



ICID News

2011/4

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Message from the President

Dear Friends and members of ICID family,

I am very pleased to write this first message as the new President of ICID. It is indeed an honour to serve as your President. First of all, I would like to thank you and all National Committees for electing me as the President of ICID. ICID is the organization that I like to contribute to and devote whole heartedly. I wish to assure you that I will do my best to uphold the Office of the President and to work closely with all National Committees and members of various workbodies in order to fulfill our mission.

Taking this opportunity, on behalf of the entire ICID family I would like to express heartiest thanks once again to Iranian National Committee and Local Organizing Committee for their exceptional work and efforts in hosting the 21st Congress, the 62nd IEC meeting and the 8th International Micro Irrigation Congress very successfully. My special thanks must go to Prof. Chandra Madramootoo, President Hon., Er. M. Gopalakrishnan, Secretary General, Vice Presidents Hon. Dr. (Mrs.) Samia El-Guindy, Dr. Shinsuke Ota, and Prof. Lucio Ubertini for their valuable contributions to ICID.

During the past 62 years, ICID has dedicated to enhance the worldwide supply of food and fiber for all people by improving water and land management and the productivity of irrigated and drained lands through appropriate management of water, environment and application of irrigation, drainage and flood management techniques. ICID has made remarkable contribution to the sustainable development of irrigated agriculture, global food supply and poverty alleviation. However, with growing population, water scarcity, impact of climate change, and expansion of

biofuel crop area, global food security scenario is becoming more and more serious and complex. In 2010, the number of undernourished population was 925 million. There are enormous challenges to achieve the MDG for food security.

Given these huge challenges, ICID will continue to promote the sustainable development of irrigation and drainage to increase irrigation water use efficiency and water and land productivity. Current global irrigated area is only 19% of the total farmland of the world and about 55% of the food production comes from irrigated/drainage land. Irrigation has played and will continue to play an important role in increasing global cereal production. To cope with climate change and water scarcity threats, we need to modernize our existing irrigation and drainage infrastructure. Some countries have already enhanced their investment in irrigation sector. Thus, the good news is that there are opportunities to extend new and improved techniques and management measures for increasing water use efficiency and productivity.

There is an urgent need to strengthen the capacity building in irrigation and drainage sector, especially in the developing countries. Exchange of experiences, knowledge and information among ICID fraternity will make a difference for the developing countries to increase their water use efficiency and productivity, and help address their food and water security concerns. The world needs a strong ICID, which is based on the strength of our National Committees and various workbodies with the active involvement of irrigation and drainage professionals, especially young professionals. We need to work actively to strengthen the cooperation among ICID National Committees and



further reinforce the collaboration with the related international organizations.

The 3rd African Regional Conference will be held in Bamako, Mali, from 29 November to 5 December. I am glad to tell you that about 200 participants including the representatives from FAO, the World Bank and other international organizations will attend this important ICID event. I will attend this conference and hope that this event will help the African region in promoting irrigation development and contribute towards addressing the water and food security in the region. I am aware that some developing countries, especially the least developed countries (LDCs) have financial problems to attend ICID events. In this regard, we have to seek ways to help them. I am pleased to inform you that CNCID will support 6 delegates from African countries to attend the 3rd African Regional Conference.

In our member countries, there are many remarkable and historic irrigation, drainage and flood control projects. These projects

Continued on page 2/-

International Commission on Irrigation and Drainage (ICID) was established in 1950 as a scientific, technical and voluntary not-for-profit non-governmental international organization. The ICID News is published quarterly by ICID Central Office, New Delhi, India.

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are not only the facilities and structures for better water management, but also are the great cultural heritage. I am always encouraged and moved by the wonders of these projects and we can draw spirits from them towards sustainable development of irrigation, drainage and flood control schemes.

