2014 | THIRD QUARTER

ICID NEWS

Managing Water for Sustainable Agriculture

MESSAGE FROM THE PRESIDENT

Dear members and friends,

By the time you receive this message you will be in Gwangju, Republic of Korea to attend the 22nd ICID Congress and 65th IEC meeting. As you are aware, my term as the President of ICID is coming to an end, and we will elect a new President during the 65th IEC meeting.

During the last three years, I have enjoyed very much serving and representing ICID as its President. Three years is not a short time, but I felt the time passed very quickly. I recall that during the 63rd International Executive Council meeting of ICID in Adelaide, Australia, I proposed some new initiatives to enrich the activities of ICID and broaden the involvement of more stakeholder organizations and individuals. In Adelaide, while IEC approved the opening up of ICID with direct membership, we decided to include World Irrigation Forum (WIF) in our three-year cycle of events. We also took the decision to launch the World Irrigation and Drainage Prize (WID Prize), select and recognize the Heritage Irrigation Structures, and enhance our support to Young Professionals to enable them to participate in ICID activities, etc. It gives me great satisfaction that these proposals were accepted by the Council and they were quickly developed and implemented within a short span of time.

As you know the First World Irrigation Forum (WIF1) was successfully organized in Mardin, Turkey in October 2013, where WID Prize was also presented during the opening ceremony. With these initiatives we have attracted and reinvigorated the interest of our National Committees, and various international organizations, institutions and individuals. At the Forum, we discussed and collected many new thoughts and ideas on achieving sustainable irrigation and drainage development by focusing on core issues. Through interactions among policy, science and society; and discussions on challenges and developments in financing irrigation and drainage, the Forum was able to work towards integrated water management approaches for sustainable food production. We were able to listen to the views of farmers' representatives and identify the gaps in institution, infrastructure and technology for the countries under different development stages. In order to bridge these gaps we must take advantage of the ICID platform for sharing knowledge and tools such as information technology among members of the National Committees, direct members and related international organizations and individuals.

During the 65th IEC meeting this year in Gwangju, Korea, we will announce the first batch of Heritage Irrigation Structures (HIS) to be included in the ICID list of Heritage Irrigation Structures. The main objectives of recognition as a "Heritage Irrigation Structures" are: (i) Tracing the history of and understanding the evolution of irrigation in the civilizations across the world; (ii) To select and collect information on heritage irrigation structures from around the world, understand their significant achievements and gather knowledge about the unique features that have sustained the project for such a long period; (iii) To learn the philosophy and wisdom on sustainable irrigation from these structures; and (iv) To protect/preserve these heritage irrigation structures.

It is heartening to see 13 young professionals having been selected and awarded the YP Scholarship to attend the 22nd ICID Congress and 65th IEC Meeting and allied events. In recent years our program for supporting young professionals to participate in ICID activities received more financial contribution not only from international organizations, such as IFAD and FAO but also from our own National Committees of China, Turkey, Russia and Korea. Hopefully, we will be able to continue to encourage more young professionals to actively participate in ICID events and make ICID realize sustainable technical growth.

We have continued to strengthen our relationship and cooperation with international organizations, such as FAO, ADB, IWMI, IFAD, IFPRI, WWC, ICOLD, the World Bank, UNESCO-IHE, GWP, UNESCO, AWC, ICRISAT, ICARDA and WMO. During the Sixth World Water Forum, in March 2012, together with FAO, ICID successfully coordinated Theme 2.2 'Contribute to Food Security by Optimal Use of Water'. ICID was elected as the member of Board of Governors of World Water Council during the 6th General Assembly of WWC in Marseille in November 2012. We have actively participated in WWC Board of Governors meeting and worked on developing strategic vision for the future of water. In the 52nd Board of Governors meeting of WWC in Mexico last June, ICID presented a proposal to initiate World Water System Heritage (WWSH). The proposal was overwhelmingly appreciated and accepted by all members of the Board of Governors of WWC.

During the last three years, cooperation among our National Committees was also promoted with more members joining and participating actively in ICID family. The Training Centers on Irrigation and Drainage in China and Iran have

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successfully organized training events and developed cooperation with other National Committees and International Organizations. The fund raising ability of ICID also saw a boost with a contribution of US$ 175,000 from the Ministry of Water Resources P.R. of China, and UN-Water and WMO about US$ 40,000 to conduct joint workshops.

During this period, I had the opportunity to visit a number of National Committees and International Organizations and was warmly welcomed and hosted. You will be happy to know that all National Committees, which I visited actively organize events, bring out publications and provide services to their stakeholders. I must express thanks to those National Committees and International Organizations for their support and hospitality.

In my term as the President of ICID, I have received great support from all National Committees, Office Bearers, Central Office and all my colleagues and friends in ICID. Hereby, I take this opportunity to express my sincere thanks to all of you for your support and help.

