

ICID NEWS

MANAGING WATER FOR SUSTAINABLE AGRICULTURE



MESSAGE FROM THE PRESIDENT

Dear Colleagues,

As we bid adieu to 2018 and welcome 2019 with open arms, it's time to reflect upon all the learning outcomes of the previous year. Despite all the globe-trotting, it was indeed a very productive time to imbibe and share new experiences and set the tone for future organizational goals.

In October 2018, I joined the ICID team to visit farmers in the heartland of the State of Punjab in India to observe, study and discuss ways to improve water and energy productivity in their Rice-Wheat cropping system. I must really congratulate the scientists and researchers of the Agricultural Technology Applications Research Institute (ATARI) and Borlaug Institute for South Asia (BISA), both based in Punjab, who are doing an excellent and highly relevant work at the grassroots level and for making top-notch arrangements for study visits to the field projects, research demonstrations and farmers' fields in several villages. Interactions with the farmers, who have adopted solar-powered micro-irrigation systems and direct seeding of rice, wheat and maize along with new cropping practices such as mulching developed by BISA and ATARI to reduce production costs, increase crop yields, save water and environment, as

part of conservation agriculture, were tremendously insightful.

Technologies that were demonstrated included surface and sub-surface drip irrigation and direct seeding of rice, wheat and maize under no-till conditions; and crop demand-based automated real-time irrigation. Such efforts are now bearing fruits as some farmers have now stopped rice-straw burning which aggravates air pollution during the winter months. Water saving of more than 50% has been achieved compared to the traditional flood irrigation methods and sub-surface drip irrigation has resulted in reduced weed growth which saves labor and money spent on herbicides as the top soil remains dry discouraging weed growth. Zero tillage has eliminated the need for expensive field preparation. This study tour served as a perfect detour before prepping for the 9th International Micro-irrigation Conference (9IMIC) held in Aurangabad, India in January 2019.

On the first day of 9IMIC, I got an opportunity to present my research and interact with more than 200 farmers at the Water and Land Management Institute (WALMI), who had come to take part in the conference. ICID Vice President Dr. Marco Arcieri, Vice President (Hon.) Dr. Mohamed Wahba, Secretary General Ashwin Pandya and the ICID's Knowledge Management Team also joined me during the conference. I also delivered a keynote address during the 9IMIC plenary session to an enthusiastic audience. Several ministers and high-ranking policymakers inaugurated the mega event that witnessed over 700 participants, including more than 100 international professionals, around 200 farmers from India and a few from abroad, and rest from various scientific and engineering disciplines; all gathered under one roof to share views and innovative ideas for large scale adoption of micro-irrigation technologies to improve productivity in the agriculture sector.

The farmers and irrigation professionals thronged the exhibition area, where more than 30 companies had showcased various technology products and services for micro-irrigation. The farmers' fair at the same venue, was flocked by the participants, where food and fiber products were sold in attractive packaging. The home-made products, mostly made by the village women from various parts of India, reminded the vital economic role women play in the agriculture sector. Another popular hub was the ICID booth that distributed promotional materials, as well as, explained the working of ICID network to the visitors.

The 9IMIC concluded on a high note with a visit to the expansive research and development facilities of the Jain Irrigation Systems Limited (JISL), an India based USD 1.3 billion multi-national company. JISL offers an entire range of micro-irrigation equipment and supplies; develops tissue culture; promotes contract farming and builds capacity in farming and extension communities. We were taken to their laboratories and manufacturing facilities. I was delighted to meet Mr. Ajit Bhavarlal Jain, Joint Managing Director and their dedicated and tenacious research team involved in developing world-class micro-irrigation products.

As I close, I wish to restate that with the onset of New Year, we have great challenges, but also 365 great opportunities and I am confident with collaborative teamwork and efforts, we will astutely meet them and make 2019 as one of the milestones in ICID's journey.

