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2017 I THIRD QUARTER

ICID NEWS

MANAGING WATER FOR SUSTAINABLE AGRICULTURE

MESSAGE FROM THE PRESIDENT

Dear Dear Colleagues,

I am very pleased to interact with you through this message in the ICID News in my capacity as the President of ICID. It is indeed an honour to serve as ICID President, and I take this opportunity to thank you and all National Committees (NCs) most sincerely for the confidence which you have shown in me. I wish to assure you that I will do my utmost to uphold the Office of the President and to work with all NCs, Office Bearers and members of various work bodies, in order to achieve the objectives of the Commission.

Over its 68 years of existence, ICID has continuously re-invented itself in response to the changing needs of its NCs by re-orienting its activities so that NCs are empowered, to become more effective at national level and more integrated at the regional level.

To this effect, as you are aware, ICID launched the Road Map to ICID Vision 2030 during the 68th IEC in Mexico. ICID Vision 2030 of "A water secure world free of poverty and hunger" through its mission to facilitate prudent agriculture water management (AWM), by encouraging interdisciplinary approaches to irrigation and drainage management is an expression of intent of the network to help various stakeholders in moving towards Sustainable Development Goals.

ICID symbolizes the spirit of partnerships in finding solutions to the most pressing problems faced by communities around the world. Water is life critical and the stress on this natural resource is becoming a formidable challenge for all of us engaged in AWM as new users of water – industry and urban masses – are making increasingly larger claims. Water scarcity, Climate change, Flood/Drought cycles are becoming more frequent and more challenging. As our domain becomes more multi-disciplinary with multi-sectoral interactions, we need to double our efforts for broad-basing NCs and leveraging existing and new partnerships so that viable solutions can emerge in a timely manner. I would like to see ICID as a knowledge hub where not only NCs but also the experts in AWM are able to draw professional benefit.

Through ICID, NCs undoubtedly serve as an important link between nationally produced knowledge and global AWM stakeholders and communities. NCs can benefit immensely from opportunities that enhance their visibility not only locally but regionally and internationally too. ICID partner organizations also play a significant role in contributing to this continuous build-up of subject-matter knowledge body that can help us collectively address many of the burning issues and build mutual capacities through innovative mechanisms such as Technical Support Program (TSP) of ICID. I envision that ICID would be able to play a more active and enabling role through TSP of ICID in bringing the Green Revolution this time around in African countries by working closely with NCs from Africa.

International Research Program for Irrigation and Drainage is another area that we need to pay more attention to as it provided the opportunity to work on issues of common concerns of neighboring countries, provide opportunities for research and technology collaboration, human capacity building, knowledge sharing and collective approaches to solve similar problems. We need to move towards higher productivity with limited use of natural resources. ICID workbodies have identified most of these issues, working on their technical aspects and creating larger partnerships. For example, this issue of ICID News talks about the work done on Question 60 which relates to water productivity in the context of Water-Energy-Food Nexus.

Well-organized and well-attended ICID network events and their technical gatherings are also opportunities that provide live platforms for policy advocacy, inter-sectoral communication, multi-disciplinary collaboration, and enhanced geographical cooperation among the stakeholders to address irrigation and drainage, and related issues. We need to manage our events professionally and making best use of technology, at the same time making them accessible to all.

Last, but not least, we all need to consider future challenges to the financial sustainability of our network activities at all levels – starting from national to all the way global. Private sector players in the water industry should be encouraged to use our dialogue platforms to enhance awareness about newly developed technologies and innovative solutions as well as feasibility of Public-Private-Partnerships for AWM. You may find the article on geo-synthetics in this issue useful as it directly addresses the water transportation losses in canals and a potential way to reduce them.

NCs, Workings Groups and every individual member has made a collective commitment to implement the activities in the Action Plan to move on the road to realizing the Vision. We all, working in the agriculture water sector, have a huge responsibility towards the society and the world at large to dream, seek and work together towards "The World We Want".

