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SUSTAINABLE AGRICULTURAL DEVELOPMENT: THE ROLE OF INTERNATIONAL COOPERATION

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Human Capital Formation for Sustainable Agricultural Development

It has been a great honour and privilege, and it has given me great pleasure, to have served as President of the IAAE which, as we all know, is one of the oldest international professional associations in the world. Previous Presidents have chosen a wide variety of topics for their Presidential Addresses. Most have discussed research issues of interest to the profession and usually, of course, the subjects considered have been closely related to the theme of the Conference.

Today I will be talking not about research itself but about the training of researchers and research administrators. I want to discuss 'Human Capital Formation for Sustainable Agricultural Development'. Although, the idea of 'sustainable development' had its origins in United Nations debates of the 1960s, it gained increasing credibility in the first half of the 1980s, reaching a new level of significance with the release in 1987 of the World Commission on Environment and Development report, generally known as the Brundtland Report. Thus, in 1988, when the theme for this Conference was being considered, 'sustainable development' was very much in the ascendancy as a concept.

In recent years, there have been a large number of papers and books published; some important conferences, including the current conference, have been organized; and there have even been some previous Presidential Addresses on the topic – notably, in the context of today's meeting, Sandra Batie's very thought-provoking presentation to the American Agricultural Economics Association in 1989.

My purpose today is not to provide a definitive statement on sustainable development, nor to attempt to set a research agenda. Instead, I accept that there has been a permanent shift in public attitudes: it is not just a swing of the pendulum but a permanent shift, not only in the developed world, but also in Third World countries in favour of sustainable development. In particular, people are demanding sustainable agricultural production systems. These demands have generated enormous challenges for agricultural scientists. At the same time, university programmes and research administrators have been slow to respond. The agricultural economists' profession has the potential, in fact it has a responsibility, to play a major role in making agricultural educa-

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tion in the universities and colleges of the world more relevant to solving the problems of sustainable agricultural development.

I do *not* for a moment advocate disciplinary arrogance. I do *not* want to argue for a kind of disciplinary imperialism. Indeed, as Batie and others have pointed out, sustainable development concepts should force us to re-examine closely some of our most basic methodology. But in doing so, there is a real risk that we could 'throw the baby out with the bath water'. As one of the major social science professions closely involved with agricultural education and administration, we must not abdicate our professional responsibility in the face of the challenges posed by sustainable development issues. We have unique contributions to make to public debates in regard to sustainable agricultural development. In particular, we can contribute a great deal to the training of the next generation of agricultural scientists, administrators and agribusiness people so that they are better equipped to cope with questions of sustainability.

On a world-wide basis, the number of university and college courses in agricultural science, and related disciplines such as agricultural economics and farm management, increased dramatically in the 1950 to 1990 period. One of the most important factors influencing this growth in tertiary training opportunities was the perceived need to enlist the assistance of modern science to solve the world food problem. That is, for the last four decades, agricultural education at the tertiary level has been primarily oriented to increasing food production. Consequently, a large proportion of the human capital (researchers, extension workers, agricultural administrators and agribusiness people) created by these educational programmes has been used to address production-related problems. The result has been a massive increase in agricultural productivity. But these gains have not been achieved without putting great pressure on the natural environment.

Gradually, the negative impacts of the gains in agricultural productivity (soil degradation, salination, species extinctions and so on) have become increasingly obvious and important. The recent growing public awareness of the need to develop sustainable agricultural production systems has given respectability to ideas which previously were dismissed by many production-oriented educators, administrators and scientists as counterproductive.

University programmes have been slow to adjust to the new reality. While the intellectual challenges associated with 'making two ears of corn grow where one grew before' inspired agricultural scientists in the mid-twentieth century, the challenge for the twenty-first century is how to ensure that the hard won gains of the last 40 years can be maintained and even developed further within sustainable farming systems.

THE CHALLENGE FOR AGRICULTURAL EDUCATORS

Two fundamental changes need to be widely implemented if mainstream tertiary agricultural education and research is to answer the sustainability challenge. First, undergraduate and postgraduate curricula in agricultural science must provide a greater awareness of the long-term costs and benefits of

technological and social change. Sustainability refers not only to physical environments but to social (and economic) environments as well. Indeed, it is the conflict between these two aspects of sustainability which creates most of the fundamental problems facing Third World agriculture today.