During the last three years ICID Central Office has made great efforts to improve the services and efficiency with reduced staff strength. You might have noticed the perceptible changes in services being provided from the Central Office in tune with the latest technology. Particularly, I am happy to be part of the newly introduced video conferencing facility. My special thanks must go to Secretary General Avinash Tyagi for his hard work with innovative ideas, timely communication, understanding of the issues, and support and friendship. I enjoyed working closely with Secretary General Avinash Tyagi for ICID.

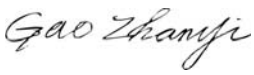
Taking this opportunity, I would like to express my sincere thanks to the Ministry of Water Resources of People's Republic of China, China Institute of Water Resources and Hydropower Research for their enormous support to ICID, and myself for enabling me to discharge my duty as the President of ICID. Last but not the least I must express my sincere thanks to all my colleagues and friends of CNCID, who gave me valuable help and assistance during my term as the President of ICID.

I must say that during the past three years, we worked as a team, and with our joint efforts we have made some progress, but we still have a lot to do in future. We need to involve more stakeholders, especially decision makers and donors to influence and address the policy and financial issues for revitalizing irrigation and drainage. We also need to have more farmers, youths and irrigation managers to join us to promote the adoption of better technologies and institutions for irrigation and drainage development. Let us work together to achieving the mission of ICID continually.

I welcome all of you to the 22nd ICID Congress here in Gwangju, Republic of Korea.

Best regards to all of you.

Yours truly



Gao Zhanyi
President of ICID

Irrigation and Drainage under Changing Climate: Highlights of the IPCC-AR5

The IPCC Fifth Assessment Report (AR5) 2014 provides a clear and up-to-date view of the current state of scientific knowledge relevant to climate change. It consists of three Working Group (WG) reports and a Synthesis Report (SYR). This article provides the gist of the reports of WG I and WG II. The SYR will be finalized in October 2014, as an integration and synthesis material of the WG reports for policymakers. Brief summary of the responses in the form of papers submitted to address the two Congress Questions, extracted from the reports submitted by General Reporters - Prof. Tsugihiro Watanabe (Japan) and Vice President François BRELLE (France), are presented in this context.

The Working Group (WG) I Report provides a comprehensive assessment of the physical science basis of climate change. WG II addresses the vulnerability and exposure of human and natural systems, the observed impacts and future risks of climate change, and the potential for and limits to adaptation. It assesses impacts of climate change on food production, irrigation and drainage, as well as rural environment, and adaptation to the climate change. WG III report assesses the options for mitigating climate change and their underlying technological, economic and institutional requirements. The following is the gist of the WG I and WG II.

WG I report about changes in temperature and precipitation

The report states "warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased." In addition to the increased air temperatures, changes in precipitation have been observed all over the world, and both might affect agricultural production as well as irrigation and drainage. Regarding precipitation, which is the fundamental element of hydrological regime of a region and one of the determining factors of irrigation and drainage, it reports the following experiences and future projections.

The future changes of precipitation due to climate change, the report states that the changes in the global water cycle in response to the warming over the 21st century will not be uniform. It also says that the contrast in precipitation between wet and dry regions and between wet and dry seasons will increase, although there may be regional exceptions. According to the report, the high latitudes and the equatorial Pacific Ocean are likely to experience an increase in annual mean precipitation by the end of this century under the RCP8.5 scenario. In many mid-latitude and subtropical dry regions, mean precipitation will likely decrease, while in many mid-latitude wet regions, mean precipitation will likely increase by the end of this century under the RCP8.5 scenario.

Extreme precipitation events over most of the mid-latitude land masses and over wet tropical regions will very likely become more intense and more frequent by the end of this century, as global mean surface temperature increases. Globally, it is likely that the area encompassed by monsoon systems will increase over the 21st century. Monsoon precipitation is likely to intensify due to the increase in atmospheric moisture. Monsoon onset dates are likely to become earlier or not to change much. Monsoon retreat dates will likely be delayed, resulting in lengthening of the monsoon season in many regions.

Projected future climate and hydrology will affect irrigation, drainage and flooding in regions and their management systems. Regarding the sea level rise, the report concludes that global mean sea level will continue to rise during the 21st century. Under all RCP scenarios, the rate of sea level rise will very likely exceed that observed during 1971 to 2010 due to increased ocean warming and increased loss of mass from glaciers and ice sheets. The sea level rise affects directly agriculture and hydrology in the coastal zone, where large agricultural production areas are spread.

WG II Report about impacts of climate change and adaptation

The report of the WG II summarizes the changes of hydrological systems:

In many regions, changing precipitation or melting snow and ice are altering hydrological systems, affecting water resources in terms of quantity and quality (medium confidence). Glaciers continue to shrink almost worldwide due to climate change (high confidence), affecting runoff and water resources downstream (medium confidence). Climate change is causing permafrost warming and thawing in high-latitude regions and in high-elevation regions (high confidence).