ICID succeeds not because it is big, or because it has been long established, but because there are people building it, who live it, sleep it, dream it, believe in it and build great future plans for it. I seek your best voluntary contribution that you can make to make the vision a reality. Let us take this great institution to new heights by working towards our newly articulated vision of a water secure world free of hunger and poverty.

With regards,

Felix Reinders
President, ICID

INSIDE

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Mexican Heritage Irrigation Structures Recognized

The process for recognition of the historical irrigation structures on the lines of World Heritage Sites as recognized by UNESCO started in 2013. Based on the recommendations of a high-level Panel of Judges, the 68th IEC meeting approved inclusion of 13 new heritage irrigation structures (HIS), which includes Australia (2), Korea (2), Mexico (2), China (3), and Japan (4). Within a short span this category of Award has become very popular and National Committees are submitting a good number of structures with all the required information for recognition. ICID was honoured to present the Mexican HIS Citations to President H.E. Enrique Peña Nieto during the opening ceremony of the 23rd ICID Congress and 68th IEC Meeting held in Mexico City in October 2017. The recognized structures include the La Boquilla Dam and the Chinampa Farm. This article provides a brief on the Mexican structures. The online Register can be accessed from http://www.icid.org/icid_his1.php.

La Boquilla Dam

A unique engineering structure, the La Boquilla Dam, located on Rio Conchos basin, a tributary of Rio Bravo in the Mexican Plateau has been in operation for more than 100 years. Built-in 1915, it was the largest dam in America at that time due to its storage capacity and is currently ranked as the 15th largest dam. Building this dam during the Mexican revolution was an achievement in the face of shortage of labour, limited machinery and tools.

The construction of this dam marks the modern hydraulic history of Mexico and was instrumental in triggering migration to the northern region due to the feasibility of agricultural activities in the area. The dam enabled development of first irrigation district, which is currently the most productive nationwide, contributing to food production and reduction of poverty in the region. It has enhanced the social and economic well-being of farmers and general population located in the south-central region of Mexico.

With a crest length of 259 m and base width of 60 m, the dam is located at an elevation of 80 m. It was constructed to meet the needs of water storage in the state especially for agriculture and for regulating extraordinary floods and for minimizing the risk of flooding in the towns. The storage capacity of the reservoir is 2894 Hm^3. It has spillway and number of intake gates for abstracting water for irrigation and hydropower generation. Due to its hydrological and structural design, the dam was considered way ahead of its time. Even after 107 years, it is in good operating condition with a hydroelectric power station of capacity 25 MW and supplying irrigation benefits to an area of about 75,000 ha.

A view of the La Boquilla Dam

To conserve the dam, funding is provided by economic resources of Mexican government and beneficiary WUA's through different departments and agencies. National water commission provides annual budget complemented with irrigation fees and usual conservation work is carried out periodically in order to keep the dam in optimal operating conditions.

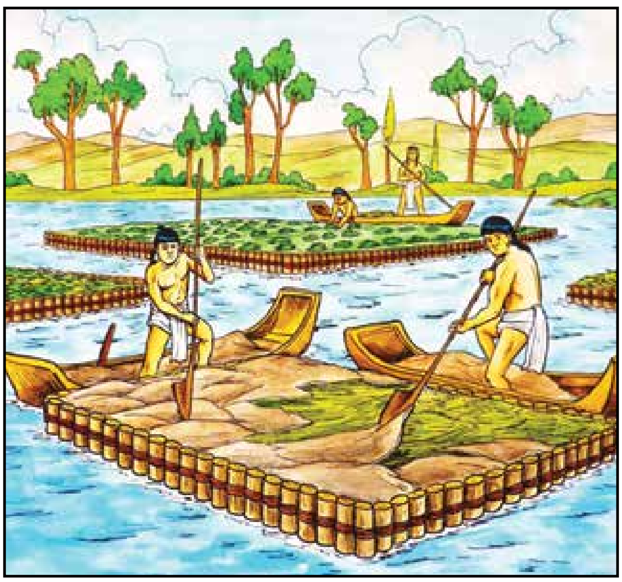
The people in the area have developed great respect for the dam and acknowledge that the well-being of the region depends on its optimal functioning and therefore they abstain from altering the environment surrounding the dam.