No doubt, we are facing many challenges, but we also have many opportunities. It is the spirit of ICID family to unite and work together and to help each other to realize

our goals. I am ready to work closely with all members of ICID family to fulfill the mission of ICID. Currently under the leadership of President Hon. Prof. Bart Schultz, we are actively involved in the preparations of the Thematic Priority 2.2 "Contribute to food security by optimal use of water" of the 6th World Water Forum. The Australian National Committee is fully geared up in preparation of the 63rd IEC meeting and 7th Asian Regional Conference, which are only 7 months away. Let us work together to achieve

more and contribute more to the sustainable development of irrigated agriculture, which eventually contribute to global food security and poverty alleviation.

Best regards to all.

Yours truly,

Gao Zhanyi

Dr. Gao Zhanyi,
President, ICID

Report from Tehran Congress

More than 1200 professionals, scientists, irrigation managers, policy makers, consultants, and students from 55 countries and international organizations gathered in Tehran from 15 to 23 October 2011 to participate in ICID's 21st International Congress on Irrigation & Drainage, the 8th International Micro-irrigation Congress, and the 62nd meeting of the International Executive Council.



H.E. Mahmoud Ahmadinejad, President, I.R. of Iran (inset) addressing delegates at the Opening Ceremony of the 21st Congress

The 21st ICID Congress was opened by H.E. Mahmoud Ahmadinejad, President, I.R. of Iran. The event was graced by the presence of high profile guests and dignitaries - H.E. Pawan Kumar Bansal, Minister of Water Resources from India; H.E. Khalilian, Minister of Jihad-e-Agriculture, H.E. Namjoo, Ministry of Energy, I.R. of Iran; H.E. Dr. Shavkat Khamraev, Deputy Minister of Water and Agriculture, Uzbekistan; H.E. Li Guoying, Vice Minister, Ministry of Water Resources, China; H.E. Eng. C.K.Chiza, Deputy Minister of Agriculture, Republic of Tanzania; Pres. Chandra Madramootoo, Presidents Hon. Aly Shady, Prof. Bart Schultz, Peter Lee and serving Vice Presidents and Vice Presidents Hon., and Senior Officers from the FAO, ADB, and WWC.

The event was hosted by the Iranian National Committee (IRNCID) with the leadership of H.E. M.R. Attarzadeh, Deputy Minister of Energy for Water and Wastewater Affairs, and Chairman, IRNCID and Dr. S.A. Assadollahi, Secretary General, supported by several Ministries and National Organizations (Private and Government) from Iran. All the events were held at the magnificent IRIB International Conference Center (IICC), Tehran.

The theme of the Congress was "Water Productivity towards Food Security". More than 200 papers were presented during the Congress. Besides the Congress, meetings of 30 ICID workbodies, workshops and a large technical exhibition were held. The other side events held were

FAO side event on Investment in North Africa; Australian Special Session; FAO-ICID Special Session, Special Session on 6th World Water Forum, and the Young Professionals meeting. During the Opening Session, three publications (a) Towards Sustainable Development of Tidal Areas: Some Principles and Experiences (Prepared by WG-SDTA); (b) Half a Century with IRNCID; and (c) History of Water in Ancient Iran, prepared by IRNCID were released.

Post-congress technical tours to Mazandaran Province on the north, and Khuzestan on the south of Iran were organized.

Challenges of Food and Water Security

President Prof. Chandra Madramootoo in his opening remarks at the 62nd Council meeting highlighted the current key drivers as - the continuing food crisis and volatile food prices, climate variability - floods and droughts, competition from other water users, population growth, Lack of water storage capacity, growing demands for energy and alternative fuels, changing dietary patterns, weak institutional capacity, lack of investments in agriculture and water, weakened applied research and technology transfer capabilities, and environmental and water quality degradation. The following are excerpts from his speech.