With best regards,

Felix Reinders
President, ICID



Micro Irrigation in Modern Agriculture

In order to promote the use of micro irrigation on large-scale, ICID launched the hosting of International Micro Irrigation Congress commencing from the year 1971. The 1st International Micro Irrigation Congress was held from 6-13 September 1971 in Tel Aviv, Israel. During the 66th IEC Meeting at Montpellier, France, 2015, it was decided to rename the congress/symposium as conference. The 8th International Micro Irrigation Conference (8IMIC) was held in Tehran, Iran, 2011. The 9th International Micro Irrigation Conference (9IMIC) was successfully organized from 16-18 January 2019 in Aurangabad, Maharashtra, India on the theme 'Micro Irrigation in Modern Agriculture'.



The conference was inaugurated by Hon'ble Union Minister Mr. Nitin Gadkari (Ministry of Road Transport and Highways, Shipping and Water Resources, River Development and Ganga Rejuvenation, Government of India); presided by Hon'ble Chief Minister of Maharashtra Mr. Devendra Fadnavis, and Hon'ble Union Minister Mr. Radha Mohan Singh (Ministry of Agriculture and Farmers Welfare, Government of India); Hon'ble Minister Dr. Mahendra Reddy (Ministry of Agriculture, Rural and Maritime Development and Waterways and Environment, Government of Fiji). In the presence of Mr. U.P. Singh, Secretary (Ministry of Water Resources, River Development and Ganga Rejuvenation, Govt. of India); Mr. S. Masood Hussain, Chairman, (INCSW, Central Water Commission); Engr. Felix Reinders, President, ICID; Engr. A.B. Pandya, Secretary General.

9IMIC was hosted by the Indian National Committee on Surface Water (INCSW), which is a part of the Ministry of Water Resources, River Development and Ganga Rejuvenation (MoWR, RD&GR), Government of India in association with WAPCOS Limited. The event witnessed a large group of eminent international and national experts and local farmers sharing their experiences in the field of latest development in micro irrigation technology to enhance crop production and water management for optimal use in agriculture, technical and sociological interventions for sustainable water, food and agriculture.

9IMIC initiated a multi-disciplinary dialogue for discussions and deliberation through seminars, exhibitions and sessions and raised awareness regarding large-scale use of micro-irrigation including new techniques in micro irrigation for increased crop productivity, micro-irrigation in cluster level farming and canal irrigation systems. Around 700 delegates from 30 countries participated in the conference that provided a global platform to professionals and exhibitors to showcase their knowledge and technologies from around the world.

As a result of intense deliberations, the following recommendations has been emerged:

Recommendations

Importance of the Micro-Irrigation Development

- ◆ Water should be considered as a resource, instead of a commodity to be distributed among the farmers. Investments in micro-irrigation can help in increasing GDP per unit of water deployed, as saved water can be used for economic activities that generate more GDP per unit of water.
- ◆ Micro-Irrigation builds resilience against climate change and secures water for people, environment and food production.
- ◆ Micro-irrigation needs to be developed as a viable agriculture business model for the farmers with better productivity and economic returns in tangible and intangible forms. Ramthal (Karnataka), India's largest drip irrigation project, where the irrigated area has been almost doubled by adopting

integrated micro-irrigation, is an excellent example of technology driven, community-based, efficient, large-scale irrigation system.

- ◆ All borewells should be integrated with micro-irrigation, integration of lift irrigation schemes with community drip, adoption of micro-irrigation for all agriculture crops. All efforts should be made for making micro-irrigation mandatory for water intensive crops such as Rice, Oil Palm, Sugarcane, Banana, Papaya, Citrus and Coconut.

Technology, Innovations and Products

- ◆ Hi-Tech green-houses equipped with climate control, micro sprinkler, subsurface drip irrigation and mechanized farming techniques have the potential to increase the yield three to four times. The success of such prototype projects needs to be replicated on a large-scale with appropriate hand holding and capacity building of the farmers.
- ◆ New concept such as "more crop per drop per kilowatt" should be promoted. Pressurized irrigation systems can be effectively bundled with solar pumps which are best suited in areas with no or erratic power supply and for the farmers growing less water intensive crops.
- ◆ More focus is required on the agronomic practices such as mulching, which is cost effective also, along with drip irrigation for areas having a water shortage. Drip irrigation, if used along with mulching may provide better water efficiency. This also increases crop yield. In the case of field demonstration on Potato increase in yield was to the tune of 40%.
- ◆ Latest research carried out on different crops viz. sugarcane, banana, horticulture

and vegetables concludes that fertigation is the most effective and convenient means of maintaining optimum fertility level and water supply according to the specific requirement of crops with drip system. Field studies showed that drip irrigation along with fertigation increased the yield of the crop to a great extent

