

Summary of Session 3 : Technological Issues after the Green Revolution

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The Green Revolution certainly contributed to the introduction of modern high-yielding varieties and brought about changes in cropping systems and crop management, in particular for rice. The session covered mainly the production of rice which was further expanded to other crops, cropping systems and farming systems. The papers presented in this session can be broadly divided into two groups. The first group mainly focused on particular technologies developed for the Asian region such as resource management, cropping systems and so on. The overview was given by Dr. Kabaki followed by Dr. Kokubun and myself to introduce research on technology development at JIRCAS and IRRI. Technological aspects and problem related to rice-wheat cropping system, which is widely adopted in the Indo-Gangetic plains region, were presented by Dr. Abrol in detail. The second group focused more on processes rather than the individual technology. The processes of the farming system evolution were described systematically by Dr. Son using an example of Mekong Delta. The adoption processes of a new technological package into farming communities in Indonesia were clearly presented by Dr. Suryana together with its assessment processes.

Highlights of papers presented in this session are summarized below :

1. The introduction of high-yielding varieties led to the intensification of crop management and cropping systems, including the increase in the use of agricultural inputs (fertilizers, pesticides, herbicide), the increase in the frequency of croppings and the promotion of crop rotation (rice-legumes). As a result, both crop production and acreage increased and irrigated areas expanded during the seventies and eighties. Thereafter, however, yield stagnation became a main concern in intensive rice-based cropping systems. The causes of yield stagnation are diverse, including the reduction in biodiversity due to the increased application of external inputs, the occurrence of pests and diseases, water management-related problems and decrease in soil fertility. Increase in crop production resulted in changes in the socio-economic conditions, including industrialization in urban areas, decrease in land area devoted to agriculture, decrease in water resources allocated to agriculture, shortage of labor in the agricultural sector. Yet agricultural production must still increase while the need to protect the environment must be considered. This situation leads to the development of alternate systems of cultivation. For example, the dissemination of rice direct seeding culture requires the development of methods of weed control. Integrated weed management should be promoted since the tendency to use increased amounts of herbicides due to labor shortage exerts a deleterious effect on the environment. Also rice direct seeding culture requires the adoption of minute water control for weed management. Postharvest technology and methods of quality control should be further promoted. Research on multiple cropping systems including rice-upland crop rotation such as rice-wheat system should be upgraded as rice monoculture

is not an ideal system. Such rotations would enable to suppress weeds as well as injury by nematodes and fungi, while nitrogen availability could be increased by soil drying.

2. The description of the three comprehensive projects implemented by JIRCAS indicated the importance of the integration of multi-and inter-disciplinary approach, including physiological, ecological, socio-economic aspects for a better understanding of ecosystems and for the development of a rational system of management of ecosystems.

3. Technology development should include technology transfer and assessment as indicated by Dr. Suryana. The program implemented in Indonesia involved a technology package consisting of the use of high-yielding local varieties, application of direct seeding systems, locally produced fertilizers, introduction of mechanical tools, use of free land cropping stand. Assessment indicated that higher productivity and higher land gross profits could be achieved. In another example, in the Mekong Delta Development Project, diversification of cropping systems was emphasized as rice monoculture is associated with low rice prices, uncertain market, poor marketing facilities and negative effect of intensified farming technology on the environment. Development proceeds through two matrices, namely horizontal development depending on the utilization of natural resources and vertical development depending on the utilization of farmer's knowledge and resources and mobilization of farmer's contribution.

4. The technology development in agriculture should involve two aspects: 1) Seed-based technology which should enable to break the yield plateau for irrigated ecosystems and incorporation of tolerance to biotic and abiotic stresses for rainfed ecosystems, even upland ecosystems. In this approach, local and specific environments, local preferences and local marketing structure should be considered, while placing emphasis on farmer's participation in the various processes, including breeding. 2) Resource and knowledge-based technology. The development of technology in research institutes or in the private sector should become increasingly knowledge-intensive and locally or site-specific. The development of technology packages and farmer's participation approach are important. In technology development, environmental effects are essential if it is to be long-lasting. For technology transfer and assessment, recognition of target regions in the two way matrices as recommended by Dr. Son is most suitable while the Indonesian model could be adopted for the formulation, implementation and assessment of a program.