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**Conference of Directors and Representatives of Agricultural Knowledge Systems (AKS)
(Agricultural Research, Extension and Higher Education)**

**COMPARATIVE ANALYSIS OF AKS APPROACHES IN ADDRESSING
PROBLEMS RELATED TO AGRICULTURE - ENVIRONMENTAL
INTERACTIONS IN OECD MEMBER COUNTRIES**

This document is submitted for INFORMATION and DISCUSSION to the Second Conference of Directors and Representatives of Agricultural Knowledge Systems under item b) of the Plenary Session No. 3 of the Conference Programme.

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COUNTRIES**

(Note by the Secretariat)

This paper, prepared by Dr. Ken MILNE, Director of graduate studies and professor of plant health, College of Sciences, Massey University of New Zealand, is the third in a series of three reports that present a comparative analysis of country notes submitted by Member countries. The other two documents deal with the AKS organisation and functioning in individual countries and food safety issues as addressed by Agricultural Knowledge Systems.

COMPARATIVE ANALYSIS OF AKS APPROACHES IN ADDRESSING PROBLEMS RELATED TO AGRICULTURE - ENVIRONMENTAL INTERACTIONS IN OECD MEMBER COUNTRIES

SUMMARY

1. Papers from 20 OECD countries were considered for this comparative analysis paper. Content varied markedly in terms of structure and detail, but overall valuable information was provided. Specific trends were not always readily apparent, although with regard to the problems associated with agriculture and its interaction with the environment, pollution, impact on rural landscapes, natural habitat losses, and soil/water conservation impairment were consistently mentioned.

2. Public awareness of environmental issues varies greatly with some countries using media and consultation processes very effectively. Several countries were committed to using education and advisory services to improve awareness and understanding of environmental issues related to agriculture. Country notes stressed that AKS must continue to play a dominant role in this knowledge improvement process and to raise awareness of agri-environmental interactions. Further, it is apparent that the positive contributions agriculture makes to the environment should be better promoted to the industry and the wider public..

3. The multifunctionality of agriculture is now widely accepted. There is also increasing recognition of the need to better understand the non-productive sector of agriculture, as well as the complexity of the socio-economic interplay in rural sectors. There is a need to consider the types of research which should be applied to enhance understanding and management of agri-environmental factors in the rural sector.

4. The place of legislation in effecting changes of attitudes and practice varies greatly. Models described range from a single or few pieces of legislation to a multiplicity of Acts, often administered by a number of Ministries and/or Departments. The trend is towards adopting a more unified approach, if not through legislation than by way of national plans/strategies/programmes with specific aims or goals. It is however being stressed that these must be accompanied by realistic performance indicators which are regularly monitored. The desirability of few versus multiple legislation and administrative agencies for effectively leading and managing agri-environmental improvement should be considered. It emerges from the reports that there is a need for the AKS to be more proactive in its efforts to influence legislators is also apparent.

5. The strong influence of the European Union (EU) on member countries policy and procedures is very apparent. The extent to which legislation is used as the driver to change agriculture to be more environmentally friendly varies between countries. There is evidence that in some countries the voluntary approach is working, particularly in cases where the farmer or corporate entity has 'ownership' of the initiative(s) for change.

6. There is a trend toward combining legislative initiatives with a variety of incentives, particularly to offset implementation of non- or less – productive practices to protect or enhance the agri-environment, reflecting the influence of the multi-national EU on policy and support practices for member countries. The

effectiveness of incentive schemes to support non-productive agriculture, such as enhancement of rural landscapes and natural habitats, is not clear and this deserves further consideration. It becomes also evident that any incentives must be transparent and clearly targeted to prevent confusion with the older systems of subsidies for production agriculture.

7. The development of codes (e.g. for agriculture, fertiliser use, agrichemical use) appear as powerful tools to enhance uptake and application of best practices and new knowledge. Some excellent examples are provided by several countries and they show how AKS can make a very valuable contribution to ameliorate adverse agri-environmental interactions.

8. Application of Environmental Impact Assessments and/or Risk Assessment and Management is also a trend which is emerging. Implementation of a Quality System for Agriculture, or for sectors of it, has the advantage of providing greater "ownership" by farmers and others in the agribusiness sector. Internationally consumers are seeking more detailed assurance of the origin, the sustainability of practices in the supply chain and the health and safety of agricultural products. This external influence seems to provide a more powerful driver of Quality Assurance than from within the agriculture sector. Examples of Quality Systems, benefits and evaluations of effectiveness for ensuring sustainability of agriculture, environmental protection and production of quality products require further consideration.

9. The part played by AKS in the development of agri-environmental policy and the involvement of these systems in interacting together, with farmers and related agribusiness, varies greatly. This suggests that the AKS needs to reflect on what models provide effective AKS interactions and synergies to enhance positive agri-environmental outcomes.

10. Several countries identify the need to undertake more research on agri-environmental interactions and influencing factors which again highlights the opportunity for AKS to be more proactive.

11. While there is increasing recognition of the importance of improved knowledge transfer on agri-environmental interactions, at least one country advised that there is no 'market' for such knowledge. This situation needs addressing in the context of the experiences referred to in para 2 of the Summary.

12. AKS currently performs an important role in the trend towards reducing or eliminating adverse agri-environmental interactions. However numerous papers show the need for better interaction of AKS components – namely education, research and extension – and other factors external to agriculture which contribute to the complex supply chain humans increasingly depend upon for their sustenance and indeed survival.

INTRODUCTION

13. This paper presents an overview of information on how governments and AKS are dealing with questions of the interactions between agriculture and the environment provided by 20 OECD countries (Austria, Canada, Czech Republic, Denmark, Finland, France, Hungary, Iceland, Italy, Ireland, Japan, Korea, Mexico, New Zealand, Norway, Portugal, Spain, Switzerland, The Netherlands, and the United States of America).

