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Changes in the Agricultural Sectors of OECD Member Countries Relevant to Higher Education in Agriculture

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"The word 'change' has been over-used and abused. We tend therefore to overlook its meaning and implications and we rarely take the trouble to project into the future the consequences in the field of learning. This is due first of all to our learning systems which are geared towards maintenance and pattern reproduction and are not at ease with dynamic processes"(2)

Mahdi Elmandjra conti-nues to point out that what is new about change is its rapid rate which has greatly reduced the time allowed for adaptation to quantitative as well as to qualitative changes.

The task of Higher Education in Agriculture (HEA) was in the past essentially linked to the dissemination of knowledge required for sufficient production and supply of food for a growing population - a task which it accomplished in the OECD area with much success indeed. However, with a rapidly increasing integration and diversification of agricultural activities, the role and scope of HEA has been broadening considerably to serve what is generally understood today by the term "agro-food sector".

Over the past few years additional important socio-economic, technological and political changes have been evolving representing a new challenge and calling for further adaptation of HEA in most OECD member countries. Although the OECD represents a group of countries which have many common denominators, there can be no doubt about each country's particularity due to natural conditions, historical background, etc. Comparable developments may therefore have reached different stages in each single country and also show some national particularities but three major sectors can be singled out in which dynamic changes took place and are still going on in all OECD member countries creating new conditions highly relevant to the HEA systems. These new conditions are characterized by the following:

- new economic and market situations;

- changes in society, values, and in the rural countryside; and,

- rapid scientific progress and the emergence of new technologies.

More recent developments in these three areas are having not only a major impact on the programme content of HEA but also on its objectives and structures and will require new methods of delivery and closer cooperation within and without the agricultural discipline.

I - New economic and market situations

At the beginning of the present decade, the first signs of oversupply of some agricultural commodities occurred in some countries. Since then their development has escalated in the OECD area to include today all major agricultural commodities on principal world markets and there is no reason to expect any change in the near future. On the contrary, the competition for market outlets at almost any price has led to serious tensions between nations and there is a danger that resulting protectionist measures might spill over from agricultural commodity markets to global world trade. The current market disequilibrium is basically due to the fact that the agricultural sectors of OECD countries have not sufficiently adjusted to stagnating effective market demand and continuing technological progress (3).

While both public opinion and policy-makers have now recognised the seriousness of the problem and the urgent need to provide solutions, for example, through reduction of support measures, HEA will have to contribute its share to a better adaptation of production to market demand. The analysis of markets and the changes being transmitted there must be made carefully, taking into account the forces that have shaped the decisions reflected by the market. The conditions which are expressed by prices need to be carefully transmitted to producers so that they can look for alternatives and make appropriate decisions regarding their long-term futures. More and more the complexity of markets coupled with policy factors, productivity factors and macro-economic factors is leading to a systems approach in decision- making, a technique which HEA in particular will have to transmit to potential users as an adequate tool for problem solving and decision making.

This requires an inter-disciplinary approach as various factors have to be considered ranging from crop selection and rotation to new technology adoption, financial structuring, debt and/or financial management, market and contractual arrangements, risk management and appropriate crop and/or commodity systems management techniques. Incorporated in such systems is the managerial capacity of an enterprise which is the ability to analyse various factors, place them in perspective and make appropriate decisions. The goal is to remain as effective and low cost as possible in order to be competitive. To provide knowledge in these fields for a growing number of users will increasingly become a task for institutions of HEA.

Marketing represents a specific challenge to HEA having in the past not always received the appropriate attention. The importance of this sector is underlined by the fact that in advanced industrialised countries, marketing, processing and transport costs account for roughly two-thirds of the total cost to the consumer of food and fibre. Yet HEA has so far been much more centred around questions related to production. Programmes will therefore need to be widened to include more information on the efficiency and productivity of marketing of agricultural products, including subjects like alternative market outlets, cooperatives and forecasting. In view of the surplus production in all major crop and livestock branches, specific attention needs to be given to alternative production such as plant species for the chemical, aromatic and pharmaceutical industry and the use of biomass, or in the livestock sector to fish and fur farming, to list only a few examples.

