General Discussion

Chairpersons :Kang, B.T. (IITA), Inoue, T. (Japan), Sudjadi, M. (Indonesia) and Wakatsuki, T. (Japan).

Chairman : Kang, B.T. (IITA) : I would like to suggest that we discuss first several definitions of sustainability. As proposed by ICRAF, sustainability should involve production and conservation. For the CGIAR, productivity and sustainability should be combined. According to ASA (1989), sustainable agriculture is one that over the long-term enhances environmental quality and the resource base on which agriculture depends. It should provide for human food and fiber needs, be economically viable and enhance the quality of life of the farmers and society. For UNEP, sustainable agriculture is ecologically sound agriculture which secures maximum stable yield for renewable resources but conserves or even increases the value of non-renewable resources. As I mentioned yesterday, at a lower level of sustainability, sustainability is the ability of a production system to produce a stable annual yield of the desired crop over a long period of time.

Chairman : Wakatsuki, T. (Japan) : The concept of sustainability comes from the World Commission on Environment and Development (Brundtland Commission : "Our Common Future"). In this report emphasis is placed on sustainable development, which implies that human needs must be satisfied.

Randhawa, N.S. (India) : In the definition of sustainability, the human element is present. In the Indian context, I feel that the continuous improvement of the threshold of production may lead to permanent desertification. In the case of Punjab, 1.5% of the area contributes to the production of 11% food grains, 28% cotton, 11% milk, 2,000.000 tons of food surplus, 11% fruit, 7% sugar, etc. Food grain production increased from 1.24 million tons in 1947 to 18 million tons presently. The limit of production is going to be determined by the hydrological balance which is markedly disturbed (over that period the water level decreased by 30 feet), as fossil water is being currently used. To prevent desertification from occurring, it will be important to decide which is the most critical element in sustainability for the future generations. The problem is how to sustain a growing population and satisfy a minimum level of aspiration and how fixed land resources with competing demand on them can contribute to maintain the quality of life for the populations. Sustainability should be considered in terms of such parameters as biotic pressures on land unit including requirements for man, livestock and wildlife.

Bentley, C.F. (Canada) : I would like to submit a definition of sustainability as follows : Sustainable agriculture entails systems of agricultural production and land use which are suited to the agro-climatic regions and soils concerned to take into account diversity and which employ soil and crop management practices and cropping systems (crop rotations) which without subsidies maintain or enhance long-term soil quality and productivity without cumulative or short-term adverse effects on the healthfulness of food or the environment. I believe, indeed that the healthfulness of food is an important factor.

Takase, K. (Japan) : Sustainability must take into account the need for development and production while making effort to preserve the environment, in other words, sustainability must be conceived in terms of development for creating a better environment for human beings.

Chairman : Sudjadi, M. (Indonesia) : I would like to ask Prof. Bentley why he referred to the absence of subsidies in his definition of sustainability. In some countries sustainability cannot be achieved without the intervention of the government in the

form of subsidies.

Bentley, C.F. (Canada) : Government policies can have a considerable influence on agricultural systems and production but in many developed countries, 30 to 70% of the net farm income is derived from subsidies. Agriculture which requires such a high level of subsidies is not sustainable.

Randhawa, N.S. (India) : Sustainability must be considered in terms of economic competitiveness.

Greenland, D.J. (UK) : Do you consider as subsidies government financial intervention for land management measures aimed at erosion control or other factors?

Bentley, C.F. (Canada) : If production increases as a result of such measures and if there is a net return on the investment, the term subsidies should not be used.

Craswell, E.T. (FAO) : According to the Brundtland Commission, sustainable development can be defined as one that meets the needs of the present without compromising the ability of future generations to meet their own needs. The Technical Advisory Committee definition of sustainable agriculture is as follows : "Sustainable agriculture involves the successful management of natural resources to meet changing human needs without damaging the environment and the natural resource base". Both definitions imply that sustainability has dynamic dimensions which must be kept in mind. We need now to move from these general definitions not to more specific definitions but to setting the criteria by which sustainability can be measured in our research. This is necessary before sustainability can be operationized in research programs.

Chairman : Kang, B.T. (IITA) : We will now analyse in greater detail some of the soil constraints on sustainable plant production depending on the agro-ecological zones as well as the measures that can be taken for their alleviation.