14. The geographic size, population and economic significance of agriculture in these countries varies greatly. It has long been recognised that agriculture and the environment are closely inter-related but it is only over recent times that consensus about agriculture and adverse environmental effects have become a key issue for citizens and in turn governments. Today agriculture, along with other economic sectors, is expected to be more productive and efficient, while slowing down or even reversing the negative environmental effects it is associated with.

15. This OECD Conference theme is thus timely in providing an opportunity to review the situation in a number of countries with different stages of agricultural development and sophistication. Sharing knowledge on the problems, comparing policies, organisational structures, funding approaches and other perspectives is important. So too is the consideration of the AKS organisation and functioning which is covered in another Country Analysis paper, and where possible the identification of the relative successes and outstanding issues of agricultural interactions and the environment.

16. The agricultural industry has not always welcomed the increased interest of policy makers and the general populace in seeking to reduce adverse environmental impacts. For instance, when the Netherlands introduced nature management agreements in the mid-70's, farmers were initially quite opposed despite compensation by area payment for loss of yields and extra costs. In Austria it is reported that "Initially, agricultural producers and agrarian authorities showed resistance and objected to the problem issues attributed to agriculture". In the Czech Republic, enforcing sustainable agriculture most frequently failed through lack of communication and management. In some countries, and perhaps particularly in Europe, the increasing strength of countries with a strong awareness about environmental problems, often with a strong ecological bent, the increased concerns about genetically modified foods (GMF), and animal welfare lobbies have captured much greater media attention than ever before. Spain refers to creating a climate of distrust, suspicion and apprehension across the whole world, through intelligent handling of mass media by pro-environmental lobbies. In some cases scientists have become divided on issues such as GMF, and certainly the general public is often confused and uncertain about health issues, including food safety.

17. This comparative analysis paper will consider the topic of interactions between agriculture and the environment as follows:

- Problems of Agriculture and the Environment;
- Related Government Policy, Responsibility Structures and Collaboration;
- Forms and Sources of Programme Funding;
- Assessment of Results;
- Conclusions.

PROBLEMS OF AGRICULTURE AND THE ENVIRONMENT

18. From the submitted papers a range of problems can be identified and clustered into four areas:

- Pollution
- Impact on Rural Landscapes
- Natural Habitat Losses
- Soil and Water Conservation Impairment

1. *Pollution*

19. Agricultural chemicals are high on the list of concerns identified with an adverse effect on the environment. The work of the late Rachel Carson, author of "Silent Spring", which highlighted the accumulation of the pesticide DDT in the natural food chain, unleashed a flood of concern about the potential dangers of synthetic pesticides which were produced in large quantities after World War II. Crop protection chemicals are particularly associated with intensive production systems and hence it is not surprising that they are associated with the high energy crop cultures in a country like The Netherlands where residues of these chemicals pollute surface groundwater.

20. Concerns about agriculture harming the environment are illustrated by the Austrian report where a survey in 1981 found 71 per cent of the adult population considered the use of chemicals in agriculture

harmful. This report notes that “the awareness shift occurred mainly on account of the scientific studies of environmental damage caused by industrially-oriented agriculture, the discourse at educational institutions and the differences between the impact of conventional and organic agriculture, and the respective media coverage these issues received, especially on radio and television”.

21. But what of the environmental issues for Austrians in the late 90's? Eighty percent of consumers have a negative attitude toward the application of genetic engineering in agriculture and food, with 86 per cent being found in a 1998 poll to be opposed. The dramatic development however is that 60 per cent of farmers agreed in a case study, which was part of an agricultural environmental programme, that mineral fertilisers and pesticides have a negative environmental impact.

22. High use of fertilisers has led to problems in surface and ground water contamination with phosphorus (P) & nitrogen (N) (nitrate accumulation in particular) as mentioned for instance by Austria, the Czech Republic, Finland, Spain and The Netherlands.

23. Finland identifies eutrophication as a major concern, e.g. “massive blue-green algae blooms in both inland waters and the sea in 1997 were considered an alarming sign of eutrophication and its harmful effects”. Their report estimates that if 28 per cent of the diffuse total P originating from agriculture is potentially available to algae, then from 560 to 1120t of algal-available P enters surface waters annually.

24. The paper from the Netherlands discusses the issue of mineral surplus that occur in pig and poultry sectors and in a number of instances from the dairy sector. Here then the problem is not from application of manufactured fertilisers but rather of the waste generated from intensive animal production systems. Problems are not only of minerals, but also of gases such as ammonia. Japan makes reference to the appropriate management of livestock faeces and the recycling of organic wastes. Korea also mentions that care must be taken with the use of organic fertilisers, with due regard to application of proper quantities and consideration of their components. The paper also highlights “it is a fact that the continuous use of chemical fertilisers would degrade the soil quality in various ways”.

2. *Impact on Rural Landscapes*

25. The paper from the Netherlands focuses on a second major concern which has been slower to be realised than pollution and that is the impact of agriculture on rural landscapes and their amenity or aesthetic value. The problem here manifests in a variety of ways, including the impact of urbanisation and the need to conserve the land resource.

26. Canada provides a powerful example of a non-agricultural impact on rural landscapes which should not be overlooked when considering adverse environmental changes. In Southern Ontario, where the population pressure and conflict between agricultural and urbanised land is highest, 60,000 ha of prime agricultural land has been lost to urbanisation in the 20 year period 1966-1986. The tragedy of this is further emphasised in this large country in that only approximately 7 per cent of the land area is available to agriculture. About 85 per cent of this is in Western Canada and 13 per cent is concentrated in Ontario and Quebec, with these two provinces contributing 55 per cent of Canada's agri-food GDP. But this graphic example is not unique to Canada and is repeated the world over. Consider the situation in Orange County in Southern Los Angeles, USA, which is now covered with houses and other urban developments, theme parks such as Disneyland and Knott's Berry Farm, hotels, shopping plazas, parking lots and freeways; this County was formally a highly productive citrus region.