Chinampa (Pre-Hispanic sub-irrigated Farm)

Blooming Flowers at a Chinampa Farm (Photo by Jose Luis Martinez)

The name 'Chinampa' roughly means "weaving fence of canes." The Chinampa is one of the oldest and most sustainable farming practice that consists of small permanent artificial islands, built on a freshwater lake for agricultural purpose. Recognized as an integrated agricultural system, Chinampa is like a sponge of organic soil that allows the cultivation of diverse agricultural products with highly effective water channels surrounding it. It is one of the best alternative farming techniques for sustainable food production and employment, and it also preserves natural resources.

Located in the Mexico Valley basin (Xochimilco-Chalco sub-basin), this ancient agro-system is still practiced in some parts, mainly south of Mexico. Surrounded by water and structured as rectangular islands 60 cm above the lake water level, it is 5-10m wide and 50-100 or more meters long. Together several such structures form a network with small channels between each Chinampa and other broad channels which provide navigation routes and irrigation water supply.



The ancient Chinampas were built by hand, constantly enriched using organic material from aquatic plants and sediments from the bottom of the lacustrine bodies and supplemented with small amount of animal manure from the vicinity. Recent studies have calculated that a Chinampa of Xochimilco is five and a half times more productive per unit area than the rainfed agriculture.

Developed and adapted more than 3000 years ago by the Meso-American cultures that inhabited central part of Mexico, Chinampa was an innovative idea during its time. The system is still in use and the actual Chinampa area at present is around 25 km^2 that can be developed to promote conservation of wetlands, and protect and stimulate the biotic wealth of lake environments.

For its historical and cultural value, in December 1984, the Chinampa zone was declared by UNESCO, a cultural Humanity Heritage. In 2004, it was declared as RAMSAR site by the convention of wetlands. Benefits of Chinampas also include water culture preservation, a natural barrier against the advances of urban sprawl, preservation of wetlands, vital recharge of Mexico City aquifers, and as a diversified ecosystem. The Chinampa also represents one of the ancient irrigation technologies, preserved practically intact, and is funded by the local city government and farmers for its operation and maintenance.

In the recent past, the expansion of the urban areas has encroached upon the Chinampas and the impact has been quite severe as they almost became extinct. The water quality of lacustrine zone was affected severely and overexploited for quenching the water supply demand of Mexico City. As a consequence, local springs dried up and the government decided to supply treated water to Chinampa zones to maintain them. It was estimated that there were about 20,922 Chinampas in Xochimilco, out of which 3,586 are active and the other 17,336 are inactive. Some farmers are adapting their agro-systems such as a greenhouse producing high-value flower on a Chinampa. Average Chinampa size has increased from 221 m^2 during Aztec times to more than 2,000 m^2 in the last century.

ICID Register of Heritage Irrigation Structures (2017)

- Australia (2)
- China (13)
- Egypt (2)
- Japan (31)
- Korea, Rep. of (4)
- Mexico (2)
- Pakistan (1)
- Russia (1)
- Sri Lanka (2)
- Thailand (2)

The type of the structures or facilities to be considered for recognition shall fulfil: (a) The structure shall be more than 100 years old; and (b) The structures shall fall under one of the following categories: (i) Dams (operational largely for irrigation purpose), (ii) Water storage structures such as tanks for irrigation, (iii) Barrages and other water diversion structures, (iv) Canal Systems, (v) Old waterwheels, (vi) Old shadouf, (vii) Agriculture drainage structures, (viii) Any site or structure functionally related to present or past agricultural water management activity.