Secondly, researchers need to be taught how to identify the real problems and to be rewarded for tackling these issues. A great deal of the agricultural research effort over the last 40 years has been misdirected. Most decisions about *precisely* what research will be undertaken are in the hands of the researchers themselves. Their concepts of 'what counts' towards their own professional advancement greatly influences *exactly* what research is undertaken. We need to question whether the traditional personal reward structures for agricultural scientists are consistent with the social goal of working towards long-term sustainable agricultural systems.

THE KNOWLEDGE EXPLOSION: THE NEED FOR A NEW STRATEGY

The amount of scientific information relevant to agriculture has expanded greatly in the last 40 years. No longer is it possible to 'cover everything', even in relatively high specialized university programmes. A new strategy for training agricultural scientists is required.

Some would advocate the holistic agricultural systems approach. While there is great merit in a systems approach to research (see, for example, Nagy and Sanders, 1990), it is not the answer in regard to agricultural education. Students still need a rigorous disciplinary base on which to build. The question is, which disciplines and what degree of depth in each is required?

The traditional agricultural science programme has been built on the basic physical and biological science disciplines. Exposure to the social and behavioural sciences has been minimal. These traditional programmes, for the most part, do not place sufficient emphasis on the social science concepts relevant to analysing sustainable development issues. A new educational strategy is required which retains a strong disciplinary basis but, at the same time, inculcates a different philosophy and set of values. The next generation of agricultural scientists, extension workers and administrators must place a much higher value on the need for agricultural technology which can increase productivity within a production system which is sustainable in social and economic terms as well as in a technological sense.

SUSTAINABLE DEVELOPMENT: SOME OF THE BROAD ISSUES

Sustainable development is a more complicated concept than many advocates of the idea acknowledge. In an excellent brief review of the issues associated with the concept of sustainable development, Veeman (1989) suggests there are three interwoven aspects to be considered: a growth component, a distributional component and an environmental component. The following three sub-sections draw heavily upon Veeman's ideas.

Growth component

Early theories of economic growth placed great emphasis on the accumulation of physical capital and the need for a high marginal rate of savings to finance capital accumulation. Gradually, the emphasis shifted to acknowledge the contribution of human capital formation to the growth process. The recent emphasis on sustainable development has added two more dimensions: the need to give greater weight to the stabilization of growth over time and to the intergenerational implications of economic growth; and the need to emphasize the role of natural resources in long-term economic growth.

There are two major difficulties with the traditional approach to analysing economic growth which the recent sustainability debate has moved to centre stage. The first concerns the hypothesis that the role of natural resources in economic progress declines as economies become more industrialized. There are at least two compelling reasons why this hypothesis should be rejected. First, many of the natural resource products and services which are inputs to human well-being (such as clean air, personal space and 'green' surroundings) are not included in the conventional indicators of growth such as changes in GNP. Secondly, the income elasticities of demand for these (mostly non-market) products and service appear to be extremely high. Therefore, from both the supply side and the demand perspective, natural resources tend to become increasingly important determinants of aggregate human welfare as growth progresses.

The second major difficulty with conventional discussions about growth which the sustainability debate has highlighted is that national accounting measurement procedures do not allow for the depreciation/deterioration in natural resource assets. Improvements in national income (and hence economic growth) based on changes in such indices as GNP, therefore, may seriously overstate the true rate of improvement in the welfare of society. Economic progress, especially in the Third World but also in wealthy countries, makes sustainable development possible. Yet, paradoxically, the growth aspect of sustainable development is frequently in conflict with the other two aspects of sustainable development (that is, the distributional and the environmental aspects). Agricultural students need to be educated to appreciate the complexity of this paradox. They must be given a conceptual framework and a set of analytical tools/skills with which to resolve this conflict on a case-by-case basis. Traditional agricultural science curricula have concentrated on scientific and technological approaches to increasing productivity and hence growth. They have not developed human capital which can recognize and contribute to the solution of the growth/sustainability paradox. Hence the emergence of a plethora of environmental science courses. Agricultural scientists have become the 'bad guys' trained to exploit the natural environment in the name of agricultural development. Environmental scientists are the 'good guys' trained to protect the environment.