- ◆ The Pipe Irrigation Network (PIN) System requires less land as compared to conventional Canal Irrigation Network (CIN) System. Its adoption can address the growing problems of land acquisition as well as for providing effective Rehabilitation and Resettlement. PIN systems are required to be standardized for replication.
- ◆ It is assessed that micro-irrigation with a reliable water source and Pre-Paid Meter and Smartcard could save around 50 to 90 per cent of water.
- ◆ Sub-surface Drip Irrigation (SDI) system is a promising technique especially in arid regions. SDI can reduce losses by evaporation and deep percolation significantly. SDI also promotes a very good development of the root system in arid conditions. However, maintenance and clogging of drippers is a major concern.
- ◆ It is necessary to conduct the physical and chemical analysis of the water before designing a drip irrigation system and choosing an appropriate filtration system. It is important to analyze the sample for suspended solids, dissolved solids and the acidity (pH), macro-organisms, and microorganisms.

Micro-Irrigation Funding and Social Involvement

- ◆ Water pricing is one factor which can act as a trigger for adaptation of large-scale micro-irrigation with water saving objective and it should be increasingly factored in the irrigation policies.
- ◆ In addition to the horticultural and cash crops, the micro-irrigation also needs to be adopted for cereals and pulses on large scale, to broad base the water savings. There is a need for a review of funding policies for micro-irrigation for cereals and other crops.
- ◆ Micro-irrigation Fund to be created to facilitate States in mobilizing resources for expanding coverage of Micro-irrigation by taking up - special and innovative projects, and for incentivizing micro-irrigation beyond provisions under PMKSY-PDMC to encourage farmers to adopt micro-irrigation systems.
- ◆ There should be a gradual shift from grant-based to loan-based model and from Project-based to Program-based approach in micro-irrigation.
- ◆ Cost effectiveness is the key to popularize MI. Low cost drip lines have been useful in



As a part of the conference, Water and Land Management Institute (WALMI), Aurangabad organized a one-day "National Micro Irrigation Workshop for Farmers" on 15 January 2019. Around 200 farmers from various states of the country participated in the event. President Reinders was invited as Chief Guest to address the gathering. He made a presentation on Micro Irrigation and introduced different practices and technologies used in various countries.

popularizing the MI. The initial higher cost of sub-surface drip irrigation gets offset by its long-term advantages in water saving and hence sustainability.

- ◆ Study result indicates that energy subsidy in lift irrigated areas does not support water and energy savings. The shift of the subsidies from energy to water saving technologies in lift irrigated areas will improve water and energy use efficiency.
- ◆ Small land holdings which are considered uneconomical for intensive farming need consolidation approach through local institutions as ecological units.

O&M Services and Capacity Development

- ◆ The geometry of emitters leading to clogging by roots, soil and salts should be considered during design and manufacturing processes. The effect of discharge rate on emitters clogging, smaller the discharge rate more are the chances for clogging.
- ◆ Areas having higher hardness should have a different design of emitters and paths. There can be a separate design of MI systems depending on the hardness of the source of water.
- ◆ Life Cycle Cost Analysis of pipes of various materials needs to be carried out which includes construction cost, operation cost, revenue loss, replacement cost and disposal cost. Findings of a study on Life Cycle Cost Analysis on commercially available diameter may lead to ready reckoner for the planning of micro-irrigation and piped irrigation system
- ◆ Ground water based pressurized irrigation system run on the same pump or motor which lifts the water without any additional electricity
- ◆ High initial investment, relatively higher maintenance cost, clogging of drip emitter, availability of water-soluble fertilizers and

their compatibility and overdosing of fertilizers are few problems being faced in fertigation and chemigation. Further research work in this field can enhance the effective usage of fertigation and can help Indian farmers to adopt a micro-irrigation system effectively.

