnology-based processes for adding value to agricultural products, especially those botanical elements that are currently discarded;

. trials of new biotechnology-based processes for adding value to animal products, e.g. to improve via new genetics or nutritional innovations, the performance of pigs; enzymatic modification of milk proteins to obtain new functional properties; and a wide range of other possibilities across the whole of animal rearing and animal products;

. pilot projects which have as their objective the adaptation of food processing technology through new biotechnology-based processes to use indigenous rather than imported raw materials;

. assessment of new processes based on biotechnology for the production of alternative chemicals based on carbohydrate rather than fossil hydrocarbon resources and of their potential risks for the environment;

. trials of biotechnological processes using natural lipids as raw materials to manufacture non-food products;

. the development of generic methodologies to assess the effects on the environment of projects or programmes (in accordance with the lines indicated by Directive 85/337) and concerning in particular the possible consequences of the use or, a fortiori, deliberate release in the environment of genetically modified organisms.

7.4 Of particular interest might be

- projects of special relevance to the problems and possibilities of Mediterranean agriculture, or of regions with specific disadvantages to which biotechnology might offer a contribution:

- projects indicating how less familiar crops, of potential relevance to the objectives and requirements indicated in the earlier sections, could be brought towards economic viability (e.g. flax, bitter lupin, cuphea, jojoba, guayule, medicinal plants, and many others).

7.5 The projects should typically combine the use of biotechnology and other advanced technologies, usually in conjunction with traditional skills and techniques, to produce products under acceptable economic conditions with a contribution to the objectives of cost reduction, diversification, marketing and quality, new outlets, and environmental concerns. The projects must have a sound scientific basis, and must be economic, taking full account of environmental requirements.

The Community contribution will be only partial, and will be an incentive to overcome threshold costs. Calls for proposals will be related to clearly defined themes with criteria for assessment.

8. CONCLUSION

The ultimate aim is to establish a long-term programme of biotechnology-related pilot projects to stimulate agro-industrial development, following up the declaration made previously by the Commission in its Communication to Council on the implementation of its memorandum[11] "Towards a European Technological Community", and in accordance with the needs outlined in the Green Paper and subsequent agricultural papers.

It is therefore the intention of the Commission to complete an already-started process of extensive consultation, in order to define in depth: needs, targets, risks and scale of finance and assessment criteria for future pilot, trial and demonstration actions. The content of the intended programme is coherent with the guidelines published by the Commission regarding the future Framework Programme (1987-1991); which include for Biotechnology and Agro-Industrial technologies an estimate of 350-460m. ECU.

These ideas will be further developed through meetings with interested bodies, including scientific, agricultural, industrial and environmental bodies at European level, and in the Member States. The Commission will also consider the publication in the Official Journal of a "call for expressions of interest", which, while not binding on the respondents, will aid in the preparation of the programme proposal.

All industrial and other enterprises able to use animal, plant and forest products or wastes for transformation into food and non-food products, and firms specialising in the application of biotechnology to agricultural and industrial production techniques (e.g. for providing substitutes for the use of chemicals, or for making use of certain wastes) will be invited to make known their future needs and their ideas.

The programme will be designed to reinforce Community policies in this area, building upon the existing policy for agriculture and activities in biotechnology, taking full account of Community environmental policy, and taking full advantage of the progressive development of a common internal market.

In the preparation of options for this programme, the Commission will also seek to assess the likely impact of the selected actions upon the inter-regional balance of agricultural and of industrial activities in the Community.

The Commission intends to present, before the end of the year, a proposal for decision on a programme to implement the ideas presented in this Discussion Paper.

The Council and Parliament are invited at this stage to offer their reactions to the ideas presented in this Discussion Paper.