Photo: IRNCID

rising demand for water from industrial and domestic sectors at the expenses of agriculture" said President Madramootoo. In the Province of Alberta, Canada, for example, the competition for water from other sectors of the economy has been growing significantly. Adopting the package of improved technology in water application, seeds, fertilizers, and farm machinery, farmers in Alberta could dramatically decrease the irrigation water application from about 900 mm per annum in mid 1950s to only 380 mm today. At the same time barely yields have actually increased over the same period from about 2.5 tonnes per hectare in mid 1950s to about 6.5 tonnes per hectare today. Farmers of Southern Alberta have come to realize that they can remain comparative in an international market and sell their produce across the world. "We therefore need to continue investment in irrigation

infrastructure rehabilitation and maintenance and also in research and development, technology transfer, and in capacity development/ building," said the President.

Groundwater irrigation has many benefits in terms of its availability on demand and not been constrained by institutional systems and supply variability. In countries like India and China, tube well irrigation has expanded rapidly, while canal irrigation remained very modest. Groundwater irrigated areas in India is about 39 million ha, in China 19 million ha, and in the USA it is 17 million ha and the area is increasing. Pres. Madramootoo said that we must be concerned in protecting our aquifers to avoid depletion of groundwater resources. ICID needs to pay attention to this subject and that there is a need to develop a better framework of groundwater management and its protection.

"The challenge of doubling the food production over the next 25 years to meet the food requirements of world's rising population has to be met with the reduction in cropped area in many countries and the

The Irrigation Sector Shift from Construction to Modernization: What is required for Success?

On 19 October, the 8th N.D. Gulhati Memorial Lecture was delivered by Prof. Dr. Charles M. Burt, Chairman, Irrigation Training and Research Center (ITRC) at California Polytechnic State University (Cal Poly) San Luis Obispo, USA. He stressed the need for improvement of irrigation performance through modernization of irrigation schemes while caring for the environment. Dr. Burt, with his vast experience spanning over 33 years in irrigation project modernization, elucidated common pitfalls to avoid by citing practical experience in the western USA. The following are excerpts from his lecture.



Photo: IRNCID

but most importantly: the irrigation sector must do more with less (i.e., crop production must increase per unit of water and energy consumed), and the environment must be protected.

In the past, irrigation projects have traditionally operated as autonomous entities that are answerable only to their own bureaucracies and regulations. However, continually increasing external pressures on irrigation projects to improve performance no longer allow this to hold true. The main factors that impact not only irrigation agencies, but the environment, governmental policies, and the public in general are declining groundwater levels, increasing and more affluent populations, environmental restrictions for construction of new dams, and climate change impacts on usable water supply.

Strong irrigation departments in most countries were built with a focus on the construction of dams and large canals. Irrigation departments need to recognize that the days of construction of new dams and

canals have diminished and should have a vision of re-organizing to meet today's complex irrigation demands. "ICID can play an important role in effectively promoting this new approach," suggested Prof. Burt.

Dr. Burt said that the shift to modernization must be addressed in a successful program that will provide excellent service to farmers while strengthening the environment. Such programs require a dedicated cadre of technical specialists with extensive experience in successful modernization. Developing that cadre takes many years, serious funding, and pragmatic training – an effort that is as large as, and more important than, building several large dams. Modernization is expensive, and must be approached slowly with excellent attention to detail. The good news is that there is tremendous potential, through modernization, to improve the environment and increase the "crop per drop" of water and energy consumed, concluded Prof. Burt.

The full text of the lecture can be accessed at <http://www.icid.org/nd_gulhati_2011.pdf>

ICID Elects New Office Bearers

At the 62nd Council meeting held in Tehran, ICID elected a new President and three new Vice Presidents and also ratified the appointment of the new Secretary General.

President



Photo: IRNCID

Prof. Dr. Gao Zhanyi (China) was elected as the 22nd President of ICID for three years term (2011-2014). He took over from Dr. Chandra Madramootoo whose Presidential term ended after the Tehran Council meeting. Dr. Zhanyi is the Director, National Centre for Efficient Irrigation Technology Research. He has also served as the Vice President of ICID (2005-2008). He is the youngest ICID President so far.