27. The report from the Czech Republic pays considerable attention to forest management and the environment. It is noted that current forests have, as in all Central Europe, been heavily impacted by human activities. Natural vegetation has been “liquidated and exploited for pasture since the 13th

century". Ecosystems are so altered that permanent human intervention is now required. Not only are forests important in the Czech Republic but they also contribute as national parks, protected landscape areas, national nature reserves and nature monuments.

28. Both Austria and Hungary refer to the draining of wetlands as part of the environmental impact of agriculture. This intervention of man into natural habitats has had dramatic effects on both flora and fauna, which leads to the consideration of natural habitat losses.

3. *Natural Habitat Losses*

29. Habitat and landscapes are inter-linked and in New Zealand concerned public and conservation groups frequently take issue with the Government and regional authorities about logging native forests and the loss of native bird habitats.

30. Several country reports refer to the importance of habitat protection and are paying particular attention to this. For example Ireland is seeking to protect wildlife habitats and endangered species of flora and fauna. Italy refers to the environmental service provided by farmers in the conservation of natural habitats and of genetic diversity. Landscape disturbances and the loss of balance is referred to in this report and also by the Czech Republic, and The Netherlands. In some countries proactive initiatives are being taken to reverse this trend.

4. *Soil and Water Conservation Impairment*

31. In New Zealand there is considerable evidence of physical degradation of land resource in the indigenous grasslands of the South Island, affecting 300,000 ha or 2 per cent of the total land area of that island; overgrazing by sheep has been a major contributing factor as has the introduced herbivore, the rabbit. In the North Island some 285,000 ha on the East Cape have suffered severe soil erosion. In this case cyclonic storms, frequent droughts and grassing of steep, unstable hill country have all contributed to the severe, adverse environmental effects. Indirectly, a period of Government intervention by way of a variety of agricultural subsidies also helped contribute to the ultimate outcome by masking market signals for wool, beef, sheep meat and dairy products. This provides a classic example of the dangers of applying production-based financial assistance measures in isolation from other policy areas, including particularly the application of environmental and resource management policies. Since the mid-1980's New Zealand has removed these production-based supports for agriculture, including land development loans, fertiliser and irrigation subsidies and subsidised credit.

32. The Canadian paper concentrates on the conservation of soil and water using no-till systems. This approach is seen as best suited to offsetting the ravages of nature, namely wind and water erosion, whilst also combating the reduction of soil quality through loss of organic matter, salinisation, tillage erosion and compaction. Despite application of no-till systems, some 10 per cent of cropland in Ontario still remains at high risk from soil degradation.

33. In Portugal, where agriculture and forestry occupy approximately 82 per cent of the country, only 12 per cent of the soils have high agriculture rentability or value. In this country 77 per cent of the total volume of water consumed is in agriculture, with much of this used for irrigation. Soils are generally poor, and climatic conditions vary. Soil erosion is a major concern with the potential risk for this being 68 per cent high, 26 per cent moderate, and 6 per cent low (c.f. actual risks of 80 per cent, 55 per cent and 15 per cent respectively). Portugal recognises the challenge is to overcome natural weaknesses in areas of extensive production systems, while recognising the multi functions of agriculture, the need to conserve

the environment and the landscape as well as preserving a human presence and the rural heritage. This surely is the challenge that all countries must face as we move into the next millennium.

34. The paper from Spain captures well a more widespread situation, namely that the need for a sustainable agriculture is clear for most stake holders. The Spanish challenge is to do this in the context of two main problems:

- the huge variability of the environment and technological conditions of Spanish agriculture, which covers a wide range of climatic conditions and soils, as well as very specific agro-systems for particular areas;
- the lack of knowledge on particular environmental characteristics of particular climates and topography, mostly due to insufficient allocation of resources for research programmes addressed to these areas.

35. These problems are not unique to Spain and of course must be added to the need to maintain or even increase production, or at least livelihoods for populations in the rural areas, while diminishing or preferably reversing environmental degradation. Achievement of this is already being assisted by the ever increasing recognition, indeed acceptance, of the multi functional nature of agriculture. Recognition and acceptance are important of course, but even more essential is the need to encourage the further development of multi functionality of agriculture. In regions where a reduction in the intensity of production agriculture may be the only way to bring sustainability and environmental preservation, this may be particularly important. Encouragement may be financial, but also must include effective information transfer through education and extension activities. This should be approached by capitalising on the growing demand for life-long learning as illustrated by the growth of 'open learning' opportunities world-wide. This in turn requires making knowledge packages available which are of reasonable size, and which are readily accessible to adult learners. In the case of educational qualifications, transferability between these and staircasing are initiatives which are being used very effectively. (Staircasing involves the arranging of qualifications in stepwise units such as certificate, diploma, degree, graduate/postgraduate diploma, etc).

RELATED GOVERNMENT POLICIES, RESPECTIVE STRUCTURES AND COLLABORATIVE APPROACHES

36. There is considerable contrast in the papers provided in terms of policies, responsibility structures and collaboration. The influence of the EU is very apparent, but even in EU countries the sophistication of approach varies considerably. This is not surprising considering the various stages of economic and, agricultural development in the member countries and the varying lengths of EU membership of these countries. The Netherlands highlights the acceptance of the multi functionality of agriculture and gives examples of the legislative approaches to deal with major environmental concerns in that country viz. mineral surpluses and rural landscapes. The links between agriculture and ecological aspects of natural systems is well illustrated in the Austrian report and Ireland also reflects concerns for society by bringing out the importance of maintaining not just a healthy environment but also a viable rural environment.

37. Another tension underlying the establishment of policies for protection of the environment is the emphasis which is put on legislation versus allowing farmers and indeed society to take ownership of the problems. This in turn requires good education and communication, an area where the education and advisory or extension aspects of the AKS come into full play.