- ◆ Imparting training, skill development, providing technical support through research institutes, NGOs, state and central government institutes can encourage farmers to adopt fertigation and chemigation as part of micro-irrigation for increased field application efficiency and crop yield improvement.
- ◆ Safe and efficient utilization of sewage effluent is of great significance to ensure agricultural production and optimize the balance between supply and demand. Reclaimed water use has special concerns like:
 - ◆ Great seasonal variability is observed in the quality of the treated water. however, it should remain in compliance with the reuse standards, especially in periods of high demand for irrigation water
 - ◆ It is better to irrigate with treated wastewater because of the degraded quality of the groundwater.
 - ◆ Problems of clogging the drip irrigation network in the near future may occur due to the weakness of the filtration system.
 - ◆ With a view to safety, avoid crops that are eaten raw (salad and vegetables)
 - ◆ Creation of specifications for drip equipment for treated wastewater reuse projects that take into account the quality of the water (algae and salts)

For more information, please visit http://www.icid.org/9th_microirri.html



Rice Cultivation in Italy under the Threat of Climatic Change: Trends, Technologies and Research Gaps

Dr. Marco Arcieri*

The International Society of Paddy and Water Environment Engineering (PAWEES), International Network for Water and Ecosystem in Paddy Fields (INWEPF) in collaboration with the ICID's Asia Regional Working Group (ASRWG) organized PAWEES-INWEPF 2018 conference in the historic city of Nara, Japan; to exchange knowledge and discuss current issues of importance for paddy agriculture in our pursuit of the SDGs. The theme of the conference is "Promoting sustainable paddy farming to achieve the SDGs". Vice President Dr. Marco Arcieri was invited as one of the key speakers to address this important topic. This article covers a briefly summarizes the presentation.

Italy is the largest rice producer amongst the European Union (EU) countries; more than two thirds of Europe's rice is produced in Italy, whilst about 60% of the national production is exported to EU countries (two-thirds of the exported amount) or to other countries, mainly in the Mediterranean area and in Eastern Europe. Production is mostly located in north west part of Italy. The largest rice producer areas being Lombardy and Piedmont regions, even though important areas of production have subsequently developed in Sardinia Island and in Southern Italy Calabria region. Rice production in Italy started around the middle of the 15th Century, greatly influencing its distinguished cuisine so that today the country is famous for its risotto dish, the most famous one being of course "Risotto alla Milanese", based upon the use of the saffron spice. According to tradition, the dish was conceived during the construction of the beautiful, gothic style Milan cathedral at the beginning of 16th Century; saffron was introduced to colour the stained glass windows of the cathedral at the time and was added to a risotto dish almost as a joke, giving birth to this very worldwide appreciated recipe. Even though Italians do not eat much rice (about 8.5 kg/person in 2010), they have a nice saying which quotes "Rice is born in water but dies in wine."

Today, this cultivation in Italy is highly specialized and represents 70-80% of the rice farming surface. The crop is grown from April to October and extends over about 240.000 ha, which represent 1.4% of the total arable area of the country (16.800.000 ha). The expected production is approximately 1.4 million metric tons of paddy rice and the average yield is about 6 tons per ha, 85% of the surface being cropped with "japonica" type varieties, the rest with "Thaibonnet". On average, Italian consumers prefer bold and chalky



grain, so that indica-type rice is entirely exported. The new "japonica" rice varieties are planted under irrigated conditions in large and highly mechanized farms. During the last twenty years, rice cultivation area has been increasing of about 20%, thus bringing positive impulse to Italian economy because of the significant export of its total production, which counterbalances the imports of large quantities of food and feed products coming from abroad. As a matter of fact, Italy has become an important rice-exporting country, considering that its domestic consumption hardly exceeds 40% of the total rice production. Although Italian rice production represents a very small fraction of the world production, the volume of exports reaches 5% of total rice traded in the world. As to what regards the agronomical aspects of cultivation, the main constraints of rice production in Italy can be identified in low temperature at sowing and flowering time (especially in the north), blast of diseases, weeds and red rice. Recent research has proven that possibility exists to increase the potential yield by means of varietal improvement, with emphasis on disease resistance, low temperature and dry conditions adaptability, besides lodging resistance. Moreover,

the increasing awareness regarding ineluctability of climate change has been fostering new research programmes, focused on breeding for yield stability and grain quality, for cold and disease resistance as well as for salt tolerance, besides the introduction of new weed control techniques and biotechnologies (another culture, transformation) which might well lead the way to unprecedented levels of production for Italian rice, bringing higher resilience to this crop cultivation especially considering the quality and quantity of grains.