Working Towards A Water Secure World Free of Poverty and Hunger

Avinash C. Tyagi*

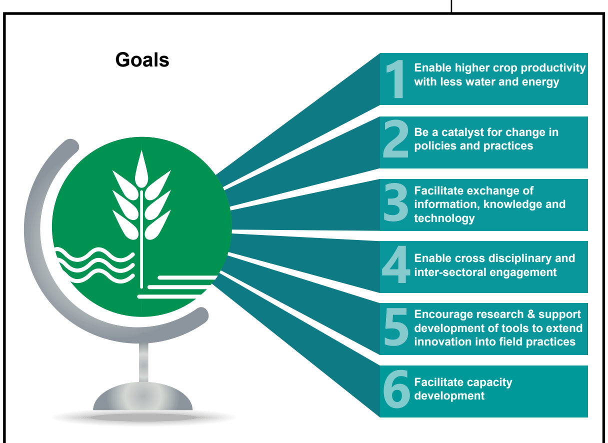
The International Commission on Irrigation and Drainage (ICID), is perhaps the only global professional irrigation and drainage network, which strives to bring together various stakeholders to promote sustainable management of water for agriculture worldwide. The network is a product of the times when sharing of experiences and transfer of technologies were largely guided through professional platforms. Sustainable Development Goals (SDGs) adopted by the United Nations General Assembly in September 2015 pushed forward the political process set by RIO+20 to achieve 'The Future We Want'. For providing support to National Committees and irrigation professionals in fulfilling these expectations, ICID started a systematic review of its vision, mission, and goals. This article introduces the readers to the Road Map to achieve the ICID Vision 2030 adopted by ICID at its 66th IEC Meeting, Montpellier in 2015.

ICID provides a unique platform for exchange of knowledge and information related to agriculture water management - irrigation, drainage, drought and flood management. In existence for seven decades, it has actively contributed to the success of the first Green Revolution by facilitating information and knowledge exchange, technology transfer to developing countries of Asia, Africa, and Americas by promoting research and development. The Commission promotes its objectives through a network of professionals associated with National Committees (NC) in member and non-member countries, like-minded international organizations, private companies, and institutional and individual members.

The mandate of ICID has evolved over the years, from a purely engineering perspective of canal irrigation to the integrated water resources management approach by embracing the technical, agronomic, socio-economic and environmental perspectives of agriculture water management. With Information Technology and World Wide Web subsuming, some of the networking functions of the professional organisations has evolved. ICID has been making incremental changes to re-orient its course of action and introducing new emerging tools for sharing knowledge from time-to-time. The two World Irrigation Forums organized by ICID in 2013 and 2016 have helped in experiencing closer interactions with the other stakeholders such as farmers, policy makers, professionals, researchers, academicians and private sector.

The challenge of eradicating poverty and hunger requires greater cooperation and collaboration among actors working in different related sectors through effective partnerships. ICID Vision 2030 "A water secure World free of poverty and hunger through sustainable rural development" is a small contribution from ICID in

this endeavour. Based on extensive and inclusive discussions that took place in Montpelier meeting, not only with NCs but also a number of our partners such as FAO, IWMI, World Bank, WMO, and ICRISAT richly, six organizational goals were identified.



"A Road Map to ICID Vision 2030" has been developed subsequently over past two years that presents an Action Plan that outlines the strategy to convert the vision into a reality. It identifies the activities to be undertaken by members of the network, i.e., the National Committees, the technical Working Groups (WGs), the Regional WGs s, the Management and ICID Central Office. At the same time, the Road Map will motivate and guide all the network members to contribute to the ICID Vision 2030.

It is expected that the network members would be able to benefit from this collaborative effort and be able to contribute to their national as well as individual professional goals. The actions required to be taken up by the network for fulfilling of this vision are broadly categorised under following four categories:

- Strengthening of the ICID Network and NCs;
- Collective Network Knowledge Manage-ment;
- Organizational Changes in the Network; and
- Enhanced Visibility of ICID Activities

National Committees, which form the pillars of ICID need to be strengthened by broad-basing to be able to convene all stakeholders in agriculture water management within the country and

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by enhancing regional cooperation. Recognizing that lack of capacity at various levels is constraining the development of irrigated agriculture, support would be provided to NCs by providing training and capacity development. A Technical Support Program has been established with the overall objective to "undertake capacity development activities in the field of agriculture water management (AWM) in support of rural development." The target audience for these trainings are working irrigation and drainage professionals, professionals from other sectors associated with AWM related activities, intermediary or extension service providers and non-governmental organizations working at the community or farm level.