Impacts of the changes of temperature and hydrological system of food production such as negative impacts of climate change on crop yields, which have been more common than positive impacts (high confidence). Climate change has negatively affected wheat and maize yields for many regions and in the global aggregate (medium confidence). This implies that the climate change impacts on food production, even on the major crops, are still under assessment, and their output would be increase with development of the methods and available climate data.

It has been made clear in the report that impacts from recent climate-related extremes, such as heat waves, droughts, floods, cyclones, and wildfires, reveal significant vulnerability and exposure of some ecosystems and many human systems to current climate variability. Impacts of such climate-related extremes include disruption of food production and water supply, and damage to infrastructure and settlements, which are consistent with a significant lack of preparedness for current climate variability in some sectors in countries at all levels of development.

The report identifies eight risks, four of which are related to production and water management in agricultural area:

1. Systemic risks due to extreme weather events leading to breakdown of infrastructure networks and services,
2. Risk of mortality and morbidity during periods of extreme heat,
3. Risk of food insecurity and the breakdown of food systems linked to warming, drought, flooding, and precipitation variability and extremes, and
4. Risk of loss of rural livelihoods and income due to insufficient access to drinking and irrigation water and reduced agricultural productivity.

According to possible severe impacts and higher risks, adaptation has an important and urgent role to mitigate the adverse climate change impacts. The report introduces adaptation experience from across regions in the public and private sector and within communities. Governments at various levels are starting to develop adaptation plans and policies and to integrate climate-change considerations into broader development plans.

The report discusses the risk on fresh water in detail. With this information like changes of temperature, water availability, flood damage, etc., adaptations in rural areas both in production and life and environment can be developed. The report concludes that major future rural impacts are expected through impacts on water availability and supply, food security, and agricultural incomes, including shifts in production areas of food and non-food crops across the world. These impacts are expected to disproportionately affect the welfare of the poor in rural areas, such as those with limited access to land, modern agricultural inputs, infrastructure, and education.

Responses to the Congress Questions

Q.58 How Irrigation and Drainage Play an Important Role in Climate Change Adaptation?

As the phenomena or factors associated with climate change and its apparent impacts are difficult to be projected and evaluated accurately, one of the more effective and feasible approach for adapting to the impacts are to take actions incrementally as in a trial-and-error manner, utilizing the best available current knowledge and past experience, and collecting additional information as needed. In pursuing such an adaptive approach, the step-wise integrated assessment is effective and reliable.

For adaptation to and mitigation against global warming in agriculture, farmers, their associations and cooperatives, and other organizations interested in climate, water resources, and agriculture need to be involved jointly. For adaptive management approach, the following factors should be considered:

(a) identify the current water-use system and its significance in the regional hydrological regime,

(b) monitoring the water dynamics between human activities and the regional hydrological regime,

(c) predict the changes in the hydrological regime, including its impacts such as the ecosystems,

(d) employ incremental or gradual development and note feedback responses, and

(e) include all stakeholders in decision making.

At present, using on-going observation and advanced modeling technologies, future events are to be predicted to some extent within certain bounds of accuracy, and we should react actively to them. Now, with a combination of advanced prediction and local traditional knowledge, there is the potential for wise irrigation and drainage management, smart agricultural production, and improvement of regional environments. All stakeholders should participate at some level or some extent in the process of monitoring, assessing the baseline and impacts of climate change, making decision for adaptation, and establishing mitigation measures. Although the well designed preparedness is quite general to be proposed, it would be most dependable and reliable action. Research and development for establishing better management system should be promoted, not only against the climate change but also for everlasting improvement of the system. Such an approach might lead to a greater harmony of humans living with nature.

Q.59 How do irrigation and drainage interventions secure food production and livelihood for rural community?

A key element in irrigated agriculture development is the concept that long-run sustainability which can be achieved only if water resource is properly conserved, with the active participation of the major stakeholders, i.e. the farmers and by recovering of O&M and water management costs.

These conditions rely on a secured water resource and the livelihood of farmers / water users. Both are closely dependent on the performance of the irrigation, from water resource management to distribution, which thus appear as a key factor for improving farmers' revenue and rural population livelihood.

The number and the quality of the paper submitted for Questions <http://www.icid.org/22cong_abst_vol.zip> reflect the vitality and the richness of academic and operational work on these major issues throughout the world and particularly within ICID community. Unfortunately, selection has been inevitable, and many proposals could not be retained in spite of their quality. Those selected as posters will contribute as well to the debate and to enhancing the state of the art.

One last remark: What was not addressed here is whether farmers are or not entitled to claim for being remunerated for the ecosystem services they produce. Agriculture is indeed often contributing to land management and landscape preservation. Is this something like public service, citizens should pay for? Answering these questions may give solutions for enhancing farmers income and living standard of rural population in general.