Collaboration between ICID Asia Regional Working Group, PAWEES and INWEPF in the "PAWEES-INWEPF International Conference, Nara 2018

The "PAWEES-INWEPF International Conference Nara 2018" (Nara Conference) was held from 20-22 November 2018 in Nara city, Nara prefecture, Japan. The Nara Conference was jointly held by the International Society of Paddy and Water Environment Engineering (PAWEES) and the International Network for Water and Ecosystem in Paddy Fields (INWEPF) in collaboration with the ICID

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Asia Regional Working Group (ASRWG). Under a common purpose of sustainable development of paddy farming, the PAWEES organizes activities with an academic approach, and the INWEPF mainly with policy and engineering approaches. During the conference, a total of 552 participants including researchers, policy makers, engineers and private sectors from 21 countries and regions and 4 international organizations (ICID, FAO, IWMI and MRC) discussed the issues on paddy farming including water use, water management and water environment under the joint theme

“Promoting sustainable paddy farming to achieve the SDGs”.

The PAWEES and the INWEPF re-acknowledged the significance of ensuring the multi-functionality of paddy farming as well as sustainable and stable food production. Toward achieving the SDGs, both parties expressed their contribution with mutual cooperation to further development of sustainable paddy farming in harmony with the environment, strengthening the partnership among countries and related organizations such as ICID and FAO.

The “ICID-PAWEES-INWEPF Collaborative Workshop” was held in the Nara Conference by the Japanese National Committee, ICID (JNC-ICID) in close cooperation with the ASRWG in order to strengthen partnership with the PAWEES and the INWEPF, and contribute further development of sustainable agriculture in Asia. The participants discussed on irrigation and drainage in Asia to achieve the SDGs. Expert speakers stressed the significance of strengthening collaboration and cooperation among the international organizations. Innovations to solve the issues that Asia will face in the medium to long term such as reduction of farming population, increase of paddy productivity, and promotion of crop diversity and high profit crops, gathered a lot of interests from participants.

At the end, it was decided that the next PAWEES and INWEPF joint international conference will be held in South Korea in November, 2019. The ASRWG will further strengthen partnership with the PAWEES and the INWEPF including through cooperation for the next conference.



Diagnosing Drainage Problems in Coastal Areas Using Machine-Learning and Geostatistical Models

Abdullah Darzi-Naftchali¹, Fatemeh Karandish², and Ahmad Asgari¹

ICID instituted the 'Best Paper Award' to recognise the outstanding paper contributed to 'Irrigation and Drainage', the Journal of ICID. The award consists of a citation plaque and either US\$ 500 cash or US\$ 800 worth of Wiley books from M/s. Wiley Blackwell (UK). The Wiley-Blackwell 2018 Best Paper Award was awarded to this paper published in the ICID Journal (Volume 66, Issue 3 in 2017). The award was presented during the 68th IEC meeting on 10 October 2017, Mexico City, Mexico. Full paper can be accessed from http://www.icid.org/best_paper_2018a.pdf

This study focuses on diagnosing drainage problems in the coastal areas of Mazandaran Province, northern Iran. Rapid population growth and increased water demand for drinking, domestic, industrial and, especially, agricultural uses have put more pressure on the natural water balance and consequently on the total hydrology of the region, resulting in greater emphasis on the exploitation of groundwater resources. In addition, the area is beset with the problems of waterlogging during rainy seasons and salinity during summer months, mainly due to imbalanced groundwater recharge and extraction. Sustainable agriculture in this area is primarily dependent

on diagnosing and combating drainage problems. Waterlogging, which occurs due to the relatively flat topography, inadequate natural drainage facilities and excess rainfall, prevents year-round cropping, resulting in considerable areas either going out of production or experiencing reduced yield. However, there are increasing concerns about overexploitation from shallow aquifers during spring and summer months.