II - Changes in society, values and the rural countryside

Most futurists agree that changing patterns in values and attitudes might be the most important single factor for the direction in which our world is going to develop. We might, for example, be facing not so much the problem of mastering new technologies but a future that could be value-biased.

2.1. Changing attitudes of society towards agriculture - the new priorities

Dramatic changes in agricultural production techniques and productivity over the past few years have led to a marked change in public perceptions of agricultural activities and have given rise to a number of concerns. Questions are particularly being raised about the logic of continued pressure on the environment to produce agricultural surpluses. This is being seen as one of the most paradoxical phenomena of present day agriculture in the OECD area. But consumers are also becoming increasingly discerning about the quality of food and particularly its effect on health. Animal welfare has also become an issue discussed by the public resulting in important changes of legislation in most OECD countries and establishing minimum conditions for keeping animals. HEA will no doubt have to give greater consideration to such shifts in the relative value given by society to different aspects of life and particularly to the restrictions that a growing public consciousness about the environment and ethical issues at large are imposing on agricultural production.

Within a few years, for example, nitrate pollution of ground water resources and the eutrophication of surface waters became one of the major environmental problems related to agriculture (4). In many OECD countries new legislation is already limiting the use of nitrogenous fertilizers and the European Community, for example, has set a limit of 50 mg of nitrate per litre of drinking water, a limit which is already surpassed in various European regions and hence will require action. Instead of subsidising fertilizers and pesticides as in the past, some countries started to introduce taxes on nitrogen fertilizers and certain pesticides. In other countries, restrictions through nitrogen fertilizer quotas are being discussed. The current political discussion in the United States over the $20 billion Clean Water Bill is demonstrating the dimension of the problem.

Under the circumstances, HEA is being called upon to contribute to the resolution of the inherent problems. Adequate information needs to be enhanced on more effective fertilizing techniques, continuous and more effective crop cycles capable of making the best possible use of available soil nitrate throughout the year, and preventing the leaching of nitrate into the sub-soil. Propagation of more efficient plant varieties capable of providing high yields with less intensive fertilization, integrated pest management systems, as well as the dissemination of more information on less intensive and more traditional agricultural practices, including elements of organic farming, would seem appropriate reactions of HEA in response to the new requirements.

Such concepts would aim at optimising rather than maximising agricultural production. The optimum being defined as the best use of all resources in a sustainable production system within biological and economic constraints that would permit the indefinite maintenance of the integrity of the production base and the ecosystem at large, recognising that applied ecology is nothing less than long-term economics. In livestock production, it is not only animal welfare considerations which are going to have implications for livestock production but also an increasing consciousness about healthy eating habits. The output potential of livestock has been greatly enhanced in recent years through the use of various veterinary medicines and feed additives such as antibiotics, hormones, various trace elements, etc. Traces of these additives, however, were found in animal products for human consumption and attention was drawn to the potential dangers for consumers. Many OECD countries have therefore already banned the use of such

additives while others are at present considering certain restrictions on their use.

In view of these developments, it would seem to be a mistake if institutions of HEA do not integrate into their programmes what could be summarized under the term "ethical issues". These issues are already having an important impact on the formulation of agricultural policies, on agricultural production and food consumption and their influence is growing constantly.

2.2. Changes in the rural countryside

Important changes in the rural countryside have a strong impact on economic and social living conditions. Not only have rural areas been depopulated, but those remaining in these areas have become less and less agricultural in the original sense. Because of limited employment opportunities in urban centres and industry, on the one hand, and deteriorating incomes from agriculture on the other, efforts are being made to create new jobs in rural areas with the aim of offering people engaged in agricultural production additional income possibilities and of retaining existing or attracting new non-agricultural people in order to justify the maintenance of adequate infrastructures and social services.

This entails an increasing horizontal and vertical integration and a diversification of agricultural production systems. For example, the processing of agricultural raw materials into higher value-added products and the direct sale of food products to the consumer is being explored on a broader scale including the marketing aspects. Farm tourism has been developing fast in certain regions and has become a regular source of additional income. Other new activities in rural areas are linked to forestry and/or the conservation of the natural environment, including such issues as the maintenance of the beauty of the landscape and the value of the countryside for recreational purposes or even for the foundation of national parks. It is worth mentioning here that agriculture should not be seen only as a polluter of the environment as it is recognised that a number of environmental benefits are directly associated with agricultural practices.