World Water System Heritage (WWaSH) Program

In order to manage water systems properly both hardware facilities as well as appropriate software institutions, are equally important. Unfortunately, the latter has only been regarded as appurtenant of the farmer and has not been given its due importance. In addition to the physical infrastructure, including institutions play a crucial role in the sustainability of water management systems. People centred institutions and practices have managed water systems for over generations and are in themselves crystals of wisdom of humanity worth protecting and preserving as heritage. To realize this there is a need to formulate and launch an initiative to implement it properly and effectively. A breif extract from the submissions made by ICID at the 52nd BoG meeting of WWC at Mexico City with contributions from Vice President Hon. Shinsuke Ota and Prof. Dr. Kazumi Yamaoka.

The World Water System Heritage (WWaSH) is proposed to be a global initiative to provide appropriate recognition and value to the wisdom and energetic activities of people centred institutions and practices, including with regimes and rules, which have substantially contributed to socio-economic development in their respective regions through sustainable management of water system for over generations thereby bringing peace and prosperity. As such the WWaSH program will place greater importance on community based institutions, groups and organizations.

Local communities are generally conscious of the fact that they must take the initiative to actively protect and preserve their systems, and they have a firm awareness of their rights. Furthermore, while the above organizations are associated with regulation of water allocation and maintenance/repair of facilities, there are many cases in which they are closely connected with traditional events, ceremonies, and religious rituals that are related to water and agriculture. In this sense, they share a role in developing regional society. These people centred institutions and practices constitute feature of collective activities by people managing natural water resources by utilizing natural and artificial physical facilities, while there are commonalities of social practices, oral traditions, expressions, and folklore which constitutes the intangible cultural heritage. Systems managing water for drinking, agriculture, fisheries, industries, electricity generation, navigation, flood prevention, measure to defend from storm surge, preserving ecosystems and controlling waste water from drainage, and sanitation are intangible social heritage important regardless of regions and sectors would be eligible for WWaSH.

Dujiang Weir, China

WWaSH is a new global initiative to properly value the wisdom and energetic activities of people centred groups and organizations which has realized sensible water management through creation of a system bringing together people's wisdom. It is a valuable intangible heritage common to humanity. These systems have contributed to peace and socio-economic development through sustainable management of water systems for over generations under the adverse natural and social conditions.

WWaSH programme will aim to preserve and protect people's wisdom of the management systems encompassing groups, organizations, regimes, rules and related facilities as a heritage from around the world considered to be of outstanding value to humanity. The objective is to draw lessons to provide ideas for creating a coexistent social system for humanity and sound environment by disseminating the knowledge of the wisdom and activities. It targets contributions from intangible people's groups, organizations, regimes, rules and related facilities, i.e. systems that manage natural water resources by utilizing functions of natural and artificial physical facilities, which many stakeholders created together and have developed through collective activities for over generations. The criterion proposed to identify such systems is given below:

Primary criteria

1. It has a people's group/organization managing water systems by creating a system bringing together people's wisdom;
2. It realized a sustainable management of water system;
3. It has contributed to socio-economic development and tackled poverty in the region by involving many stakeholders.

Secondary criteria

1. It has an outstanding historical background;
2. It has an outstanding system to overcome adverse natural and social conditions, water quality degradation and water-borne diseases, and so on;
3. It has an indispensable element necessary for an outstanding culture,

bio-diversity and socio-economic activities in the region;

4. It has an outstanding universal value being common to humanity.

The program will create databases including data of actions and wisdom and activities and encompasses whole of them as a target of evaluation, an intangible heritage around the world considered to be of outstanding value to humanity. It will help provide ideas for constructing similar social systems by assimilating and disseminating knowledge, wisdom and activities.

It is proposed that the World Water Council and ICID in cooperation with UNESCO, FAO and other global institutions and authorities with expertise in water management, constitute a World Water System Heritage (WWaSH) Committee that would establish a Center for WWaSH designated within the office of WWC as secretariat of WWaSH program.

The WWC through national and international organizations as its members and the National Committees of ICID will play the major role in activating WWaSH program.

Within the international frameworks, UNESCO has carried out programs on the World Heritage, the Intangible Cultural Heritage and the Memory of the World, while FAO carries out the Globally Important Agricultural Heritage Systems (GIAHS). However, none of the systems place a high value on people's groups and organizations as well as regimes and rules, which have managed water system for over generations, and protecting them as heritages.

The target of WWaSH is different in comparison to the 'World Heritage' program and the 'Memory of the World' of which targets are respectively physical and immovable estates, areas and documentaries. It also has different concept and targets other than that targeted by GIAHS which focusses on only agriculture.