In this study electrical conductivity (EC), exchangeable sodium percentage (ESP), acidity (pH) and groundwater level (WD) were selected for classifying drainage requirements. These parameters were analyzed by using geostatistical methods,

SVMs and ANFIS models on three occasions, including pre-planting period (winter), cultivation period (spring) and post-harvest period (summer).

The experimental site with 25,000 ha area is located within longitudes of 654651 m to 675625 m and latitudes of 4038241 m to 4070903 m in Mazandaran Province. Of the total area of the study region, 43.3, 38.3, 13.2 and 5.2% are attributed to paddy fields, dry lands, orchards and abandons, respectively. Groundwater level (WD) and quality were monitored at 37 observed wells scattered over a 25,000 ha area at different times. Figure 1 shows the location of observed wells in the study area and the land use pattern.

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Paddy fields, as the dominant land use in the study area, have a specific hydrology, with the wetland condition prevailing during the growing season as well as in rainy seasons. Paddy farmers generally apply more water to the field to control the weed germination than is needed for meeting crop water requirements. So, a substantial amount of applied water is lost by deep percolation from the root zone.

Classification of drainage requirements of the study area was done based on salinity, sodicity and waterlogging problems. Regions with groundwater EC and ESP higher than 4 dS m⁻¹ and 15, respectively, were considered to have salinity and sodicity problems.

Also, regions with WD lower than 2 m were considered to be waterlogged. Therefore, it is assumed that regions with EC > 4 dS m⁻¹, ESP > 15 and WD < 2 m require some form of drainage to control salinity, sodicity and waterlogging problems, respectively.

In summer, more than 87.7 and 66.9% of the study area had salinity and sodicity problems, respectively. However, only 19.1 and 7.9% of the study area had salinity problems in winter and spring, respectively. Also, the values of ESP in winter and spring were more than 15, respectively, in 20.6 and 24.8% of the study area, but waterlogging was common problem in winter and spring, occurring in 99.4 and 97.4% of the study area. Salt leaching in winter and increased WD as a result of groundwater pumping exceed the groundwater recharge rate due to unsuitable management activities in summer, caused salinity problems in winter and summer compared with those in spring.

Considering the high risk of salinity and sodicity in summer, improvement of drainage conditions is inevitable if sustainable agriculture in the region is

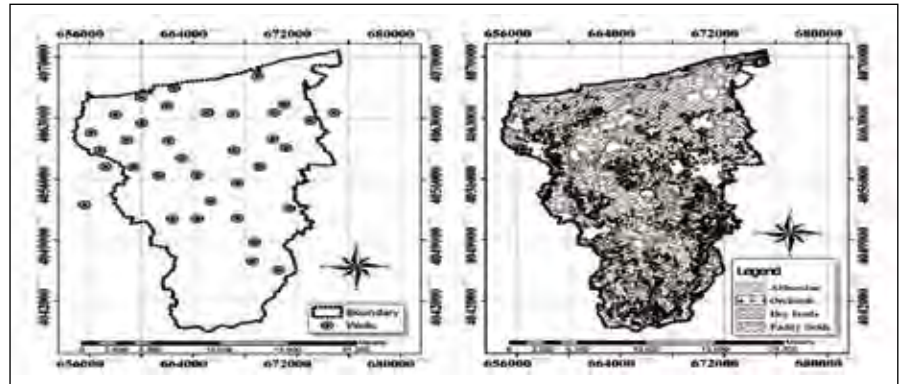


Figure 1. Location of shallow wells in the study area (a) and the land use pattern (b)