Vice Presidents



Photo: Editor

(From Right) **Prof. Tai Cheol, Kim (South Korea)** is the Professor in Irrigation, Drainage and Rural Engineering in Chungnam National University; **Mr. Adama Sangare (Mali)** is the President of the Mali National Committee (AMID) and Co-Director of the BETICO; and **Dr. Gerhard Backeberg (South Africa)** is the Director of Water Utilization in Agriculture at Water Research Commission.

Best Performing National Committee/ Workbody and Best Paper Awards



Photo: IRNCID

South African National Committee on Irrigation and Drainage (SANCID) has won the 4th Best Performing National Committee Award for its outstanding achievements and contributions to ICID activities. The Trophy was received by VPH Felix Reinders, Chairman, SANCID



Photo: IRNCID

The 3rd BPWA was presented to the **ICID Working Group on Sustainable Development of Tidal Areas (WG-SDTA)**. Dr. Park Sang Hyun (Korea), Chairman, WG-SDTA received the award



Photo: IRNCID

The Best Paper Award 2011 was presented to **Messrs Yanbo Huang, Guy Fipps, Stephan J. Maas, and Reginald S. Fletcher (USA)** to the paper titled "Airborne Remote Sensing for Detection of Irrigation Canal Leakage" published in Volume 59, No. 5, December, 2010. The award was received by VPH Larry D. Stephens, Executive Vice President, USCID



Photo: IRNCID

Secretary General M. Gopalakrishnan will be retiring at the end of December 2011 after serving ICID for 8 years. He was honoured by presenting a plaque by President Chandra Madramootoo



Photo: IRNCID

The 62nd IEC ratified the selection and appointment of Mr. Avinash C. Tyagi as the Secretary General with effect from 1 January 2012. Mr. Tyagi presently is the Director at the World Meteorological Organization (WMO), Geneva

Winners of WatSave Awards 2011



Photo: IRNCID

Prof. Dr. Subhash Taley (India) has won the **WatSave Innovative Water Management Award 2011** for his work on "Participatory Rainwater Conservation of Rainfed Agriculture of Vidarbha Region (Maharashtra), India". Please see page 7.

for their work on "SAPWAT 3: Irrigation Water Planning Tool".



Mr. Jerry Erstrom (USA) has won the **WatSave Farmer Award 2011** for his work on "The Willow Creek Piping Project".



Messrs. Pieter S van Heerden and Charles T Crosby (South Africa) have won the the **WatSave Technology Award 2011**

The award winning water saving/ conservation contributions can be accessed at <<http://www.icid.org/awards.html#watsave>>

Key Recommendations of the 21st Congress on Irrigation and Drainage and 8th Micro Irrigation Congress

Question 56: “Water and Land Productivity Challenges”

Prepared and presented by VPH Dr. Saeed Nairizi (Iran), General Reporter

- Irrigation efficiencies should be studied and recommended for planning and decision making based on basin water balance rather than measurement at the farm level.
- Irrigation water productivity (IWP) is a promising tool to evaluate the effective-

ness of water allocated to agriculture from economic and environmental consideration, particularly within the water stressed region. The definition of IWP should be framed based upon the different objectives, and scales.

- Evaporation from the field is an actual water loss within the irrigation schemes, which is not recoverable. So attempts should be directed to the technology and management of irrigation planning and operation to minimize such water losses.

- The concept of crop water requirement needs to be reconsidered with the aim to focus on the actual water consumed by crops. Irrigation technology should be deployed to minimize the real water losses.
- In order to achieve high water productivity, other important factors like proper agro-technology, improving the soil condition, better seeds, appropriate fertilizer application, and above all the better farm management should be given due attention.

Question 57: “Water Management in Rainfed Agriculture”

Prepared by Dr. Theibe Oweis (ICARDA, Syria), General Reporter and presented by Dr. N. Heydari (Iran)

- Policies need to be developed to encourage the use of water efficient and productive practices such as supplemental irrigation, water harvesting and other rainfed farming inputs and tools. Supplemental irrigation for early sowing and for alleviating soil moisture stress during dry spells in the crops growing seasons is very effective in improving rainfed agriculture. Deficit supplemental irrigation can maximize water

productivity especially in water scarce areas.