Enhanced visibility of ICID activities can be achieved through better projection of NCs within the Member Countries. For NCs to be able to support/influence their government policies, needs to position themselves as the representative of irrigation and drainage sector and provide the link between the national AWM communities with the wider ICID community. Private-public partnerships in NC needs to be further explored for improving the profile of NCs within the countries and ensuring their long-term financial sustainability.

The ICID Vision 2030 and the strategies adopted to achieve the identified goals require strengthening of mechanisms for ICID network's knowledge - generation, assimilation, representation, and sharing as well acknowledge dissemination among NCs to enable them meet their national obligations and objectives. It has serve as a Knowledge Hub in AWM where knowledge exchange and collation takes place in the functioning of WGs, making extensive use of Information and Communication Technology (ICT).

In order to address this challenging task, organizational changes in the Network would be required. Well-organized annual ICID events, efficient functioning of WGs, active participation of young professionals in ICID activities would be essential to accomplish the goals. To address this issue, ICID has established ICID Young Professionals' e-Forum providing an international platform to young engineers/ scientists/ practitioners to engage, network and share their experiences, and also learn from the experiences of senior professionals (Mentors) in the field.

ICID collaborates with all the major international organizations dealing with AWM such as FAO, IWMI, IFAD, ICRISAT, WWC, ICOLD, IWRA and WMO among others to address challenges associated with food and water security and AWM. As a partner organization of UN-Water, ICID interacts with various UN agencies dealing with water and thereby utilize this platform for advocacy for irrigation and drainage. ICID needs to strengthen its relationship with Multilateral Development Banks (MDB's) to further develop cooperation and collaboration with these institutions for their active support and participation in ICID initiatives and programmes.

ICID has taken a decision to work on all these fronts to make the ICID Vision 2030 a reality. WGs have started working in accordance with the Road Map in the right earnest. They have started reporting their progress accordingly and would be monitoring and benchmarking their contributions to the Road Map. The Council has set up a Task Team to review the organizational aspects of its annual meetings to make them more effective and useful to all the participants, duly integrating the ICT tools now available for their efficient functioning.

NCs would serve their own interest and the interest of their countries better by widening their network, taking the private sector and other stakeholders within their fold and improving their own visibility within the country. NCs would bear in mind that the Road Map is dedicated to the farmers and would help strengthen NCs and facilitate them, together with the private sector, in supporting their national governments in achieving the targets set under a number of SDGs related to water and poverty. This is an opportunity for NCs to interact with the policy makers.

ICID management has dedicated itself to provide the required leadership, facilitate NCs through the concerted efforts of the Central Office and make ICID fulfil its vision for a water secure world free of poverty and hunger through sustainable rural development.

The document 'A Road Map to ICID Vision 2030: A water secure world free of poverty and hunger' is downloadable from http://www.icid.org/icid_vision2030.pdf.

Revisiting Water Productivity in the Context of Water-Energy-Food Nexus

VP Prof. Abdelhafid Debbarh[1], and PH Dr. Gao Zhanyi[2]

The triennial International Irrigation and Drainage Congresses organized by ICID since 1951 focus on the upcoming issues that need to be addressed in agriculture water management that encompasses irrigation, drainage and flood management. So far, ICID has held 23 Triennial Congresses, the most recent was held in Mexico City in October 2017. During the 23rd Congress, papers were invited and discussed for two Questions. This article gives a brief outcomes of Question 60: Revisiting Water productivity Concept in the Context of Water-Energy-Food Nexus.

Achieving sustainable increases in food production required to feed over 9 billion people by 2050 with no new sources of freshwater in sight is by no means a major global challenge. Therefore, understanding the water security in the backdrop of water scarcity due to climate change, drought and/or competing demands from other development sectors is critical in meeting this challenge. In this context, Water-Energy-Food (WEF) nexus is emerging as a comprehensive framework that addresses multiple development issues by providing opportunities for better coordination of policy among diverse agencies and ministries involved in resource utilization and management, and to redirect infrastructural and technological investments for sustainable development.