From Famines to Food Bowl

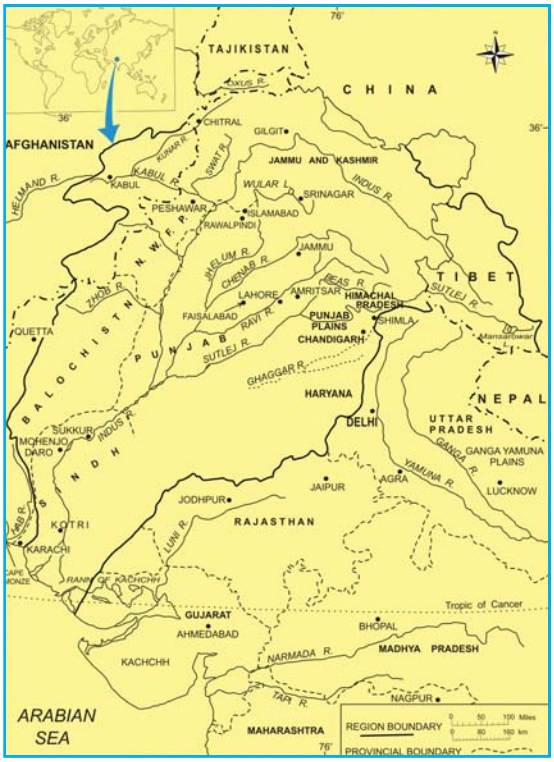
History of Irrigation in Indus Basin

The Indus basin is home to about 200 million people, spread over a vast expanse of 96 million ha and having fertile and highly productive agricultural arable land mass of about 40 million ha. The basin is now, reckoned amongst the economically advanced areas in the subcontinent and constitutes the bread-basket of the region. The population in the basin continues to grow at a relatively high rate as compared to the South Asia region as a whole. Secreary General Avinash C. Tyagi and Eng. M.L. Baweja provide a brief on the history of irrigation in Induis basin.

However, not long ago, before the advent of canal irrigation systems, large parts of the lands in the basin were 'sterile', without water where wells were deep. Large tracts of arable lands of the basin, which lie in the arid and semi-arid region and adjacent to the Thar dessert, suffered due to scanty, erratic and highly variable monsoon rainfall. The ground water was brackish, fluoride contaminated and not potable and vegetation dominated by a few stunted, bushes or a temporary crop of grass scattered over great parched plains. Although irrigation was practiced in the Indus basin from pre-historic times, cultivation was confined to the narrow strips of land along the rivers. With the increase in population between the 16th and 18th Century AD, with the advent of foreign conquerors and settlers, the unreliable food production started resulting in famines whenever the monsoons failed.

The Indus River is the sixth largest river of the world. In terms of water carried. The Indus system of rivers comprising of the main tributaries: the Jhelum, the Chenab, the Ravi, the Beas that join from the west and the Sutlej that joins the Indus from the east. As the deficiency of rain was the rule and not just exception, in this potentially fertile basin, the irrigation was considered as an essential input even for a meaningful survival of the population living in harsh environments.

Almost till 1850, only narrow fringes were enjoying the benefits of irrigation from inundation canals in a width of 80 km to 150 km dependent on the annual rise of river water levels in monsoon. Obviously, this seasonal unregulated irrigation was confined to lowlands along the rivers. Thus the irrigated area in the Indus basin in Punjab with wells and river spills, stood at nearly 0.5 million ha in 1860s. Due to frequent incursions of the invaders from the west, most of the canals were inadequately looked after.



Middle of the nineteenth century saw an impetus to new developments in irrigation in the Indus basin, which is a landmark in the Indian subcontinent when the then British Government decided to take up irrigation works as a measure to fight famines which were visiting the area with a regular periodicity. The existing irrigation works were renovated and improved to extend the benefits to more areas.

The period saw construction of a few large canal systems for irrigating *doabs*. Amongst the first was the Upper Bari Doab Canal (UBDC) in the state of Punjab from the Ravi river completed in 1859 for providing water to nearly 0.4 million ha area lying between the Ravi and the Beas rivers. The second large canal was the Sirhind Canal of 170 m^3/s capacity, opened in 1872 to provide irrigation to 0.39 million ha in Punjab and other adjoining States. The old inundation canals in the Punjab from the Sutlej, the Chenab and the Indus were also improved by providing weir control. Likewise in Sindh also, improvements/extension of older canals including provisions of head-works and embankments on the Lower Indus substantially increased the annual irrigation.

The year 1890 witnessed completion of the Lower Swat Canal in the North West

Frontier Province and the Kabul River Canal, while two other canals, Paharpur and Upper Swat canals, came into being in 1907 and 1914 respectively. Another small non-perennial canal called Kashmir Canal located on the upstream of Madhopur Headworks, was built for Jammu Province.

An area of about 48,000 ha of the desert lands was developed diverting the waters of the Indus by constructing the Lower Sohag and Para Canals in 1882 and the Sidhnai Canal built in 1886. Further in 1890, irrigation was extended to the Punjab desert areas by constructing two canals, one from the Chenab (now Lower Chenab Canal - LCC) opened in 1887 and the other from the Jhelum (now the Lower Jhelum) opened in 1901. The Lower Chenab Canal was subsequently converted into one of the largest and most developed systems in the world providing irrigation to 1.5 million ha. The Lower Jhelum Canal opened up 0.6 million of the wastelands to irrigation.