38. But what of Government policies, responsibility structures and collaboration between different agencies? Austria provides an excellent example of the changes which have occurred in the approach to

agriculture and the environment. In the late 1980's and early 1990's agricultural subsidy programmes were restructured and reoriented. The driving force for this was two-fold; the reality of the EU requirements and the anticipated outcomes of the Uruguay round of GATT talks. Concurrent with this was the increased emphasis on agri-ecological aspects of funding and environmentally-related direct payments being integrated into the funding system. Within the framework of EU regulation 2078/92 Austria introduced the OPUL agri-environmental programme. OPUL aimed to secure former environmental efforts as well as provide new incentives for reducing resource use, for landscape management, subsidising biodiversity, protecting ground and surface water and preventing natural hazards. It also involved a 'carrot and stick' approach. Incentives and opportunities (the 'carrot') were provided for every farmer to assemble measures best suited to their enterprise and region with the 'stick' being the stringent measures for implementation. The package also attempts to take into consideration socio-economic factors. The paper details six (6) measures which impact on the four areas of agri-environmental concern outlined in the Introduction to this paper, including the very important measure of education.

39. Canada traces developments from 1986 with soil and water conservation defined as one of five (5) elements of a long term National Agricultural Strategy. The 1989 Policy document "Growing together - a vision for Canada's agri-food industry" included increased emphasis on environmental sustainability. The 1990 "Green Plan" agri-food component built off the 1989 Policy. In 1997 the Federal Government of Canada called for a sustainable development strategy which places agriculture in harmony with nature. The outcome is a strategy for the development of an environmentally sustainable agriculture and agri-food industry in Canada.

40. Austria provides an example, based upon organic farming, on how research and education were integrated through the formation of a separate institute for organic farming. This integrative approach for education and research has been used at a New Zealand University where staff in a College of Sciences (which includes some 6000 students and 650 staff) have been organised into eight academic units which are research focussed institutes. Each institute also has teaching responsibilities and undertakes a variety of extension initiatives including seminars, industry meetings, and block courses.

41. The Spanish paper reports that the Government has various tools available and allocated resources to control environmental hazards due to agricultural expansion. These include rural development programmes on reducing agricultural pollution, residues impact and protecting the public by minimising water pollution.

42. The Czech Republic is in the process of preparing a unified system for agricultural environmental policy which will include a system of subsidies which will support environmentally friendly farming, a Code of Agricultural Practice and the determination of zones vulnerable to water contamination by N from agricultural sources. An Agricultural Act enables recovery for environmental service provided by farmers and Government has decreed support for non production functions of agriculture (assistance in landscape maintenance for farmers and less favoured areas); this approach for landscape preservation and enhancement has also been adopted by the Netherlands. An Act on Fertilisers provides rules on marketing, storage, application and particularly considers environmental issues. The papers acknowledge the influence of the EU as a driver of these developments.

43. In Denmark the environment has a high priority on the policy agenda and more than 30 public agencies and institutions collect environmental data together with a few private institutions. There is close collaboration between the Government, counties, municipalities and a variety of other organisations. Despite major legislative reforms by the Ministry of the Environment through the 70's, Denmark considers it still has not properly balanced the treatment of nature and the environment. To address this, environment impact assessments are now required for any new productive activity. The Government and Folketing (parliament) strongly emphasise a more targeted, long-term and holistic environmental approach.

44. Environmental impact assessments are an important initiative which has also been utilised in New Zealand. Equally important to the assessment is the devolution of responsibility to the sector or local level; this will increase the likelihood of 'ownership' and reduce the risk of resistance to what might be perceived as a heavy handed, top-down approach. The importance of local ownership is a characteristic that has been provided for in countries such as Norway and The Netherlands and is discussed later.

45. Finland has been monitoring the environment since 1962 and most water protection activities in agriculture are conducted on a voluntary basis. To combat the main environmental threat in this country – the eutrophication of inland and coastal waterways – the main focus is on decreasing nutrient losses from agricultural areas. This is being achieved by modifying cultural practices and includes the establishment of vegetative buffer zones between cultivated fields and water courses (most on voluntary basis).

46. Ireland's Department of Agriculture and Food has a stated policy to foster development of environmentally friendly systems of production and processing (operating through Teagasc – The Agriculture and Food Development Authority), and this sits alongside the Department of the Environment which operates through the Environmental Protection Agency. Ten (10) key strategic actions are set out in the 1997 document Sustainable Development – A Strategy for Ireland. This includes initiatives such as promotion of a Code of Good Agricultural Practice, revised P application and reduction of P losses from agriculture, a Biodiversity Plan and continuing support for organic farming. The need for precaution on the use of GMO's is included, and educational services and advice also play an important part in this strategy.

- Ireland's environment must be protected for its own intrinsic value.
- Economic growth and social development cannot be to the detriment of environmental quality and must be within limits set by nature; in particular, this must involve changes in production and consumption patterns.
- A quality environment is the natural heritage of the whole of Ireland.
- Responsibility towards future generations involves sustainable use of renewable resources and the optimized use of non-renewable resources.

47. Italy reports that environmental issues became of interest to the Italian public towards the end of the eighties. The Ministry for the Environment was created in 1986, and created a natural perspective, accompanied by various environmental and consumer protection associations and movements. If environmental interventions involving farmland and farms are used, these are the responsibility of Councils for Agriculture. The Italian paper acknowledges that at institutional level national and regional public structures rarely act in a co-ordinated and interconnected way.

48. In Japan, the parliament discussed in June 1999 basic laws on food, agriculture and rural areas. The law places the multifunctions of agriculture as one of the basic roles, together with the securing of a stable food supply, sustainable agricultural development and development of rural areas.

49. Korea has Regulations which seek to minimise use of chemical fertilisers and agrichemicals and reduce total SO₂ and suspended particles into the air. Livestock excreta measures, water quality or waste management plans are required.

50. In Mexico, national projects are being reviewed and interpreted with respect to their environmental significance and the conditions of their environmental significance and the conditions of their biophysical feasibility or sustainability. The report emphasises the importance of interaction between international policy, and the benefits of utilising opportunities provided by multilateral and bilateral agreements.