Agricultural educational programmes for the future must seek the middle ground. They must be designed to train people who can devise agricultural production methods which both contribute to increased productivity (growth)

and satisfy the distributional and environmental aspects of sustainable development.

Distributional component

Economic growth only becomes economic development when the benefits of growth are widely distributed. A major debate has emerged in the last decade about whether agricultural research projects should be screened for distributional consequences. Research, for example, which promises to lead to significant growth (increased agricultural productivity) but which will benefit larger, wealthier landholders rather than the poorer smallholders, is seen as inappropriate research. This raises at least two questions.

First, can research administrators identify such 'inappropriate' research *ex ante* with any certainty? Research originally conceived as inappropriate on 'distributional' grounds may become most appropriate *ex post*. As in the case examined by Yee and Longworth (1985), this could occur because the advances achieved eventually prove not to be biased either towards wealthy/larger producers or towards certain factors of production (such as capital) because conditions in the factor markets (and hence factor rewards) change during the gestation of the research. Secondly, and more fundamentally, should agricultural research be used to solve distributional problems in the rural sector? Research policy is an extremely blunt instrument with which to attack such problems. Other more direct policy measures such as tax reform and land reform are more appropriate.

This is not the place to pursue this debate. However, it illustrates the critical need for agricultural educators who are training future agricultural researchers and administrators to acquaint their students with these broader issues of research policy. While the need to develop appropriate technology in a technological sense is relatively straightforward, the broadening of the definition of appropriate technology to encompass its distributional consequences raises a more complicated set of issues. Most agricultural science students are not being trained to understand or to address these distributional aspects.

Environmental component

Economists have a long tradition of tackling environmental issues rather differently from biological scientists. The concepts of externalities, property rights, optimum rates of depletion and option values are only four of the many ideas which economists have developed to help analyse environmental issues. Perhaps the biggest difference between the economists' paradigm and that of most biological scientists is that economists do not perceive natural resources as a fixed quantum with a predetermined finite capacity to satisfy the needs of mankind. Instead, economists stress the ingenuity of man. Our capacity to adjust over time and our creation of new institutions (for example, property rights), technological change (for example, development of fusion energy)

and substitution opportunities (such as alternative food sources) can all greatly change the value to society of a particular set of natural resources. In general, economists are more optimistic and positive about the environmental component of sustainable development than most biological scientists (Goeller and Weinberg, 1976).

Natural resources are often grouped into renewable or flow resources (fisheries, forests, rangelands, natural populations and so on) and non-renewable or stock resources (minerals, for example). For certain analytical purposes, this is a most convenient division. In the case of renewable resources, a number of conservation or management strategies have been suggested, such as maximum sustainable yield (MSY) and optimum stocking rate or carrying capacity, by biologically trained scientists. Unfortunately, in practice, it is usually extremely difficult to implement these strategies with any degree of precision. Furthermore, they are not usually optimal in an economic sense. Normally, for example, the economic optimum level of use for a renewable resource will be less intensive than that suggested by the MSY criteria. This is another instance where the paradigm of the economist is more constructive and positive with respect to the environmental component of sustainability than the approaches advocated by ecologists and other biological scientists.

There is a world-wide need for mankind to develop appropriate policies and management strategies for renewable resources such as soil, pastures, native forests and native terrestrial and marine animal populations. In many parts of the world, over-exploitation is causing irreversible changes. Renewable resources are becoming non-renewable. Appropriate policies and management strategies cannot be developed, nor successfully implemented, from a purely biological perspective. For example, new institutions which create appropriate economic and social incentive structures are usually required. To be relevant in the future, agricultural research will need to address these non-biological constraints to the development of sustainable systems.