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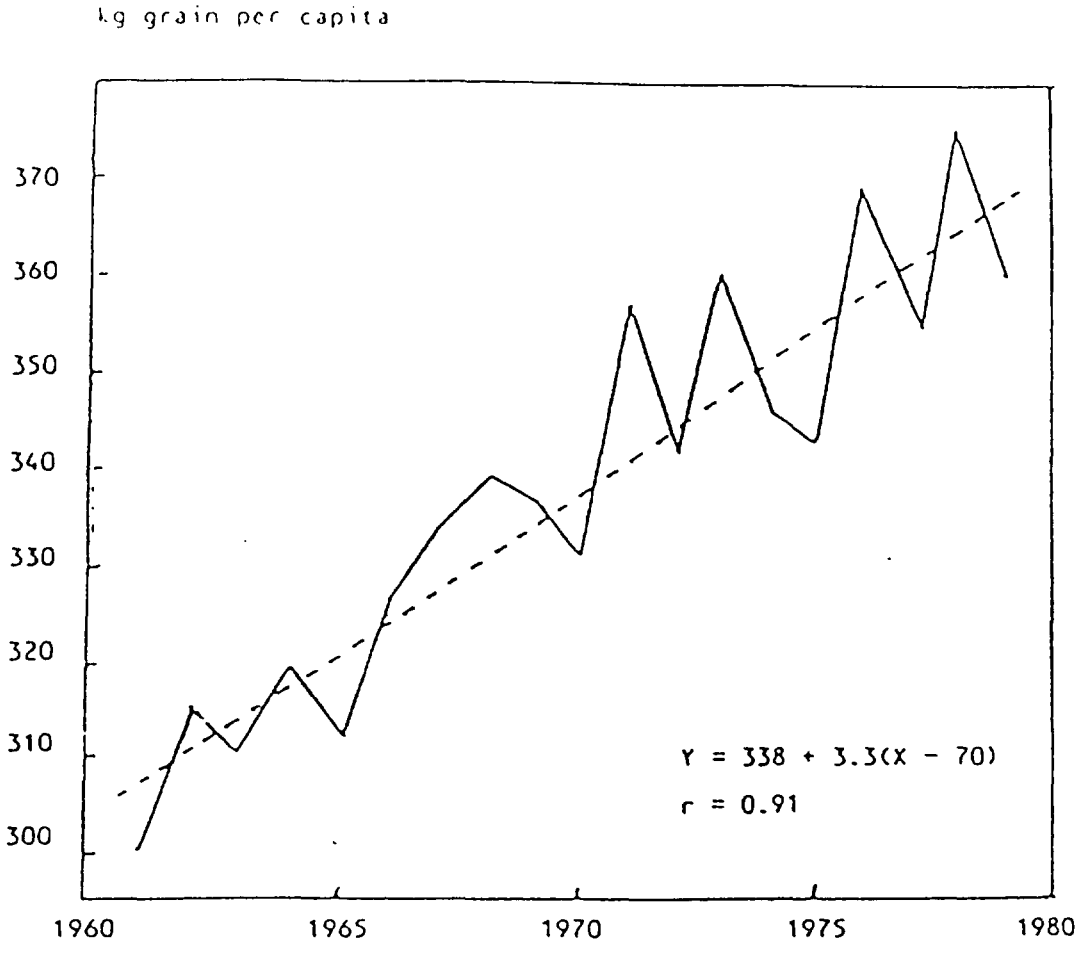
[11] COM(85)530, September 1985, "Implementation of the Commission's Memorandum "Towards a European Technological Community"