51. In New Zealand the key regulatory mechanism for addressing environmental issues in agriculture is the Resource Management Act 1991 (RMA). The RMA brings together into a single Act, all or part of 75 statutes. This legislation includes some fundamental changes to previous laws. The RMA is concerned with managing the effects of activities and its purpose is to “promote the sustainable management of natural and physical resources”. Elected Regional and District Councils take this central government legislation and, in consultation with their counties address agri-environmental issues such as soil conservation, water quality monitoring and control. A Ministry for the Environment has established a Sustainable Management Fund (SMF) which provides support for practical initiatives which help to achieve the sustainable management of New Zealand’s resources. Information and technology transfer from technical reports to the wider community must be included in these proposals.

52. Norway’s Ministry of Agriculture has introduced an innovative Quality System for Agriculture (KSL). The objective of KSL is to document quality through the entire system of agricultural products and products from soil to consumer”. For farms producing livestock, farmers are personally responsible for establishing their own quality system. Biological diversity, cultural landscapes, farmer’s health, working conditions and safety are all included. It is a collaborative effort involving Committees headed by a farmer, with all the agricultural sectors participating in the development of KSL. Government is addressing agricultural environmental issues, agricultural pollution and erosion, compulsory planning of fertiliser use, reduced health and environmental damage by use of pesticides (1998-2000), with a targeted reduction of risk by 25 per cent, plus a new tax system for pesticides introduced in March 1999. Support schemes are in place for cultural landscapes and organic farming is developing marketing strategies for organic products. Research, higher education and extension are collaborating in Norway to work with farmers through the KSL approach. With the increased demand from consumers for food and health safety, together with preservation of the environment and quality assurance, the Norwegian integrated approach of having the ultimate responsibility with the farmer appears to have much to commend it.

53. The Netherlands paper refers to a new (1999) policy agenda of Vigour and Quality. Agriculture is placed in the wider context of society with, like Norway, an emphasis on quality. Recognition is given to the need to supplement the legal approach of permits and regulations with specific programmes aimed at target groups, regions and production chains and which appeals to farmers’ skills. Prescription is replaced with clear specific targets which allow the entrepreneurs to find the most cost-effective manner of achievement. This approach is being applied to the two themes of The Netherlands paper viz. mineral surpluses and rural landscapes. Farmers initially opposed a system of nature management agreements, despite compensation for losses in yield and extra costs being compensated through area payments. Since 1992 the objectives of agreements have become more ambitious and the system is now national and included under the Regulation for agri-environmental measures of the EU which now co-finances it.

54. Portugal’s policy for agriculture and rural development aligns with the EU’s Common Agricultural Policy, but also aims to define the specific conditions of Portuguese agriculture, always aware of the diversity of regional and local agriculture and the need to promote viability and competitiveness. The latter issues will always be important considerations for any country and understandably so. Portugal has based its Policy for Agriculture and Rural Development on two major, fundamental strategic guidelines: the agri-commercial and eco-rural approaches. A balanced harmonious design for the use of land is sought. To achieve this different levels of intensification for agri-food and agri-forestry production should be in agreement with the principles of the diversity of regional agriculture, sustainable natural resources, landscaping and the multifunctions of farms in the rural environment.

55. A series of general principles underpins the Basic Law for Agrarian Development followed by strategic objectives of agricultural policy. Environmental concerns are dealt with specifically in the Basic Law and include the sustainable long-term development of agricultural productive systems, safeguarding soil productive capacity, availability and quality of water resources and protection of biodiversity

associated with flora and fauna. Agrarian production methods are expected to be compatible with economic and ecological use of natural resources using technologies that do not have negative, irreversible environmental effects. A Basic Law on Forestry is also similarly defined in recent legislation. A variety of policy instruments, both economic and non-economic are described. Rural tourism is recognised as an area needing encouragement of the multifunctional nature of agriculture and Portugal has revised legislation pertaining to this.

56. Cooperation in Portugal is by the three components of AKS working together on research projects. Information is disseminated in a variety of ways to different audiences, scientific and farming. Cooperation allowing the AKS to co-ordinate with farmers' organisations, is established through contracts between both, or by signing cooperation agreements. France also uses a contract approach, together with incentives with the regional farming contracts, or CTEs (*contrats territoriaux d'exploitation*). Under these arrangements, farmers will be remunerated for undertaking to ensure that their activities have a beneficial impact on the environment, and for the services they provide to the community, thus ensuring that agriculture is multifunctional. A strength here is that 5-year contracts combine a farmer's own development plans and collective goals set out in national regional and departmental specifications. Three governmental departments work together to mobilise the AKS. Technical agricultural education has introduced and is developing teaching strategies to optimise the kind of courses the public wants.

57. In Spain, the R+TD Sectoral Programme supports research in the interaction between agricultural crops, livestock farming, forestry rational exploitation and reforestation, natural resources preservation, harmonised with a clean and well preserved environment. A new Ministry for Environment (MMA) was established in 1996. A National Plan for R+TD and derived programmes are described as the highest, clearest and most direct expression on the Spanish Government policy on interactions between agriculture and the environment. The Plan includes sections on global change and the rural environment; physical-chemical processes and environmental quality; preventative technologies for environmental safety. Focal points of legislation include reforestation of agricultural lands (1m ha, including set-aside areas) within five years; actions aimed at cropping, livestock farming becoming more environmentally compatible, relates to irrigation water savings, modifications to type and application rates of plant protection chemicals, fertilisers and crop residue removal. New initiatives by the EU relating to efficiency of reforestation including research, demonstration projects and special actions have also been implemented since 1996.

58. Cooperation between different organisations and agencies in Spain is by a variety of different interactions. For instance, several public and private institutions are working in the area and subject-specific seminars, workshops, and meetings are frequently conducted. Research Centres, University and Professional organisations offer postgraduate and technical opportunities to exchange information. Seminars are held to develop scenarios of environmental risk assessment of Plant Protection products. Biannual congresses on subject and specific courses on Environmental Impact Assessment and Environmental Audits of intensive livestock production systems. There are also a variety of international cooperative initiatives.

