Concluding Remarks

David Molden
International Water Management Institute (IWMI)

The symposium brought together researchers from a wide variety of disciplines and a number of countries to address important issues of water scarcity. It was truly a learning experience, and demonstrated the need for people with different skills to come together to meet the challenge of water for sustainable agriculture to meet food security goals. To meet the challenge, environment-friendly strategies are required. Agriculture has multiple functions besides food production, including food security, land conservation, and creation of a favorable landscape. Agricultural water management can support this multifunctionality of agriculture, supporting multiple uses like drinking water, bathing, and supporting ecological services. These were the challenges set forth in the introductory sessions.

The opening sessions stressed the need for a multi-disciplinary approach to increasing the productivity of water. This is an effort that requires skills in breeding, agronomy, water management, and expertise in rainfed agriculture. There is a need for closer collaborative ties between Japanese scientists, CGIAR centers, advanced research institutes, and developing country researchers. It will require a great deal of effort in capacity building. In the spirit of multi-disciplinarity and collaboration, the conference first took a global point of view, then proceeded to present the role of crop breeding, agronomic practices, water management, and approaches in rainfed agriculture in arid and semi-arid regions.

Global models show us that many regions will face water scarcity, and that the situation will worsen in the future. The amount of additional irrigation is a key factor for the future sustainable use of water. It was argued that at present there is a water crisis, characterized by malnourishment and environmental degradation. The challenge then is to develop and manage water for both food and environmental security in light of increasing stress on water resources.

Improving water productivity in agriculture is necessary to solve the water crisis. But, it is not sufficient. In addition, there needs to be focus on water for improving livelihoods, and promoting approaches that support the many other human and environmental uses of water. Special attention needs to be given to those regions such as many locations in sub-Saharan Africa, where water development has not been as intensive as in Asia. People face water scarcity because of lack of access to adequate and reliable supplies for agriculture and other uses.

Future water development and management approaches should include "ecotechnologies" in irrigation. Important trends will be 1) landscaping irrigation, 2) individualizing irrigation, 3) diverse cropping patterns and use, 4) communalizing rural development plans and implementation, 5) regionalizing irrigation for combined rural and urban water management. Key messages are to pay attention to local adaptations, and to listen to the people in developing and using water for agriculture. Because of different environments, we need to look for revolutions (as opposed to just one like the Green Revolution). We need to look for

technologies that can be adapted locally.

The presentations then moved to focus on crop management and breeding. Again, a variety of ecological approaches are needed to reduce crop water stress: root length, intercropping, mulching, conservation tillage, plant traits for escape, tolerance and recovery. We heard how traditional breeding can be assisted with DNA markers for selection of new cultivars with enhanced adaptation to water-scarce environments. A breeding paradigm of genotype x environment x crop management x policy x institutions x people was introduced to show the important human dimension in breeding. Biotechnology appears to hold keys important to help crops, and poor farmers, deal with water stress. Exciting research is on-going to identify promoters of drought, salt, and cold resistance in many important crops.

Soil tillage, and understanding soil properties play a crucial role in the improvement of water use efficiency. For example, compacted layers below soil surfaces often cause unstable crop production. Sub-soiling technologies have allowed more effective crop water use. We learned that unsaturated hydraulic conductivity limits the rate of water movement from soil to plants, and that a better understanding of soil-water characteristics is important for design of irrigation. We learned that trickle irrigation can and cannot give increases in WUE, and that design criteria may poorly match individual soils. While we may have thought that trickle irrigation is relatively advanced, it appears that still basic and applied research will yield gains in WUE.

To get more crop per drop, we need to move the basic research to farmers fields. We had excellent examples of applied research in Thailand, Sri Lanka, Mali and Senegal aimed at increasing productivity, farmer income, and stimulating rural economies using integrated biophysical, agronomic, socio-economic approaches with particular attention to farmer decision-making. Farm ponds in rainfed areas were shown to have an impact on yields and crop failure. Insurance irrigation in dry periods can reduce vulnerability, and increase income by growing horticultural crops. It was shown that there is scope for improvement in productivity in tank cascade systems in Sri Lanka considering combined water and labor availability. Decision support tools can help in developing options for people to manage water, land, and labor resources better.

Arid and semi-arid Africa holds a special challenge, crossing a range of climate and agro-ecological situations. The appropriate management of water resources is indispensable. Fortunately there are successful cases integrating water into agricultural development programs in Kenya. While not in Africa, Saudi Arabia has shown that precise water management can help increase production in arid areas. Provision of affordable access to water will play an important role in livelihood improvement. We had examples from Senegal where trust by the local community leads to success. We also understood that women manage most of the rural activities in Senegal, and many other locations, so special attention is necessary for poor women.

There remain several basic questions - how much irrigation, and what type of irrigation will be needed in the future? An exciting area of research lies in between the continuum of fully rainfed to fully irrigated agriculture. How can the adoption of promising technologies, management approaches and tools be promoted?

I would like to thank JIRCAS for bringing a group of researchers with a variety of interests together. On behalf of those coming from abroad, we give special thanks for the chance to learn from the symposium and to interact with Japanese colleagues. We request JIRCAS to help promote sustainable water management practices by actively engaging the international community in scientific exchanges and field research, and sharing the knowledge of Japanese scientists. I hope that this symposium marks an important beginning and milestone for collaborative research for the better management of water resources. A special thank is required for the organizers of the symposium.