The twentieth century proved eventful as it heralded an unparalleled era of irrigation development in the Indus basin. In 1915, the Triple Canals Project comprising Upper Jhelum Canal, Upper Chenab Canal and Lower Bari Doab Canal were completed, which provided irrigation to about 1.5 million ha. Another group of two canals called Ranbir and Pratap were constructed on the Chenab river benefiting 60,000 ha of area in Jammu province of erstwhile Kashmir State.

To provide perennial irrigation to desert lands, located in the heart of the Thar Desert in the erstwhile Princely States of Bahawalpur and Bikaner, summer supplies into the then existing inundation canals of Sutlej were augmented by constructing four fully gate-controlled barrages at Ferozepur, Suleimanki, Islam and Panjnad to feed 11 canal systems covering nearly 3.26 million ha. The Sukkur Barrage Project was yet another landmark project taken up on the main Indus and completed in 1932. The project consisted of seven canals that provided assured irrigation to a Culturable Command Area of 3.16 million ha.

With the partition of India into as two separate countries India and Pakistan in 1947 the Indus basin also got divided and the two successor countries initiated massive programmes of further extension of irrigation to their respective areas of Indus basin.

Pakistan took up construction of the Kalabagh Barrage on the Indus in Upper Punjab and Thal Canal became operational in the fifties which helped in transformation of an area of about 4.3 million ha waste sandy desert into a blossoming irrigated tract abounding in fruit orchards. The Kotri Barrage, with four off-taking canals was constructed in 1955. It provided irrigation to an area of 1.21 million ha in the Lower Sindh region.

India, which was faced with the problem of providing irrigation to its vast areas so far uncovered by the schemes implemented by the British before 1947, took up the work of enlarging the capacity of the Sirhind Canal, and Upper Bari Doab Canal system as well as the construction of the Bist Doab Canal system. It also constructed the Bhakra system and started construction of Bhakra Dam, Nangal Barrage and its canal system.

Pakistan embarked upon a very extensive system of inter-river transfer of water through construction of seven link canals, as well as the construction of two reservoirs at Tarbela on the Indus and Mangla on the Jhelum. Besides, work was completed on six new barrages in addition to remodelling of four old ones. This programme was executed through the Indus Basin Development Plan, which was funded by the World Bank and a consortium of donors.

India in the meanwhile, completed the projects of the Bhakra Dam system including the taking up of the mammoth Indira Gandhi Canal Project. Dams have also been constructed on the Beas and the Ravi to enable the country to utilize all the allocated waters of the eastern rivers under the Indus Water Treaty.

The "dug-well" irrigation from groundwater, the traditional ancient activity in the basin, also got a boost due to induction of large amount of fresh canal waters, which resulted in rise of water table and thus promoted large scale ground water irrigation by farmers. Subsequently the governments in the region also promoted tube-well irrigation in the command areas for conjunctive use of surface and ground waters. The vertical drainage by tube-wells coupled with construction of extensive network of surface drainage helped in the mitigation of the problem of waterlogging and salinity.

Large tracts in the basin that used to be uninhabitable until about 150 years ago now bristle with intense agricultural activity and rich harvests. The life blood of irrigation water is now pulsating far and wide in the sinews of the land through a vast and complex network of canals generating the hum and throb of life that one witnesses around today. The respective parts of the Indus basin in India and Pakistan are now the granaries of the two countries. These irrigation systems have contributed heavily to the stabilisation of food production in the two countries and have helped them to graduate from food importing countries to net exporters. The continued development of irrigation in the Indus basin has contributed to the improvement of the socio-economic conditions, brought about prosperity to the people inhabiting the basin and increased agricultural production. Irrigation has brought economic prosperity to the people. With assured irrigation supplies, the income of farmers has multiplied, thereby transforming the inhospitable wastelands and desert into lush green landscapes.

The current scenario indicates that while the developments so far have been outstanding, some concerns remain inadequately addressed. At some places for instance, the over-use of irrigation water along with the lack of evacuation and disposal arrangement for excess waters has adversely affected the basin due to waterlogging and/or spread of salinity and alkalinity. New methods of removal of salts was undertaken in the affected areas indeed a milestone in the development of anti-salinity measures.

Today, Indus basin is by far the largest irrigated area in the world on any one-river system. The irrigation development in the basin has been very helpful in arresting ecological degradation and in making the drought prone arid areas of the basin habitable by ensuring a green cover and preventing the advance of the desert into fertile lands of the plains, providing freshwater recharge of groundwater and potable drinking water. The massive programme of irrigation in the Indus basin provided a boost to the emergence of modern irrigation engineering in the subcontinent.

Though changes in flora and fauna have also occurred, many of them are inevitable in any development process. However, there is a welcome awakening in the current decade that any type of development, must be accompanied by protection and preservation measures for sustenance of the ecology. Thus adverse impacts of over-irrigation such as waterlogging and salinity are being handled successfully through conjunctive use of surface and groundwater, prevention of canal water leakage, reduction of seepage losses from water carrying bodies, implementation of an adequate drainage improvement programme and promotion of efficient irrigation application methods and management techniques along with adoption of water conservation methods.