Young, A. (ICRAF) : The constraints on the application of improved management measures vary with the regions, the environments, farming systems, etc. The classical approach to this diversity of constraints that may be related to an inefficient national fertilizer distribution system, severe moisture competition problem or marketing problems is to develop techniques and wonder how they could be applied by the farmers. In contrast, the approach of "diagnosis and design" begins with the farmer : an appraisal of land use problems and of constraints to their solution. An improved land use system (it need not be agroforestry, the approach is applicable to all kinds of land use) is then developed which can be applied within the known constraints. The research needed to validate this improved system is then carried out. Thus acceptability is "built into" the research from the start. This is by no means the only approach and I believe that ICRAF "over-sells" diagnosis and design. The approach to research which starts from an appraisal of scientific potential also has a part to play. The optimum lies somewhere in between. What is certainly important is to keep in contact with farmers throughout the conduct of research.

Randhawa, N.S. (India) : Very often the technologies developed at the experimental stations cannot be adopted by the farmers and production optima cannot be achieved due to social, cultural, economic, administrative, legal, institutional, legislative, marketing limitations at the farm level in addition to the need for fine-tuning of the techniques to fit them to specific eco-situations.

Bentley, C.F. (Canada) : Twenty years ago an American political scientist once wrote that given time and resources we now have the capability to solve most technical or scientific problems whereas we do not have a good record of solving social, economic and political problems. Incidentally, in the current symposium, except for the reports from CIAT and ILCA there was little reference about the role of animals in

agriculture, although they are a significant part of agriculture in many areas. In the developing countries there are very few areas except in Latin America where a major effort is made to implement measures for the production of animal feeds by research on crops and to incorporate them into cropping systems. Vast areas in the developing countries of Asia and Africa lack wood for cooking and use crop residues and dung, thereby reducing fertility and productivity maintenance by return of dung and residues to the land. For many soils, naturally compacted subsoils or cultivation-induced compaction limit the rooting zones of grain or other crops, hence preventing crops from getting nutrients and moisture from below the superficial soil layer. Strong-rooted crops such as pigeonpea, alfalfa and chickpea can improve such soils. The search for woody species, forage and other strong-rooted crops to act as biological sub- soilers and for other uses has been entirely inadequate. The World Bank West Africa Agricultural Research Review (1986) asked the agricultural research agencies of 27 countries what were the estimated needs for research personnel for the 15-year period from 1985 to 2000. The answers were as follows: 36% for plant breeding and grain production, 6.5% for animal aspects, 5% for soil and 0% for forage crops. These figures indicate that there is a considerable imbalance in the agricultural research systems as there is an excessive concentration of research on grain production. For sustainable agriculture, more attention will have to be payed on achieving a better balance between these aspects.

Chairman : Sudjadi, M. (Indonesia) : The comments by sociologists or economits would be important in such a discussion. The technical problems can be relatively easily solved unlike problems relating to policies or economic or social aspects. The communication between researchers and policy makers should be improved.

Randhawa, N.S. (India) : I believe that sociological factors, in particular changes in social values, land tenure, structure of social groups should not be overlooked when environmental problems are considered. Indeed societal input in environmental security is vital.

Chairman : Kang, B.T. (IITA) : We will now concentrate on some of the physical and biological constraints in the various agro-ecological zones. I would like to ask Dr. Jones to indicate which are the main constraints on sustainable plant production in the arid region and which measures could be adopted to mitigate them.

Jones M.J. (ICARDA) : In the arid region the main constraint to sustainability is to maintain the soil in position. Therefore, erosion control and conservation of the natural vegetation in grazing lands are essential. The main constraint on productivity is efficient water use.

Young, A. (ICRAF) : An other constraint is the absence of responsibility for the maintenance of the land resources and ownership or resource conservation, in terms of land tenure.

Greenland, D.J. (UK) : Salinity is a major problem in arid lands and in irrigated arid areas.

Jones, M.J. (ICARDA) : In the Mediterranean region, the use of fossil water for irrigation is a very serious problem due to the dropping of the water table, in other words the disruption of the hydrological balance. I believe that the correct land use in dry areas should be grazing land and the natural vegetation of this grazing land should be maintained for sustainable use.

Chairman : Kang, B.T. (IITA) : Agroforestry is another alternative for land use as well as crop rotation. Land tenure is also important.

Chairman : Kang, B.T. (IITA) : We will now consider the humid and sub-humid regions.

Toledo, J.M. (CIAT) : The sub-humid zone in Latin America is mainly represented by savanna lands.

Chairman : Kang, B.T. (IITA) : The main constraints in the humid and sub-humid regions

include acid poor soils, high biotic stress, deforestation and soil erosion. Minimum tillage systems and proper crop residue management, in other words, conservation farming could help alleviate the constraints.

Young, A. (ICRAF) : In the sub-humid and humid zone of Asia it appears that swamp rice cultivation is a sustainable and highly productive agricultural system per unit area. I wonder why farmers in Africa and Latin America do not grow more rice?