- Water harvesting through both micro-catchments (soil water storage) and macro-catchments (surface and ground water storage) are instrumental for climate change adaptation in reducing runoff, erosion and floods in addition to increasing water availability to farmers and crops.
- Improved crop varieties and other cultural practices should be supportive to improved yields and water productivity.
- Institutions should be developed in rainfed areas and existing ones should be strengthened and empowered. Especially

the role of women and youth need to be given special attention.

- Increased support to research to fill knowledge gaps on water management and associated aspects, especially on the impacts of climate change on rainfed agriculture and its adaptation. Besides the research, capacity building is important to disseminate and apply improved practices and technologies.
- Access to markets was identified as the most important and work on developing markets in remote areas and improving access to markets in rainfed areas need utmost attention.

8th International Micro Irrigation Congress

Prepared and presented by VPH Felix Reinders (South Africa), Chairman WG-On-Farm

- Recognizing the priority of training farmers to adopt pressurized and micro-irrigation systems in countries with low literacy level of the farmers.
- There is an urgent need for extending and applying the results of the

agricultural promoter's researches to improve designs and to increase micro-irrigation systems efficiency.

- Farmers should be educated while shifting from conventional surface irrigation to drip irrigation, especially in case of trees/ orchards to avoid any adverse impact on their growth.
- Realizing that sub-surface drip irrigation is more effective than the other drip irrigation systems in decreasing evaporation losses and deep percolation especially in arid regions and light soils.

- Recognizing that increase in water productivity based on crop per drop, it is recommended that climate change factors and droughts be seriously considered, and local knowledge and modern technological information are required to increase water use efficiency.

(The Central Office, ICID has brought out Congress proceedings (printed volume) with 'Abstracts' and a 'CD-ROM' containing all full length papers of 21st Congress and 8th IMIC, both in English and French)



Launch of IRAN-IRPID

IRNCID launched “International Research Program for Irrigation and Drainage (IRPID)”, the Nodal Centre for Central Asia and Middle East in Tehran on 16 October 2011 in the hands of ICID Secretary General M. Gopalakrishnan.

On this occasion, MoUs were signed with National Committees of Egypt, Indonesia, Tanzania, Mali, Ukraine, and Uzbekistan to create a new ‘Knowledge Base’ and exchanges by cooperative efforts. Dr. Mohammad Javad Monem is the first Programme Manager of the new ICID-IRPID Centre in Tehran.

Dr. Monem may be contacted at: <monem@net.modares.ac.ir>

ICID-IGS MoU signed

A MoU was signed between ICID and the International Geosynthetics Society (IGS) during the Council meeting at Tehran. The MoU was signed by President Chandra Madramootoo on behalf of ICID, and Eng. Eric Blond, Council member on behalf of IGS.

[SOUND PRINCIPLE NO. 53]

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Enhancing Crop Productivity in Rainfed Agriculture through Rainwater Conservation

Rainfed farming (aka dry land agriculture) is practiced on some 80% of the world's cultivated land, contributing more than 50% of global food production. The productivity of rainfall in most regions of the world is relatively low and there is a considerable scope to improve through rainfall management and agro technological interventions. In Vidharbh region of Maharashtra State of India, some 93% (5 million ha) of the cultivated land is dependent on rainwater for crop production. Due to variable and uncertain rainfall in monsoon season, crop yields are quite low and unstable. Dr. Subhash Taley, Professor of Agri. Engineering and Director Agro-ecology & Environment Centre at Dr. P.D. Agriculture University, Akola has been promoting since 2007 various low cost innovative agronomic and engineering techniques of in-situ soil and rain water conservation and harvesting through farm ponds in a participatory approach. Prof. Taley received ICID Watsave Management Award 2011 for his innovative water conservation and saving contribution. A brief:

In the Vidharbha region of Maharashtra, approximately 93% of its cultivated area is rainfed, and crop production is significantly influenced by the monsoon. Rainfed agriculture supports about 65% of the rural population and is also the major producer of cereals, pulses and oilseeds. In order to enhance the crop productivity and reduce the instability of crop yields under uncertain rainfall situations, farmers were motivated through participatory approach to adopt packages of in-situ rainwater conservation measures to enhance soil moisture in-situ and also capture runoff in farm ponds for "life saving" irrigations during dry spells. He has worked with about 9500 farmers from 115 villages conserving an estimated 227 million cubic meters of water on 21,000 ha in 2009-10, plus 50,000 cubic meters were made available for protective irrigation by promoting the construction of 15,000 farm ponds, leading to a significant increase in crop yields.

In-situ rainwater conservation

Various rainwater conservation measures adopted by farmers of Vidharbha region included modified land configurations like deep cultivation, contour and across the slope cultivation, intercropping, opening of furrow in alternate crop rows and tied furrows (intermittently broken) etc. The study indicated that in deep cultivation the water use efficiency (kg/ha-mm) achieved was between 1.24 - 1.49 for the sole crop of soybean and 0.98 - 1.09 in case of cotton. Compared to shallow/ conventional cultivation, the crop yields in deep cultivation were found to be higher by 11% to 37%, runoff decreased by 8% to 13%, and the soil loss reduced by 17% to 31%. The opening of tide furrows in cotton, soybean, black gram, green gram and sorghum enhanced the yield levels by 4% to 14% and water use efficiency from 1.18 to 2.82 kg/ha-mm than the conventional field layout. In case of across the slope cultivation higher crop yields up to 50% and water use efficiency of 0.55 - 2.67 kg/ha-mm were achieved. Similarly in

contour cultivation the crop yields were higher by 39% to 88% and the water use efficiency of 0.55 - 2.67 kg/ha-mm was achieved. Similarly trends of higher crop productivity and water use efficiency were observed in case of opening of alternate furrows in across the slope and in contour cultivation.

Square basins (20 m x 20 m) prepared prior to commencement of rains enhanced the yield of chickpea by 67% and rainwater use efficiency in the range of 0.89 to 1.48 kg/ha-mm over the control trial. Green manuring of the basins during kharif (rainy) season enhanced the soil moisture content from 43% to 64%, yield of chickpea by 38% and rainwater use efficiency from 0.89 to 1.22 kg/ha-mm over the control treatment.

Farm pond storages

Runoff harvested from the cultivated fields into farm ponds was used to provide protective irrigation during prolonged spell of rainfall in kharif and moisture stress in rabi (winter) seasons. A protective irrigation through a drip system enhanced the yield of pigeon pea by 67% and water use efficiency between 0.89 to 1.38 kg/ha-mm. Two protective irrigations through drip system to cotton enhanced the yield level by 51% and water use efficiency between 1.61 to 2.13 kg/ha-mm. One protective irrigation to soybean through sprinkler system using farm pond storage enhanced the yield by 24% and water use efficiency from 2.15 to 3.48 kg/ha-mm over the controlled field treatment.

Field experiences of last three years have shown that the adoption of the modified land configurations like deep cultivation, across the slope/ contour cultivation, and opening of furrows and tied furrows, green-manuring, square basin lay out, etc., can enhance rainfall storage in the soil profile and made available to crops in terms of enhanced soil moisture, crop yields and water use efficiency and reduction in runoff, soil and nutrient losses. Farm ponds provide life saving irrigation to crops



Tied (intermittently broken) furrows in cotton



Soybean + Pigeonpea cultivated on contour layout with opening of alternate furrows



Green manuring in basins



Sprinklers irrigation using farm pond water

during prolonged dry spells. For effective and successful implementation of these conservation measures, strong commitment of the Government agencies and full participation of farmers is necessary.