Recurrent famines visiting the basin in the eighteenth and nineteenth centuries have almost been forgotten. But the increasing water scarcity due to ever rising population, improving economic conditions and changing climate continues to challenge the food security and sustainable development. The struggle for food security and sustainable development continues.

Country Profile – Republic of Korea

Geography

The Republic of Korea occupies the southern portion of the Korean Peninsula, which extends some 1,100 km from the Asian mainland. Its total area is 100,212 square kilometres. The terrain of the country is mostly mountainous, most of which is not arable. Lowlands, located primarily in the west and southeast, make up only 30% of the total land area.

Climate

South Korea tends to have humid continental and subtropical climate, and is affected by the East Asian monsoon, with precipitation heavier in summer during a short rainy season which begins at the end of June through the end of July. Winters can be extremely cold with the minimum temperature dropping below – 20 °C in the inland region of the country. Winter temperatures are higher along the southern coast and considerably lower in the mountainous interior. South Korea has four distinct seasons; spring, summer, autumn and winter. Spring usually lasts from late-March to early- May, summer from mid-May to early-September, autumn from mid-September to early-November, and winter from mid-November to mid-March.

Rainfall is concentrated in the summer months of June through September. The southern coast is subject to late summer typhoons that bring strong winds and heavy rains. The average annual precipitation varies from 1,370 mm in Seoul to 1,470 mm in Busan. There are occasional typhoons that bring high winds and floods.

Demographics

South Korea has a population density of 497.1 per sq. km as of 2011, and this is more than 10 times the global average. Most South Koreans live in urban areas, because of rapid migration from the countryside during the country's quick economic expansion since 1970. The capital city of Seoul is also the country's largest city and major industrial hub. Seoul had a population of 10 million inhabitants. Other major cities include Busan (3.5 million), Incheon (2.7 million), Daegu (2.5 million), Daejeon (1.5 million), Gwangju (1.5 million) and Ulsan (1.1 million).

Water Resources

Korea has 1,274 mm of average annual precipitation, which is estimated at 124.0 billion m^3 of water in volume, out of which 72.3 billion m^3 discharges to rivers and streams showing a 58% runoff rate and 51.7 billion m^3 evaporates or infiltrates as a direct loss. Total available surface and groundwater is estimated at 33.7 billion m^3 which includes 20.1 billion m^3 of river flows during the non-flood season, 17.7 billion m^3 of stored water in multipurpose dams and agricultural reservoirs and 3.7 billion m^3 of groundwater (National Water Plan, 2006).

Agriculture

Land resources and agricultural land use

The Republic of Korea has 100,148 km^2 of land in 2012, which includes 63,688 km^2 (64%) of forest, 16,980 km^2 (17%) of cultivated land, 19,479 km^2 of other types (19%). The average amount of cultivated land per capita is 0.034 ha and the average farm household has 1.46 ha including 0.82 ha of rice paddy and 0.64 ha of upland.

The cultivated land is mainly composed of 7,381 km^2 of uplands and 9,599 km^2 of paddy fields. There is a drop in agricultural land use due to rapid urbanization and industrialization.

The cultivated land is utilized to grow food crops (1,054 thousand ha), vegetables (227 thousand ha), oil and cash crops (79 thousand ha), orchards (154 thousand ha), green house crops (93 thousand ha), and other crops (133 thousand ha). A total of 17,829 thousand ha of yearly land use indicates a 105% land use rate by growing two or three crops on some parts of the cultivated land. The cultivated areas for food crops cover rice (854 thousand ha), barley and wheat (42 thousand ha), miscellaneous grains (28 thousand ha), pulses (88 thousand ha) and potatoes (43 thousand ha). (2012, Food, Agriculture, Forestry and Fisheries Statistics Yearbook).

Irrigated paddy fields

As a result of concentrated efforts in agricultural water resource development by Korean Government, about 800,000 ha of the rice production area was converted into irrigated paddy fields, which accounts for 80% of total rice production area. However, about 50% of the irrigated paddy fields are still subject to possible damage from the drought with 10-year frequency because of poor irrigation facilities. Besides these problems, 10,000 reservoirs (55% of the 18,000 existing reservoirs) do not function well due to this deterioration.

Physical and physiographic constraints

Major physiographic constraints are large mountainous areas, which are prone to erosion due to steep slopes and high intensity rainfall. These conditions limit development in the mountain area. Similarly the absolute shortage of flat plain area has led to the conversion of farming areas into industrial and urban areas. The recent industrial growth as well as urbanization and increase in population is the major cause of the reduction in farmland.

Agricultural Productivity

The climatic conditions in Korea allow one harvest of most crops except some vegetables and food crops. The agricultural productivity of major crops is relatively high with high inputs of fertilizers and chemicals, applying advanced farming skills, intensive extension and farm mechanization. The yields of paddy rice, barley, wheat, potato, maize and pulse in 2011 recorded 6,590 kg, 4,280 kg, 3,350 kg, 23,210 kg, 4,650 kg and 1,660 kg per ha, respectively. (2012, Food, Agriculture, Forestry and Fisheries Statistics Yearbook).