59. Switzerland has federal agri-environmental policies beyond its environmental protection legislation. Each sector of the economy must now incorporate ecological rules into its own policies. In 1997 there was overwhelming support by the Swiss for a new article in the Constitution which included an article requiring sustainable agriculture, preservation of the natural foundations of existence and maintaining rural landscapes, and that agriculture devise measures so it may perform its multifunctional tasks. In 1998 all price guarantees and farm product supports were abolished; farmers will however receive direct payments subject to ecological conditions to compensate for lost farm income so in effect one subsidy has been replaced with another.

60. The United States with its very large land mass and population has, not surprisingly, a plethora of statutes related to environmental quality and management. Responsibility is vested in several Federal and State Agencies. The paper emphasises the importance of developing sound science as being “critical for the improved management of ecological systems, but also for understanding and mitigating the ecological effect of environmental change at all scales”. The seriousness of the effort is exemplified by the USD 5.2b expenditure in the financial year 1995 on combined Federal environmental and natural resources research budget. The Clinton Administration has issued a series of Executive Orders dealing directly with improvements to the environment or with roles of agriculture in environmental conditions. Numerous interagency working groups or task forces have been established to provide priority setting and leadership in programme development on such topics as advanced soil and water pollution, invasive spp management, habitat conservation, and ecosystem restoration. An impressive model of collaboration between Federal, State and Land Grant Universities is provided by the USA. Physical co-location of US Department of Agriculture Researchers, State-funded extension specialists, and University academics (and post-graduate students) provides excellent opportunity for interaction and joint participation in programmes related to agriculture. In many cases academics have joint teaching and research appointments thus also strengthening the teaching-research nexus.

61. The formation in 1994 of a single agency, the Cooperative State Research, Education and Extension Service provided for much closer coordination between extension and research. This link also increases the likelihood that research will be done that is relevant to end user problems and the results quickly transferred. It is surprising that this holistic model of AKS has not been more widely adopted as to an external observer it appears to have much to commend it. In the USA a major increase in coordination and much improved collaboration is attributed to Presidential directives and studies by the National Science and Technology Council.

TRENDS

- the strong influence of the European Union (EU) on Member countries’ environmental policies is apparent.
- the recognition of the need to subsidise non-production agriculture, which makes such an important environmental contribution to rural landscapes and natural habitats.
- development of programmes, plans, strategies which are 'over-arching' and which can result in integration and coordination of environmental protection efforts, even when disparate bodies are responsible for policy management and implementation.
- greater emphasis on long term planning, outcomes and impacts of agriculture on the environment and greater accountability of different sectors for their own behaviour.
- development of Codes (e.g. for agriculture; best practices; fertiliser use; agrichemical use)
- development of environmental contracts, nature management agreements; quality systems.

FORMS AND SOURCES OF FUNDING

62. In EU countries Agri-Environmental programmes are largely based upon the EU framework and funded through this system. Collaboration is also encouraged and is increasing as illustrated in The Netherlands where there is not only cooperation among Institutes, but also internationally e.g. the Agricultural Economic Institute (LEI) is working with Belgian institutions because of their experienced with mineral surpluses and the similarities between policies in the two countries. In addition member countries then make varying additional inputs from national and local funding sources. In Canada, the Provinces and Universities may contribute to particular programmes. In certain instances projects with a

commercial orientation will enjoy private funding. For example in Finland feed, fertiliser, dairy and food industries are involved in providing funding for R&D which takes environmental issues into account. One such project is “Developing environmental information systems and information processing systems as a part of quality management”. This project also illustrates collaboration between the Agricultural Research Centre of Finland, the Technical Research Centre of Finland and the Association of Rural Advisory Centres.

63. Ireland enjoys funding not only from the Central Exchequer, and the EU but also from a US/Ireland fund.

64. In Korea central government funds are channeled through the Rural Development Administration (RDA) and projects are implemented at central or provincial government levels. Private commercial companies also provide funds to RDA for specific projects.

65. In New Zealand funding for research on agri-environmental issues may be accessed by Universities and Crown Research Institute’s (CRI’s) through Government agencies such as the Foundation for Research, Science and Technology, and the Ministry for the Environment. Universities and CRI’s are increasingly proactive in seeking and obtaining research funding from industry such as producer organisations (e.g. Kiwifruit Marketing Board, Apple and Pear Marketing Board, and the Meat Board) and private companies. Food production companies such as Heinz-Wattie are very active in conducting research and providing extension to vegetable growers producing organically. This research may also be contractual to CRI’s or Universities.

66. Portugal provides some interesting information on economic incentives relating to agri-food measures, the nature of these (100 per cent are subsidies), programme accompanying measures, and sources of funding. With respect to origins of funding for agrarian research directly related to the environment, the major player is the state (61.2 per cent), followed by higher education (35.8 per cent), and private bodies (3.0 per cent). Interestingly, the highest percentage of scientific staff undertaking this research are in private bodies and they consume slightly more (41.2 per cent) of the funds compared with higher education (40.2 per cent) and the state (18.5 per cent).

67. Leveraging of industry funds is also a growing trend as illustrated by the New Zealand policy of the Sustainable Management Fund (SMF) needing to be matched by non-government funds. This has the benefit that the non-government agencies have a real sense of ownership of the research.

68. In the USA federal funding to the AKS is also highly leveraged by institutions. For example, funding from the USDA’s Cooperative State Research, Education and Extension Service (CSREES) represents about 20 per cent, with 13 per cent from other Federal Agencies, 50 per cent from state appropriations, and 19 per cent from private sources.

69. Another strategy to reduce adverse environmental effects on the environments is to increase taxes on resource consumption as is being done gradually in Denmark. This is an alternative approach to the ultimate 'polluter pays' strategy where substantial fines are levied on individuals or organisations which are found guilty of causing significant environmental pollution damage has been done, hence a disincentive (such as resource tax), early in the process, has much to commend it.

TRENDS

- Increased use of funding systems which encourage collaboration and partnerships, so as to increase the value of government funds through leveraging these with other funding e.g. from industry, universities and the private sector.
- Increased funding from the non-government sectors.
- Taxes on resource consumption is emerging as disincentive to reduce environmental damage.