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Considering the finite dimension of freshwater availability, water productivity in development processes assumes a significant role. Agriculture, supposedly being the largest consumer of freshwater ignoring the return flow, immediately grabs the attention of policy makers and development agencies as the sector where quick productivity gains can play a much larger role in economic growth and human development. While water productivity is defined in many different ways depending upon our objectives or given situations, most often the underlying keyword is "water saving." In other words, we assume that any increase in agricultural water productivity will help release more water for drinking, industrial development, human hygiene and environmental or eco-system services.

Thus, water productivity improvement in food production is expected to enhance water security through three fundamental approaches: (a) Save water – efficient water use in food production; (b) Store water - development of water storage (surface and subsurface) capacity in flood situations; and (c) Share water - multipurpose use by considering return flow and reuse. Conversely, use of unconventional water resources such as seawater, excess rainwater and ambient humidity can lead to a direct improvement in water security. However, application of alternative water resources such as wastewater requires stringent sanitation regulations to avoid health risks for farmers and crop, and soil contamination. Five simple building blocks including Information, Planning, Allocation, Protection and Efficiency can support sustainable water resources management.

From practical standpoint, focus on irrigation practices is considered the first logical intervention to improve water productivity. Three different, but closely linked aspects of irrigation practices include technology used for water application on the farm, management of water supply and the water law under which the irrigation practices are adopted.

Measures available for these three aspects

PH Dr. Gao Zhanyi presenting the outcome of the Question 60.

as deliberated during the 23rd Congress of ICID are briefly discussed below:

1. Irrigation Technology

There is a vast range of technologies available for improving operation, better management and efficient use of irrigation water in the fields and at farms levels. The main actions suggested are field water-saving irrigation technologies such as laser grading, integrated water and fertilizer management, sub-irrigation, drip and sprinkler irrigation systems, rainwater harvesting, automatic water monitoring technology, water recycling technology, volumetric measurement, evaporation reduction and increasing irrigation productivity.

Emerging new information and communication technologies (ICTs) such as "big data" and "Internet of Things" offer more options for adopting precision agriculture that is based on resource conservation without compromising the crop yield or productivity. ICTs coupled with remote sensing and geographic information systems (RS-GIS) can also aid the larger scale management of water resources and in turn further strengthen water productivity and security goals.

Water losses at the field level have been minimized using a suite of techniques. Considerable advances are being made in the satellite image processing areas as well as simulation modelling, which need be leveraged for better impact assessment of measures adopted or proposed for sectoral water management. However, affordability is an issue with such modern technologies that require more research, innovation and capacity development at the local and national level; knowledge sharing at global level; and innovative financial mechanisms.

2. Irrigation Management

Irrigation management can be defined as a series of operations performed to uniformly provide crops with "sufficient amounts" of water on a "specific schedule." Smart irrigation planning, volumetric water delivery, conjunctive use of surface and groundwater, controlled drainage, using plastic covers to control evaporation from the soil surface, adopting alternate furrow irrigation technique, night irrigation, and continuous monitoring of water flow are among the measures taken to fulfil irrigation management goals. Water, energy and food nexus has multi-dimensional features and is compounded by climate and social changes as has been revealed by studies in a number of countries across the globe.

To improve irrigation services through modernization, there is need to revisit water productivity by identifying challenges and opportunities. Various water saving measures should be passed through the water-energy-food prism for identifying challenges in associated domains and help find opportunities. At the same time, user's role in irrigation management is important at all levels and need to be coordinated with better information dissemination.

Various water management techniques adopted, strongly influence the water and energy footprints for specific crops at the field level. Volumetric extraction systems for aquifers allow monitoring of allocated and recharge volumes from aquifers. Water reuse/ recycle needs assessment of site specific conditions in the contexts and should avoid stakeholder conflicts for water transfers and adoption of structural and operational reforms. Investing in improving irrigation technologies and techniques help saving agricultural water and can improve equity of distribution amongst the stakeholders but requires technology transfer through capacity development.