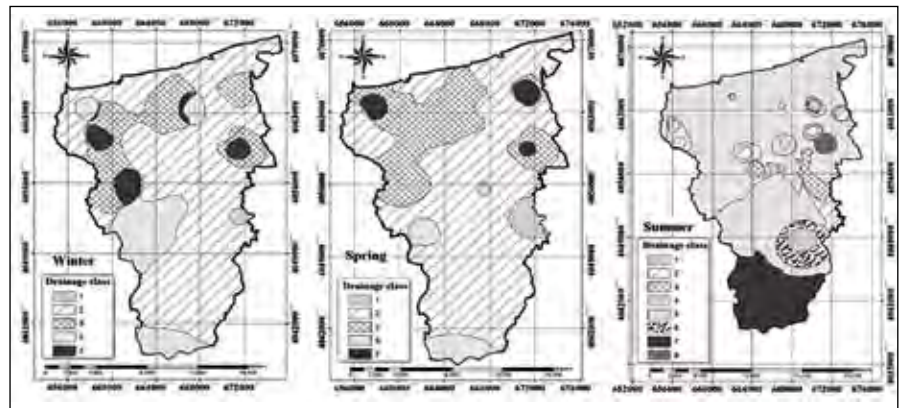


Figure 2. Classification of drainage needs in the study area in winter, spring and summer

to be achieved. Also, preparing land for on-time cultivation in spring requires implementing drainage systems to lower the groundwater table more rapidly and prevent yield losses due to delayed cropping stress. Through combination of three indicators (EC, ESP and WD) and overlaying their maps, eight drainage classes were defined. The spatial distribution of drainage classes is presented in Figure 2.

There was no drainage requirement in only about 2.6, 2 and 0.61% of the total area, respectively, in spring, summer and winter. The maximum drainage requirement in spring, summer and winter was related to, respectively, 'drainage to remove excess water', 'drainage to control salinity'

and 'drainage to remove excess water'. Generally, the need for drainage in a region mainly depends on the agricultural activities, rainfall pattern, irrigation, etc.

Based on these results, in the wet seasons, drainage should be carried out to remove excess water and to control waterlogging, while at the end of the growing season it is required for controlling salinity and sodicity.

Overall results show that more than 60% of the area needs drainage to lower the groundwater table in preplanting and post-harvest periods, while during the growing seasons, more than 72% of the area requires drainage for salinity control. This is because increased agriculture due to rapid population growth in the study area combined with improper usage of fertilizers and overexploitation of groundwater have caused almost all parts of the study area to be poorly-drained to achieve sustainable agriculture. However, drainage requirements are highly dependent on the measurement period. In fact, in the wet seasons, drainage should be carried out to remove excess water and to control waterlogging, while at the end of the growing season, it is required to control salinity and sodicity.



Towards Resilience to Climate Change

Dr. Arvind Kumar*

Climate change has emerged as a global phenomenon entailing extensive consequences and is deemed as a 'threat multiplier' entailing the potential of amplifying global risks. Tackling numerous threats stemming from climate change is fraught with an array of problems of fiscal resources, governance, transnational cooperation and pressure. Deployment of fiscal and technological resources, apart from being extremely expensive, is prone to fall apart in the absence of a governance mechanism based on natural solutions. Therefore, there is a growing recognition for the need for going in for nature-based adaptive solutions to enhance resilience to climate change and ecosystem-based adaptation (EbA) is gaining salience over adaptive solutions to climate change.

India Water Foundation (IWF), a New Delhi-based non-profit civil society and Direct Member of ICID, has been instrumental in getting EbA approach integrated into the State Climate Change Action Plan in the state of Meghalaya, located in India's North-East region, where IWF has been cooperating with the state government in policy-making and implementation in managing natural resources under the government's flagship programme entitled Integrated Basin Development and Livelihoods Programme (IBDLP). Prior to implementation of IBDLP project, Meghalaya was marred by environmental degradation. Increased and unsustainable resource utilization culminating in pushing back the boundaries of forests and turning clear streams into muddy water resulting in water stress and declining water storage capacities. Excessive mining activity created severe problems negatively impacting environment in terms of soil degradation, anthropogenic water pollution and eventually leading to the extinction of aquatic life. Absence of avian and aquatic populace made Meghalaya's predominantly tribal hunter-communities dependent on hunting for food.

Various problems identified and tackled under this project were: risks emanating from water-induced and environment-induced vagaries in terms of insecurity of water, food and energy sectors, floods, drought, water and air pollution, erosion of land, loss of biodiversity, deforestation and loss of livelihoods, bulk of land owned by local communities etc., adversely impacting upon natural ecosystems rendering them unsustainable and socio-economic and cultural lives of the local communities.