The diversification of activities in rural areas, some of which were mentioned above, undoubtedly increased the competition for land for different uses, and the active rural population is no longer necessarily engaged in production agriculture.

HEA will need to address the emerging new structures of rural areas relating to: (1) a social and economic interdependence between local, national and international communities; (2) the interrelationships between agricultural and non-agricultural sectors of the rural economy; and (3) the new forms of competition and conflict governing the use of land and water resources. New and additional qualifications are required for the planning and implementation of integrated rural development strategies calling for skills and knowledge in various sectors such as, for example, institution building and organisational forms, land-use planning and land-use economics; rural sociology; and communal planning at large with its wide-ranging aspects. This implies a considerable widening of scope for HEA and will require, in a time of budgetary constraints, close cooperation with other disciplines and faculties.

III - Scientific progress and the evolution of new technologies

Agriculture and its institutions of higher education have been adapting to scientific progress since the beginning of modern sciences. In the past, however, such progress had been developing comparatively slowly and to a large extent in the form of gradual refinements of technologies already known over a longer period. HEA institutions had therefore sufficient time to incorporate in their programmes new research findings and to transmit and disseminate them for practical application. What has changed and is new today is not only the speed but also the dimension of scientific developments, brought about mainly by biotechnology and micro-

electronic information and communication systems. Developments in these two sectors must be seen as a big leap forward in scientific evolution calling for more flexibility and imposing shorter adaptation periods on HEA.

3.1. Biotechnology

It was in the 1950s that the structure of DNA was discovered - a milestone on the road towards biotechnology. It took another 20 years to make DNA recombination possible. Since then, and since gene-splicing techniques have been discovered, development in biotechnology has gained considerable momentum opening up vast opportunities through the combination of genes of distantly related or even unrelated plants, microbes and animals. The possibility of manipulating genetic material is irreversibly changing the landscape of agricultural development. Genetic engineering in plants has already produced a number of notable successes through the acceleration of breeding programmes, the selection of desirable mutants and the production of new hybrids. Tissue culture techniques will facilitate international gene banks by making it easier to store and to manipulate plants in the form of single cells which can be regenerated into plants. Numerous other opportunities of biotechnology are emerging, e.g., the use of soil micro-organisms to reduce present-day dependence on agro-chemicals.

Equally, animal husbandry vaccines, antibiotics and reproduction technologies created through biotechnology and genetic engineering are already revolutionizing livestock production. Disease diagnosis using genetically engineered monoclonal antibodies and disease prevention through the use of stable effective animal vaccines produced by recombinant-DNA technology are major factors in improving animal health. Advanced technologies of test tube breeding, sexing, cloning and embryo-engineering are becoming common practices in animal husbandry.

Biotechnological advances are also having a strong impact on food sciences. New food processing methods are being introduced based on biotechnology ensuring safety and nutritive value of the food produced and protecting processed-food from deterioration.

3.2. Electronic information and communication systems

Agriculture has moved into an age of increased value of information in decision-making and substitution of information for traditional agricultural inputs. More complete and precise information increases the efficient use of production inputs and the awareness of economic and financial implications of input usage. Computers are increasingly being recognised as the tool that facilitates the processing of data into useful information for decision makers and for problem-solving analysis. To fully realise the potential of computers in the agro-food sector requires appropriate hardware and software.

Most important, however, is the education of users on how to efficiently use the computers as a management tool. There is perhaps no other technology that offers greater potential to facilitate the transition of agriculture to a more business management orientation than the computer with appropriate software and people adequately trained in its use. HEA must therefore increasingly seek to equip students with knowledge and understanding so as to evaluate and apply this new technology. The rate of development of micro-processor applications in agriculture is increasing rapidly and commercial organisations are already marketing a wide range of equipment based on this technology.