The yield of rice in Korea is the highest among all the food crops and indicates a high level in the world as well. Chinese cabbage is the most widely grown among the vegetables and yields 109,480 kg per ha for 2011 fall season. Apples are one of the major fruits and harvests are 12,180 kg per ha. (2012, Food, Agriculture, Forestry and Fisheries Statistics Yearbook).

Agricultural Water Resources

Reservoir is the main water resource for paddy fields and other structures including pumping station and diversion weir headwork share about half of agricultural water supply. Aged and a large number of irrigation facilities have been burdened for operation and maintenance of sound management for agricultural water resources and it requires a breakthrough to solve the cost and labour.

Agricultural water use is typically concentrated during end of April to early June for rice transplanting, which has to be accomplished before starting wet season, so that every agricultural reservoirs have to store the water for rice transplanting during dry season right after rice harvest.

Agricultural Water Management: Some Issues

Agricultural dams for reservoirs and pumping stations are the typical main water resource structures in Korea, and diversion weirs, pumping wells and infiltration galleries are usually used as auxiliary irrigation structures. Pumping stations take water from rivers and lakes. A large scale pumping stations are generally operated for water uptake from lakes which were formed by sea dike for tidal land reclamation.

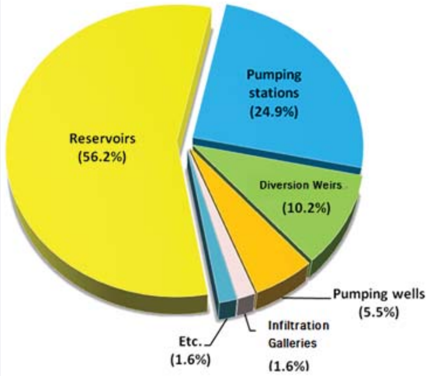
Total number of irrigation facilities in Korea is 69,323 in 2009. The number of pumping wells is 23,478 (33.9%) showing which is the most popular facility for paddy irrigation, though the irrigation area is smaller than reservoirs, pumping stations and diversion weirs. Number of agricultural reservoirs is 17,569 (25.3%) and pumping stations is 7,467 (10.8%). 18,114 diversion weirs (26.1%) and 2,696 infiltration galleries (3.9%) have operated for paddy irrigation. During two decades from 1990 to 2009, the number of irrigation facilities is increased from about 57,600 to 69,324 with 11,724 facilities construction (20.4%) decreasing the number of reservoirs, diversion weirs and infiltration galleries, and increasing pumping stations and wells.

In 2009, the total length of irrigation and drainage canals is 184,036 km with irrigation canal of 116,395 km (63.2%) and drainage canal of 67,641 km (36.8%).

About KCID

The Korean National Committee on Irrigation and Drainage (KCID) is a corporation under the Ministry of Agriculture, Food and Rural Affairs, Republic of Korea consisting of 2,700 individuals and 34 companies / organizations. The objective of KCID is to develop advanced knowledge and technology in the area of irrigation, drainage, flood management and enhance world-wide food supply and preserve environment through participating in various ICID activities, cooperating with the other member countries and relevant organizations and disseminating information worldwide. KCID has established its National Organizing Committee (NOC) for Korean Congress 2014, consisting of 17 committee members and 23 board members. KCID has been one of the most active National Committees of ICID since 1969.

Ratio of irrigation area depending on the different water storage facilities



It has given ICID three Vice Presidents in the past, namely, Mr. Yu, Keun-Hak (1993-1996), Prof. Soon-kuk Kwun (2000-2003), and Dr. HUH, Yoo-Man (2004-2007). Prof. Kim, Tai-Cheol is the current Vice President of ICID (2011-2014). KCID has hosted many ICID events, such as 52nd International Executive Council (IEC) meeting, and 1st Asian Regional Conference (ARC) in Seoul. KCID has won the 1st 'Best Performing ICID National Committee Award' during 18th ICID Congress at Montreal, Canada in 2002 for its outstanding achievements and contributions towards the mission of ICID. KCID has also contributed to Special Issue of ICID Journal titled "Sustainable Water and Land Management in Tidal Areas" published in October 2013 and a book on "Towards Sustainable Development of Tidal Areas: Principles and Experiences".

KCID is organizing 22nd International Congress on Irrigation and Drainage and 65th International Executive Council meetings from 14-20 September 2013 at Gwanju Metropolitan City, Republic of Korea.

Dr. Sang Mu Lee, the Chairman of the (KCID) has more than 16 years of professional experience in the field of irrigation, drainage and rural development. He is also the Chief Executive Officer (CEO) of Korea Rural Community Corporation (KRC). Dr. Lee started his career in the Ministry of Agriculture and Fishery as a Director General of Planning & Coordination Office. He is also the Chief Executive Officer (CEO) of Korea Rural Community Corporation (KRC).

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