ASSESSMENT OF RESULTS

70. Austria, through OPUL, provides a comprehensive, modular promotion package representing more than one-third of the entire budget for agriculture direct payments. Because of the breadth of design of OPUL not only the core areas of AKS deal with problem issues of the environment and agriculture, but there is also participation from institutions such as the Ministry of Environment, the Federal Environment Agency, and non Government organisations in the conception and continuous evaluation process. There is moderate involvement also of AKS with other areas of environmental training and counselling. Austrian environmentalists however consider stipulations are not sufficiently stringent and measures inadequately targeted. Other identified weaknesses are the high administration effort, particularly during initial implementation, and the rapid conception and implementation of OPUL.

71. With respect to the application of no-till practices to 20 per cent of cropland (mainly for soybeans and wheat) in Ontario, Canada, the reduction of water erosion was evaluated at 13 per cent (changes to other practices also contributed to this reduction).

72. The Czech Republic reports that they have a functional and efficient system to evaluate project proposals but priority will be given in relation to results application with a complementary report three years after projects finish. The lack of integration and of inter disciplinary projects is acknowledged together with the lack of experience with research results implementation. Weaknesses are perceived in the lack of targeting research and in the feedback to advisors and farmers. There is also a low demand for environmental research and farmers have a low ecological awareness. Although the Ministry of Agriculture in the Czech Republic is outside AKS it still plays an important role.

73. In Denmark, since 1981 when the quality of drinking water was recognised as being impaired by nutrient contamination, the monitoring of N levels and pesticides have been invoked nationally. Concurrent with EU regulations, research and advisory efforts the use of pesticides and nutrients in agriculture have decreased markedly. Scientific and administrative monitoring, reporting on the state of the environment, and environmental forecasting are currently combined into an overall scheme for strategic environmental planning.

74. Finland provides an example of assessment with respect to the impacts on water courses on the nutrient loads from agriculture. A study in 1995-1999 was part of the project monitoring of the Finnish Agri-Environmental Programme (FAEP). Various indicators, mathematical methods and interviews were used. Positive outcomes included significant changes in cultivation practices in the first three years of FAEP. The use of phosphorus fertilisers and animal densities had declined, and the percentage of winter green coverage had increased. Eighty – ninety per cent of farms now meet the targeted 30 per cent winter green coverage compared with 40 per cent of farms when Finland joined the EU. This illustrates that a voluntary, participatory approach supported by the AKS can be very effective. However, in this particular case in Finland, the potential impacts of green coverage on nutrient losses have been low.

75. Ireland reports a series of performance indicators based on criteria such as number of Rural Environment Protection Scheme plans prepared, number of farms accredited to recognised Quality Assurance Schemes, results of biological and physio-chemical analysis of water quality by the EPA and recorded cases of misuses of pesticides.

76. Italy acknowledges the need for technical assistance and advisory services to be based upon regular and consistent information about the technical and economic aspects of environmentally friendly techniques; the paper recognises that at present this types of information is very scarce. This refreshing frankness, one suspects, represents a view shared by a number of countries, although this is not always explicit.

77. Although no hard data is provided in the paper New Zealand reports that the withdrawal of agricultural supports in 1984 has led to several direct environmental benefits. These include reduced marginal land development, associated protection from soil erosion, reduced application of fertilisers and pesticides, and associated pressures on the environment. New Zealand Government science has also taken a new strategy of moving more to participatory research which requires the involvement of farmers and growers and an inter disciplinary approach by the science team. This form of research is commonly described as an integrated activity that combines social investigation, educational work and action.

78. Norway comments under assessment that in future consumer groups are to be more closely involved in research, education and extension.

79. Spain sets out seven (7) important goals for assessment of research outcomes relating to agriculture, including four (4) which are environmentally linked:

- reduce negative environmental impacts;
- improve rural development;
- enhance higher integration of the production systems with the environment;
- enhance integrated crop pest management.

This country reports that agricultural activity has been particularly affected by application of the Community Agricultural Policy (CAP). It is also perceived that CAP recommendations and regulations have many contradictions in its objectives. While farmers are challenged to compete internationally in a free market they are also asked to safeguard the environment, which requires a more conservative and sustainable business. This is further illustrated by way of two types of agricultural business: one based upon higher inputs, industrial-like agriculture where most of the food will come from; the second on the old cropping style, based upon varied farming activities and subsidies, and extra-farming activities, thus, additional income. Spain makes a very reasonable plea for a global scenario to design a larger Research and Technical Development framework for near future agri-environmental actions. It is felt that problems of even a macro-region, e.g. the Mediterranean economies, in the context of EU are not considered sufficiently in CAP and EU policies.

80. Although there are indications of successful assessment in several countries, many of the country papers provide no comment or clear evidence or hard data to show just how effective assessment approaches and strategies are operating. Without this comparative data, analysis of efficiency, cost effectiveness, and benefits becomes difficult and does not provide sufficient clear facts for changes to strategies.

81. Switzerland is one of the exceptions to this, reporting that integrated production has leapt forward in recent years, as evidenced by the growth since 1993 of farms practising organic agriculture. It is estimated that 64 per cent of farms and 72 per cent of usable farmland were operated in 1997 in

compliance with the rules of integrated production. That same year the proportion of organic farms was 6.3 per cent, on 7.6 per cent of usable farmland. Biodiversity has continued to rise, optimised crop rotation and soil management have enhanced soil protection and the aggregate use of mineral N has decreased by 10,000 tonnes. The N content of animal feed imports has declined by 20,000 tonnes since 1975 and the P fertiliser applied is now less than 1980 levels; plant protection product use also decreased by approximately 18 per cent between 1990 and 1996.