Tehran Declaration

The 21st ICID Congress, the 8th International Micro-irrigation Congress and the 62nd IEC meeting of ICID were held between 15-23 October 2011 in Tehran, Iran. More than 1200 delegates from 55 countries attended. More than 200 papers were presented. Representatives from FAO, ADB joined the IEC events, given the importance of topics of the Congresses, and other sideline joint meetings on Investment in Agricultural Water Sector.

While the Congress was focused on considering the theme on **“Water productivity towards food security,”** the Micro-irrigation Congress deliberated on issues related to **“Innovations in Technology and Management of Micro-irrigation for the enhanced productivity.”** As a result of intense deliberations following the presentations, the following recommendations emerged:



1. Throughout the world the increasing signs of water stress, accentuated by the climate change are too imminent. The changes in the pattern of precipitation and temperatures impacts agricultural sector severely, particularly the rainfed. Increasing physical water productivity reduces the need for additional water required in irrigated lands to meet the increasing demand for doubling food production, meeting other water requirements, while at the same time providing sufficient water for the sustainability of ecosystems.
2. As water becomes a more limiting resource than land and other resources it is logical to focus on “maximizing water productivity.” Creating an enabling environment allows the adoption of improved water management and other rainfed agriculture technologies to achieve this productivity increase. Where needed, the national policies can be changed involving all stakeholders to encourage maximizing water productivity by valuing water. A financial policy which reallocates to water use efficient practices and options can yield the desired results.
3. Rainfed agriculture is very important to enhance food security and ecosystems sustainability. However, the rainfed produces much below the potential achievable. Returns on investment in rainfed systems is high and hence essential in many areas where with of supplemental irrigation, water harvesting and soil and water conservation in addition to facilitating access to necessary inputs, better results are achievable.
4. Impacts of climate change and droughts on rainfed production require more emphasis and consideration. It is important to increase support to research and capacity building in rainfed agriculture. Especially for understanding the impacts of climate change and adaptation

- measures in addition to optimizing water management.
5. Cost of desalination of water for agriculture use is prohibitively high. Therefore water productivity efforts should focus on:
 - (i) decreasing water losses in different phases of supply, distribution and consumption;
 - (ii) improving irrigation methods, optimizing farming, garden and green area patterns; and
 - (iii) reuse of wastewater for agricultural and city green areas.
6. Irrigation Water Productivity (IWP) is a promising tool to evaluate the effectiveness of water allocated to agriculture from economic and environment consideration particularly within water stressed regions. Local knowledge and modern technological information are required to increase water user efficiency.
7. It is important to realize that irrigation has only a part role in the crop production process. In order to have high water productivity there are other important key players in this process which should be aligned with irrigation technology and management. The examples are, proper agro technology, improving the soil condition, better seeds, appropriate fertilization, and above all the importance of farm management is to be emphasized.
8. Evaporation from the field is an actual water loss within irrigation schemes, which is not recoverable. So attempts should be directed to the technology and management of irrigation planning and operation to minimize such water losses.
9. Supplemental irrigation is the key strategy, so far underutilized on a regional basis to unlock the yield potential under rainfed water scarcity conditions. Realizing that sub-surface drip irrigation is more effective than conventional drip irrigation systems in decreasing water evaporation and deep percolation especially in warm regions and light soils.
10. The concept of crop water requirement needs to be reconsidered with the aim to focus on the actual water consumed by crops. Irrigation technology should be directed to the systems which minimize losses and hence moving towards more water productivity.
11. Water management practices and technologies with high irrigation efficiencies should be studied and recommended for planning and decision making, based on basin water balance rather than measurement at the farm level.
12. There is an urgent need to improve designs and to increase micro-irrigation systems efficiency by incorporating latest research findings. Recognizing the priority of training illiterate farmers to apply pressurized and micro-irrigation systems in countries with low literacy level of the farmers.
13. Recognizing that increase in water productivity based on crop for drop needs to be given prime importance in the 21st century.