Chairman : Sudjadi, M. (Indonesia) : The cultivation of rice in Indonesia requires a high investment. The program drafted by the government to increase the rice cultivation area is not making much progress because there are not enough suitable areas for irrigation and the government has to subsidize the maintenance of the irrigation facilities.

Toledo, J.M. (CIAT) : The suggestion of Dr. Young is good only for specific areas where irrigated rice can grow. I would like to suggest that in the upland humid and sub-humid region sustainable agriculture could be achieved by promoting plant adaptation to acid poor soils and the implementation of agropastoral and agrosylvopastoral systems.

Chairman : Sudjadi, M. (Indonesia) : In the humid and sub-humid zone shifting cultivation is a constraint.

Chairman : Kang, B.T. (IITA) : Soil compaction is also a constraint. The use of deep-rooted crops could be advocated for the improvement of the physical soil properties.

Randhawa, N.S. (India) : For plant adaptation, for example to acid soils with a high aluminum toxicity, plant manipulation through the use of biotechnological procedures could be recommended in order to avoid the use of ameliorative materials based on fossil fuels and achieve sustainability.

Chairman : Kang, B.T. (IITA) : The concept of nutrient constraint would be more appropriate in the context of the discussions.

Young, A. (ICRAF) : In Africa where fertilizers are not much used, biological nitrogen fixation should be promoted to alleviate the soil fertility decline in order to achieve sustainable agriculture.

Chairman : Kang, B.T.(IITA) : We will now analyse some of the constraints affecting lowland and wetland areas and consider some measures for possible alleviation. Nutrient loss is a serious constraint in wetland rice. Rotation with a dryland crop would be desirable to promote sustainable agriculture. Also recycling of organic matter would be important.

Chairman : Wakatsuki, T. (Japan) : In Asia it appears that lowland rice cultivation ("sawah", the Malay-Indonesian term for levelled bunded field) is sustainable.

Greenland, D.J. (UK) : There is substantial opportunity for lowland rice development in Africa (30 million hectares of wetlands are suitable for rice cultivation, versus 140 millions in the world). However there are major policy constraints hindering wetland development, including the insufficient amount of subsidies for land development, problems of water management over large areas and the low price given to the farmers.

Craswell, E.T. (FAO) : Regarding the rice-based systems, it must be recognized that very intensive systems such as rice/cereal (wheat) rotations are experiencing yield decreases for unknown reasons currently examined jointly by CIMMYT and IRRI. Rice-based lowland systems may not be always sustainable.

Chairman : Wakatsuki, T. (Japan) : I believe that in the tropics there are only two farming systems that are sustainable, namely shifting cultivation systems under low population pressure (less than 10 persons/km^2) and "sawah"-based systems under high population pressure (more than 100 persons/km^2).

Chairman : Kang, B.T. (IITA) : We should be concerned about the occurrence of yield

decline in intensive rice-based/cereal systems in certain areas. In Bangladesh for example, in spite of the increase in the amount of fertilizers applied, it appears that over the last 6 year period such a yield decline has been recorded in rice-rice systems, presumably due to organic matter depletion.

Note

Discussions on the development of technologies for the alleviation of soil constraints on sustainable plant production and their transfer which had been originally planned could not be held due to the lack of time.

Based on the comments and suggestions made by several participants in the symposium, the following orientation of technologies to achieve this objective can be proposed.

1 Efforts should be made on the part of governments or regional organizations to further promote the development of detailed land use models for sustainable agriculture based on projection of population increase and climatic changes in various agro-ecological zones of the tropics. The presentation of such models to policy makers of the respective countries and regions may be more convincing for the drafting of land use plans.

2 Emphasis should be placed on studies on the soil-plant relations to improve the adaptation of plants to adverse soil conditions and promote biological fixation for better utilization of nutrients through the use of biotechnological procedures including genetic engineering. Models on nutrient cycling and water use should also be constructed.

3 For soil conservation, research on new materials, including synthetic mulches, sub-soilers, improvement of fertilizer composition and efficiency should be promoted as it appears that the use of crop residues and application of conventional fertilizers may not afford sustainability in the long-term.

4 Emphasis should be placed on the development of conservation technology involving the efficient recycling of resources including water, plant residues and animal wastes.

5 As for the transfer of technology, the cost of development of new methods or materials which may be high should be mainly borne by the developed countries within the framework of ODA budget. Research should be carried out in collaboration between scientists belonging to institutes of both developed and developing countries in the developed countries or at IARCs where sophisticated equipment is available and in the developing countries to assess the suitability.

It is also essential that the methods or materials eventually developed be applicable at a low cost and under low input in the developing countries.