This last point is illustrated on a grand scale by rangeland degradation and desertification in the half of China known as the pastoral region (Zhang *et al.*, 1991). The introduction of new physical and biological technology as part of "The Great Leap Forward" (1958–61) had a disastrous impact on the rangelands of north and north-western China. The situation has been exacerbated by the reforms of the early 1980s (Liu *et al.*, 1991). Although these changes have led to substantial and widespread development, the production systems on which this progress has been based are not sustainable in the long term (Longworth *et al.*, 1990). While the reforms have created new incentives for the utilization of the natural pasture resources of the region, the necessary institutional arrangements to discourage or prevent exploitation by over-grazing are not in place. Further major socio-economic institutional reforms will be required in the pastoral region of China if massive and irreparable damage to the rangelands is to be avoided (Niu and Chen, 1991; Williamson and McIver, 1991; Du *et al.*, 1991).

In the case of non-renewable resources, questions about how and when they should be utilized raise such issues as intergenerational equity, option values and resource stewardship. Indeed, even such fundamental philosophical ques-

tions as the rights of man versus the rights of other living creatures, may also be raised.

None of the ideas and broad issues discussed above are new, yet traditional agricultural science education, based as it is on the basic biological and physical sciences, does not equip students to address these complex matters. Future training programmes will need to recognize and remedy these deficiencies.

THE CHALLENGE FOR AGRICULTURAL RESEARCH ADMINISTRATORS

Agricultural scientists have made great progress in the last 40 years in terms of raising agricultural output per unit of land and per unit of labour. A great deal of 'the right' research must have been successfully undertaken. At the same time, enormous amounts of time and effort (money) have been devoted to 'research' which has had no practical pay-off. A major part of the motivation for most research activity is the personal rewards it will bring to the researcher. Research administrators and policy makers must be careful to structure the reward system so that 'appropriate' research is rewarded the most. Unfortunately, traditional reward structures for agricultural researchers, especially those employed in publicly funded research institutions and universities, do not encourage people to address directly the complex problems associated with sustainable development. The long-term, multi-disciplinary, non-scientific features of the problems involved 'frighten' young, ambitious and capable agricultural scientists.

The challenge for agricultural research administrators of the future is how to attract the best researchers to these complex areas of research. Two major barriers to progress are the conventional disciplinary divisions between research groups and conventional wisdom among agricultural scientists as to what constitutes 'good research'. Researchers, like all human beings, prefer to work with and to receive the acceptance (accolades) of their peers. Consequently, research institutes and university departments tend to develop enclaves of scientists of like training (and hence values). Cross-fertilization of ideas is actively discouraged because the 'best' journals in any field only accept research papers which maintain the traditional paradigm for that discipline. Future agricultural research administrators will need to break down these disciplinary barriers if worthwhile research on the development of sustainable systems is to be undertaken.

For most agricultural scientists, the personal need to be accepted as a scientist is in conflict with their social responsibility to tackle the major sustainability problems facing agricultural industries. Agricultural educators and research policy makers and administrators need to be fully aware of this conflict. Unless this problem is addressed, the *raison d'être* for agricultural science education, as distinct from a general scientific education, will disappear.

CONCLUSIONS

Sustainable agricultural development is like motherhood: no reasonable person is opposed to the idea in principle. Yet, in practice, much of modern agricultural output arises from production systems which appear to be unsustainable in the longer term. Gradually, the future sustainability of a large part of agricultural production has become an important issue in many countries. Agricultural educators, scientists and research administrators who have played a major role in the development of modern agriculture over the last 40 years have been slow to recognize the new challenges ahead.

There are no easy solutions. However, the problems associated with sustainability are not amenable to purely scientific solutions. The economic and social dimensions are critical if meaningful progress is to be achieved. Agricultural economics, farm management and rural sociology have been the poor cousins of the biological and physical science branches of agricultural science for the last four decades, yet these social science disciplines can make major contributions towards a better understanding of how to develop and establish sustainable agricultural systems. Sustainability issues will require agricultural educators, scientists and research administrators of the twenty-first century to place greater emphasis than has been the case in the past on social and economic aspects of agricultural production systems. The agricultural economics profession needs to adopt a proactive role to ensure that this change of emphasis occurs.

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SECTION I

Global Strategies for the Development of Agricultural and Rural Resources