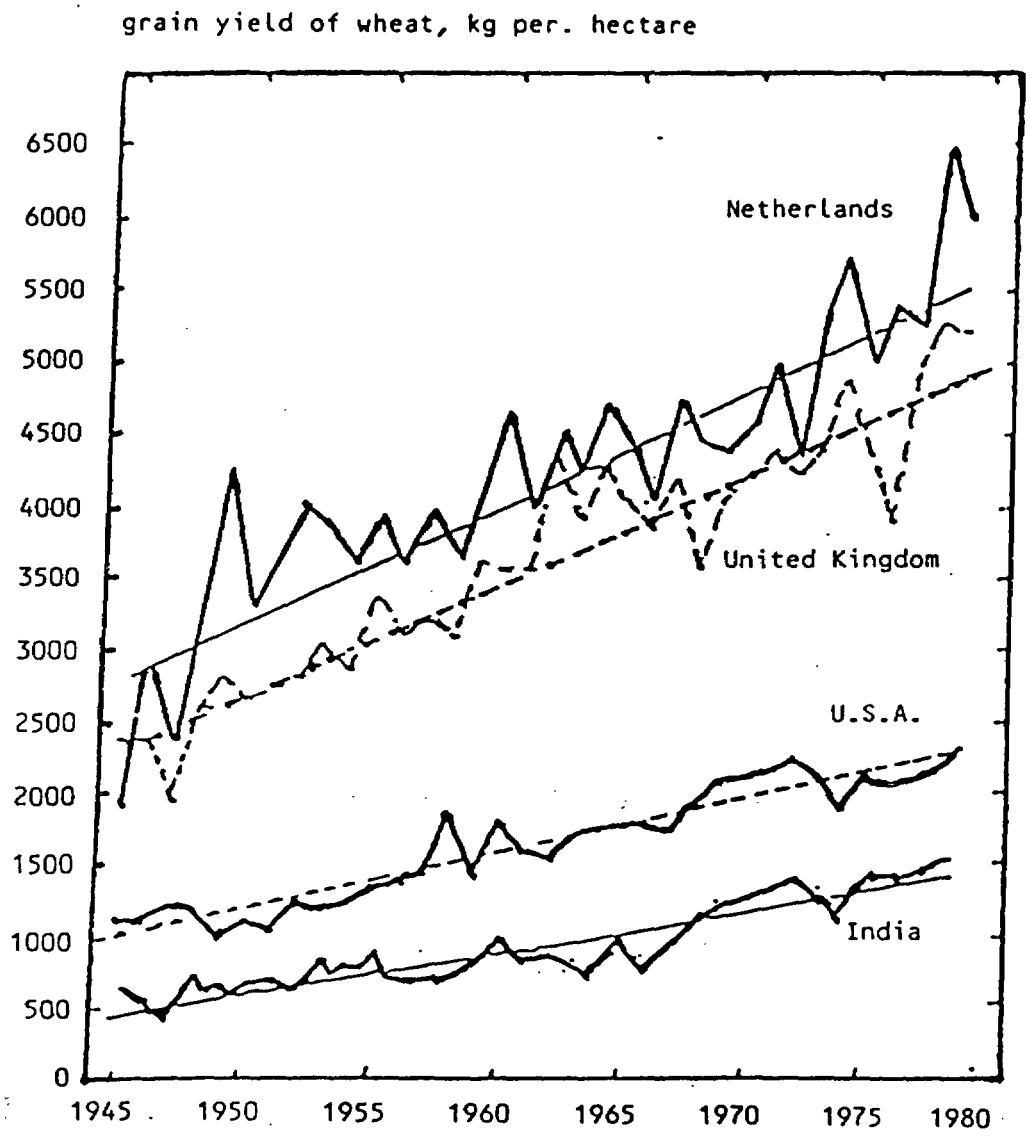
FIG 1



AVERAGE SUPPLY OF CEREAL GRAIN IN KILOGRAM PER WORLD INHABITANT OVER THE PERIOD 1961-79.

Source: Mac Key, 1981. Cereal Production. Proc. Conf. "Cereals A Renewable Resource - Theory and Practice", Copenhagen, Denmark (Eds. Y. Pomeranz and L. Munck) The American Association of Cereal Chemists, St. Paul, Minn., USA, pp. 5-24

FIG. 2



INCREASE IN GRAIN YIELD OF WHEAT IN SELECTED COUNTRIES

Source: Mac Key, op. cit. (see Fig. 1)