But computers can also be used as an aid to learning and teaching. Development in audio-visual aids and micro-computers is opening up new opportunities for HEA teaching methods, and educational program delivery. The scope for teaching through video films and micro-computers is expanding rapidly and there is a clear trend towards a greater emphasis on self-paced learning. The role of the teacher is thus shifting from lecturing to managing learning processes whilst students will gradually adopt the possibilities of studying on individual home-computers connected to a videotex system.

IV - Conclusions

The implication for HEA of the developments outlined in this paper may not yet be completely clear in detail, but it must be recognized that there are a number of important considerations to be kept in mind when reviewing HEA's agenda. First of all, there is a need for clear specification or re-specification of teaching and learning objectives relating to the political, social and economic environment at local, national and international levels. Secondly, programme contents must be reconsidered. While basic training programmes need to be maintained, new contents have to be added in response to the on-going socio-economic and scientific developments and the interactions that occur between agricultural production and related fields notably in food and bio-technology. A particular challenge to HEA is resulting from the fact that the required adjustments have to be made under severe budgetary constraints characteristic of all OECD member countries. It is therefore imperative to find solutions under which available resources could be used more efficiently.

Increased specialisation has in the past led to small institutional entities and hence expensive forms of professional training. Experiences from a number of countries indicate, however, that under the given circumstances an interdisciplinary approach seems to offer the best method in response to the broadening number of interacting subjects which HEA is facing today. Some countries have gained positive experience in concentrating interrelated faculties such as agriculture, veterinary science, forestry, horticulture and food science, while others report a successful complete amalgamation of related faculties. As a consequence of such concentration processes, there is a clear trend towards integration of related courses which, in addition to economic considerations, is also motivated by potential educational advantages, allowing students to acquire a more comprehensive view of their subject and a better appreciation of the social and professional roles. Such integration is not only aimed at within the agricultural and related faculties but also across faculties particularly in the field of advanced technologies. The scope and complexity, for example, of biotechnology and the accelerated rate of developments in this field are practically dictating national and international co-operation as no individual institution or even country can master all facets of this high technology.

In order to use available resources more efficiently there is a trend in the OECD region to concentrate specialized courses at some universities which develop into so-called centres of excellence on specific subjects. Some countries have also gained positive experience from closer cooperation between HEA, research institutions and private-based commercial research. The rapid changes in the agro-food system are enhancing the trend towards further specialisation. As a result, students sometimes experience difficulty in putting together the information which they obtain in different specialised courses. It is therefore increasingly necessary that HEA offers at one stage, perhaps at the introductory level, synoptic or integrated courses in agriculture so that young graduates may achieve a complete overview of the increasingly diverse and complex problems of the agro-food systems and rural areas.

In order to be more efficient, teaching methods for higher graduate students specialising in particular subjects have to be adjusted to the specific needs of this stage of training using, for example, case studies, the project method or learning by research. On the other hand, more basic courses containing fundamental scientific knowledge can be equally well communicated by programmed computer instruction enabling the student to learn at home and using the same basic instruction programme which is applicable to various disciplines and includes the possibility for self-evaluation. The international exchange of such programmed courses can further enhance the cost-effectiveness and some universities have already gained positive experience in exchanging programmes across national borders.

The rapid changes taking place in various sectors of the agro-food system have also increased the importance of recurrent or continuing education. Consequently, institutions of HEA will have to expand their programmes in this direction. Although computer technology should facilitate such courses, they will require special methods of teaching to take into account the maturity of learners.

Notes

(1) Mr F. Kuba is Principal Administrator in the Agricultural Directorate of the Organisation for Economic Cooperation and Development (OECD). The views expressed in this paper are his own and do not necessarily correspond to those of the OECD.

This paper takes account of contributions to and discussions at previous OECD conferences on (i) Higher Education in Agriculture, (ii) Agricultural Research, and (iii) Agricultural Advisory Services.

(2) Mahdi Elmandjra, "Learning needs in a changing world", *Futures*, December 1986.

(3) *Report by the Committee for Agriculture on the Outlook for Agricultural Policies and Trade*, OECD, January 1987.

(4) *Water Pollution by Fertilizers and Pesticides*, OECD, Paris 1986