3. Water Law and Policies

A systematic approach to water saving in agriculture requires actions at all levels, from farms to irrigation schemes, and from local to national action and strategies. Reallocation of agricultural water share, modifying or changing crop patterns, and water charges are among the self-control policies. However, effective capacity development at various levels, appropriate national/local guidelines and transparent regulations are major pre-conditions for incentivizing the self-control. A thoroughly worked out "water law" can definitely promote more effective use of water to support Sustainable Development Goals (SDG), particularly SDG-2 and SDG-6 by providing a transparent legal framework to ensure equity and social justice in rural areas in many developing countries.

Water security has environmental and social aspects. To achieve water security through reuse/ recycle of water, policies have to take associated health issues into account. For example, while managing an extreme situation, both have to be considered in conjunction. Analysis of water laws and legal frameworks to achieve sustainable water management leading to water security is, therefore called for.

Use of Geosynthetics in Irrigated Agriculture

Herve PLUSQUELLEC*

Lining canals with geomembranes is not a simple placement of a plastic film as it was the case in the early years. There are a number of technical issues to be addressed. To familiarize irrigation managers gathered at the 23rd ICID Congress with these issues, a workshop on "Use of Geo-synthetics in Irrigated Agriculture" was organized by the International Geo-synthetics Society (IGS) on 8 October 2017 in Mexico City. This article is brief glimpse on the outcome of the workshop with a focus on the superiority of geomembranes over concrete for lining of irrigation canals.

Global water issues such as increasing water scarcity, need to increase water productivity, ensuring food security while preserving environment have been the main themes and topics of questions of ICID Congresses during the last two decades. The move from engineering to global development issues reflects the vision of ICID. However, a balanced attention to technical and institutional solutions is needed to solve present deficiencies in design, construction, operation and management of irrigation systems. Innovation is a priority in some economic sectors and it should be the same in irrigation.

The IGS workshop offered an opportunity to the attendees to learn about the principles of geo-synthetics applications for irrigation canals, reservoirs, and flood management covering the functions of water containment and barriers, conveyance, reinforcement stabilization, and erosion control. Testing of geosynthetics was also addressed. Advanced yet well-proven technologies exist to solve problems in irrigation system design and construction. Geosynthetic materials have a considerable potential use in agriculture which remains to be developed, notably in irrigation canal systems. The key issue is the adaptation and adoption of these techniques.

Geosynthetics are generally polymeric or bituminous products which are used

to solve difficult engineering problems. They are used for sealing of hydraulics works, slope stability and erosion control. Geosynthetics are considered the most important innovation in geotechnical and environmental engineering in the last 50 years. They include a number of categories: Geomembranes, geotextiles, geogrids, geonets, geocells, geomats, geofoams, and the combination of these products into composite geosynthetics.

The first significant applications of geosynthetics in civil engineering date back to about 60 years ago. Drainage specialists are familiar with the use of geotextiles. Geosynthetics are widely used in dam engineering. Dams of all types, gravity and arch dams, rockfill and earth dams have been waterproofed through the use of geosynthetics. PVC geomembranes, 2 or 3 mm thick, have been used in the construction of new dams and rehabilitation of dams up to 200 m high. In agriculture, exposed geomembranes are widely used worldwide for the lining of small reservoirs and farm ponds often for storing water for drip irrigation.

Today, there are so many new and original scientific advances in many fields such as transportation and communications that anyone from two generations ago would be completely disoriented. However, an engineer of the 1950s would not be disoriented visiting many present irrigation systems. Driving along irrigation canals today that engineer would observe unlined and concrete-lined canals are very like the ones he or she designed in the 1950s. Only new to this engineer would be control centers equipped with remote monitoring and remote control of automated gates in some advanced irrigation schemes. Moving

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to the farms, he would be impressed by the adoption of water-saving techniques by the farmers, which were under development during his time. Since it was invented in the 1960s localized irrigation now exceeds 10 million ha. Areas under sprinkler irrigation have reached over 45 million hectares in 2015. However, the irrigation community at large has been slow in adopting modern techniques to improve the efficiency, management and operation of surface irrigation systems.