82. The Netherlands provide some valuable comments on assessment of results in that country. They advise that evaluations of agro-environmental work are scarce and mainly limited to peer reviews and visitations. Evaluations from the point of view of funders and users of knowledge are lacking, due it is believed to lack of concrete and explicit objectives. Researchers are looking for solutions to mineral surpluses within prevailing production systems and not accepting that these systems will not be able to be maintained in the future. In the case of the second theme of The Netherlands paper – rural landscapes – there is realisation that the perspective is still production based in most of the work. Advisory work and education appear to be adapting well, and university education in environmental issues which started in 1974 is no longer separated out but rather integrated into the various disciplines. This must be regarded as a very positive outcome for education and one which will have benefits to the various sectors of agriculture in terms of a raised environmental consciousness.

83. The United States reminds us that public policies should be based upon a process of social and economic evaluation to which research and monitoring can contribute. The information gap between scientists and decision makers requires a thorough, periodic and interactive assessment and synthesis processes. In the USA the assessments of resources habitat characterisations for instance are conducted by Federal agencies. The paper identifies as critical the need to increase understanding of the significance of the interaction among resources, their linkages to variations in the natural and human environment and responses to the various drivers of change. Integrated environmental syntheses have three components – the status of ecosystems, causes and consequences of change, and the evaluation of management options. This latter option identifies and evaluates science-based technological, management and policy approaches in response to the findings in the two previous components. Nine outcomes are identified in the paper which are broad-based and cross cutting. They encompass ecosystem sustainability, valuation of non-marketable components and the development of an integrated ecosystem modelling framework. Also included is a comprehensive assessment of the nation's natural resource. Important in this is the documentation of the relative magnitude and significance of natural and human-caused disturbances together with the contributions of physical, chemical, climatic and biological stresses in ecosystem change. Outcomes also aim for more proactive rather than reactive management with better evaluation and assessment of the ecosystem and improved information networking.

TRENDS

- greater involvement of stakeholders in research priority setting, monitoring and assessment of environmental impacts and policies.
- development of environmental risk assessment and management.
- acknowledgement of need for more information and best practices on environmental issues.
- increasing recognition of the importance of improved knowledge transfer to agricultural and non-agricultural sectors including information dissemination on the positive contributions of agriculture to the environment as well as its contribution to eliminate or minimise negative effects.
- Insufficient indicators and methods to assess policies and to measure the success of programmes and approaches.

CONCLUSIONS

84. There are undoubtedly important areas of environmental deterioration which agricultural industries are responsible for. These include pollution, impact on rural landscapes, habitat losses, soil and water conservation impairment. Community awareness of these effects has been present in some cases for many years, initially the farming sector resisted acknowledgement of them. This attitude is generally becoming more positive, with a partnership or even leadership role being taken by farmers. Analysis of the papers presented suggests that changes to agricultural practices which are more environmentally sensitive may be best achieved by a balance of legislation and encouragement. The latter may have to include some financial incentives to ensure the true multifunctionality of agriculture is recognised and enhanced. This can be rationalised and even justified as the growing urban populations of OECD countries increase their expectations of agriculture. Expectations include the provision of healthy food, fibre and sometimes fuel and shelter materials, as well as other products. At the same time there is the increasing expectation of an attractive environment for recreation and for retention of flora and fauna which are characteristic of particular regions. As rural populations continue to decline and urban populations expand, the need for policies to subsidise the non-productive side of agriculture, at least to a certain extent from the taxpayer's purse, does not seem unreasonable. However, it is pointed out that such subsidies need to be transparent and specifically targeted. Disincentives to reduce environmental pollution can be at the outset with taxes on agricultural resource inputs (agricultural-fertilisers, pesticides) as practised now in a number of countries, or some other form of polluter pays approach. Fines after the event are another approach but then the damage has already occurred.

85. Policy, responsibility, structures and collaborations reveal a wide diversity of approaches, and similarly forms and sources of programme funding varies markedly. The European Community and EU Common Agriculture Policy is a major driver in member countries but generally this does not appear to preclude these countries taking particular initiatives supported by their own funding mechanisms. Subsidies are being used in a number of countries to encourage changes in practices and attitudes. These are being applied more particularly to intensive agricultural systems, but they are in some instances also being invoked to enhance the multifunctionality of agriculture. The latter includes non productive but highly desirable aspects of this functionality such as wildlife habitat retention and enhancement of rural landscapes.

86. The need for incentives in the form of subsidies may be able to be reduced by developing more diverse rural economies. Some agriculturists, and even some regions, have become increasingly successful in this diversification through activities such as agri-tourism. While natural features may have assisted this in certain countries, the likelihood of the city dweller being increasingly drawn to attractive rural environments will continue to increase.

87. Organic farming and the resultant organic produce is a growth area and one which is generally regarded as being environmentally friendly. However we are cautioned about the need for more critical information on the effects of some accepted practices used in the organic production to confirm the environmental friendliness. The need for improved information and better transfer of this comes through in several papers. Better knowledge and understanding of ecological systems is one very important area requiring more high quality research.

88. Alternative approaches to sustainable, cost effective agricultural production still require a substantial shift in thinking to that which still predominates with respect to such practices as fertiliser and pesticide use. Here it is already evident that consumers, unhappy with these practices, are also very apprehensive about using genetic manipulation of plants and animals to make them for example more disease and pest resistant, more nutritional, more efficient in nutrient uptake and so on. It is evident that

AKS has an important role to ensure policy makers base policies and legislation on a sound scientific basis and that consumers are supplied with unbiased information on possible real hazards in order to avoid an emotionally based discussion.

89. Environmental risk assessment reports and environmental risk management strategies are likely to be more widely used in the future. Comprehensive Quality Assurance Schemes also have much to commend them and are becoming increasingly prevalent.

90. The country papers indicate that there is frequently inadequate assessment of the effectiveness of current environmental policies and strategies which suggests that the AKS could play a more important role in the field of monitoring and assessment of results using clearly defined outcomes and associated indicators.

91. Finally, one can conclude that increased collaboration on common goals between the components of AKS – research, education and extension – working in partnership with the farmers and other parts of the agricultural sector, as well as other interest groups outside the sector needs to be further improved if we are to have an environment suitable for humans to continue to live in. This is the challenge for today; for tomorrow it may be too late.