The most typical solution has been to line canals with rigid materials such as masonry, brick, cast-in-situ concrete or pre-cast concrete panels. And indeed some rigid canal linings built with high-quality standards of construction still perform well after decades. However, experience has demonstrated that under certain climatic and/or soil conditions rigid lining may lose its waterproofing functionality within a short period of time and in the most serious cases, the concrete lining loses its structural integrity.

Billions of dollars have been spent to line canals, but a large part of the investment in canal lining has been a waste of money. Water losses through a moderately cracked concrete lining or with leaking joints are close to the losses from an unlined canal. Numerical models have demonstrated that linings with small imperfections result in a small reduction of seepage losses compared to an unlined canal.

There is considerable evidence of the failures of concrete rigid canal lining. Cement concrete is a watertight material. Water losses would be negligible if it were not for the great danger of cracking. Concrete has an excellent compressive strength but a poor tensile strength. It is a highly rigid material that adapts very poorly to ground deformation no matter how small they are. Hard surface linings could deteriorate within a few years until seepage returns to what it was in an unlined canal. The cause of ineffectiveness of concrete canal lining over time is related to the quality of its construction and to the physics of seepage flow lines. Saturation of the soils caused by inevitable seepages through joints and cracks causes some settlement of the sub-base of side slopes resulting in a separation of the sub-base and concrete. The concrete slabs eventually would rest on few points, thus resulting in the development of cracks in the slab.

Furthermore, many irrigation projects worldwide – those located around the latitudes of about 45-55 degrees in the Northern hemisphere are affected by frequent freezing and thawing resulting in dislocation of pre-cast panels or cast-in-situ concrete slabs and ultimately in their slide into the bottom of canal and by the disintegration of concrete. The effect of cold climate is further aggravated by the silty nature of the soils. Regions most affected are the provinces of Inner Mongolia and Xinjiang in China, the central Asia countries, the Caucasian region (for example Armenia).

Despite the poor performance of rigid lining, some irrigation agencies continue to adhere to the design standards for canal lining and have been adverse to the adoption of modernly advanced canal lining which would use flexible materials available with the progress in the contemporary geosynthetic industry. This situation exists because many engineers are familiar with concrete linings and because, to them, "hard", is preferable as compared to "flexible". The engineers and decision-makers, who prefer cement concrete linings should be better aware of the deterioration of cement concrete linings over time.

The reasons for the slow adoption of modern innovative canal lining techniques are both administrative and behavioral: Resistance to change by irrigation departments; risk aversion and adherence to outdated designs; lack of contractual motivation for consultants to introduce new technology; lack of sufficient information about proven new technologies by the consultants. And in some cases, failures of pilot projects resulting in a long period before piloting again the well-proven technologies but unknown in a particular country.

A number of technical issues such as the stability of the composite lining over the side slopes, the selection of the type and thickness of geomembranes, drag forces exerted by flowing water on geosynthetics, uplift of geomembranes by dynamic pressures, need to be addressed while lining canals with geomembranes. The stronger is not always the better. Flexibility of the geomembrane and its capacity to conform to the variances in profile of the sub-base of the canals is essential;

Geosynthetics, and in particular geomembranes, are widely used to solve engineering problems in many sectors of civil engineering such as transportation (highways, railways), environmental engineering (e.g. waste storage landfills), mining applications (heap leach pads, tailings dams), and hydraulic engineering (dams, reservoirs). Clearly, geosynthetics have pervaded all branches of geotechnical engineering. The same should happen with irrigation canals. Indeed, there is a wide potential for applications of geomembranes and other geosynthetics in all types of canals, in particular in the field of irrigation with over 200 million of hectares of irrigated lands worldwide with canals, of which many need rehabilitation.

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International Commission on Irrigation and Drainage (ICID) was established in 1950 as a scientific, technical and voluntary not-for-profit professional international organization.

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