EbA approach adopted in Meghalaya has facilitated enhanced climate resilience, conservation of biodiversity & Eco-services. It has delivered manifold economic, social and environmental co-benefits that surpass climate adaptation and these, inter alia,

include: biodiversity conservation through enhanced habitat conditions; climate mitigation through increased carbon sequestration; conservation of traditional knowledge, livelihood and practices of local communities; improved recreation and tourism opportunities; enhanced food security etc. Another thrust area under this Project was to address the issues and challenges arising out of Jhum and Bun cultivation with active involvement of all the concerned stakeholders and community mobilization, capacity building of the stakeholders, convergence, creation of flexible and modern institutions, better delivery of services, and overall improvement in Governance. A broad platform of better governance and a high level of community participation was set up to create new and holistic initiatives to address the problem of unchecked deforestation, adopting polluters pay principle, mining and water pollution to create a circular economy.

Being convinced about the utility of EbA approach in combating vagaries of climate change, IWF as development partner of the Meghalaya Basin Development Authority, Government of Meghalaya, has been instrumental in getting EbA integrated into the implementation of the IBDLP and the salutary outcomes have reinforced our convictions about the utility of EbA as an effective tool to combat the adverse impacts of climate change. It is an on-going project to envisage all-round sustainable development of Meghalaya.

EbA interventions have enabled to transform the challenge of climate variability into opportunity under Apiculture Mission and Horticulture Mission to transform barren land tracts into tea plantations and orchids. Under the Green Mission, EbA interventions have enabled in enhancing



sustainable green cover, adoption of green technologies and building up a green movement thereby resulting in enhanced resilience to climate change, reduction in greenhouse gas (GHG) emissions and increased scope for alternative livelihood opportunities. EbA interventions under the Forestry and Plantation Crops Missions have led to forest conservation, enhanced forest-cover areas, sustainable agriculture, carbon sequestration, diminution in GHG emissions and environment sustainability thereby ensuing food security.

The practice of EbA brought into vogue in Meghalaya by IWF has enabled the local communities to garner multiple benefits accruing from restoration of man-made wetlands, forest conservation and sustainable forest management that have helped in carbon sequestration, improved water quality, reducing risks from natural hazards, biodiversity conservation, improvement in alternative livelihoods and poverty alleviation. Besides, it has also helped in realizing specific Sustainable Development Goals (SDGs), specifically improved livelihoods in terms of SDG-1, increased water, energy and food security in terms of SDGs 2, 6, 7, enhanced Climate Change resilience in terms of SDG-13 and augmented Biodiversity conservation and Eco-services in terms of SDG-13. 15

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Business as usual is not an option to manage our water, energy and food sectors

Dr. Olcay Ünver*

We all desire a world in which all people sustainably have access to water, food and energy for their fundamental needs, in a manner satisfactory to them, and where our ecosystems and natural resource base are not threatened as a result.

While the drivers of change for water, food and energy are similar (e.g. population growth and mobility, impacts of economic development, changing diets, and social and technological change) with climate change acting on all as an additional stressor, decision making in these sectors has traditionally taken place in fairly isolated processes and through mechanisms with detached and varying accountability structures. This has resulted in silo approaches where competition over natural resources cannot be tackled in a holistic manner, leading to a huge, untapped potential to seek and implement synergies, and to tackle trade-offs. We now know that the continuation of this will hurt the global economic growth, erode the economic and social gains made, and curtail the efforts towards sustainable development. Among the regions and groups that can be hurt most negatively are many of the low- and medium-income economies striving for greater socio economic development, which will face earlier than others more acute water, energy, and food shortages.

Agriculture is the largest use of water resources, globally claiming 70 percent of all freshwater withdrawals. The agro-food sector accounts for one third of total energy consumption in the world. FAO estimates a 50 percent increase in global food demand by 2050, over the 2013 figures. This will translate into greater demands for water and energy for food production, processing, transportation, storage, distribution and marketing.

Providing for these demands and simultaneously reducing the environmental burdens clearly tell us that adapting our systems, policies and practices within existing technologies from a single sector perspective will not work. We need radical

and systematic innovations deliberately designed to jointly improve the water, energy, and food resource efficiencies; and to boost overall resource productivities.

There is plenty of evidence from around the world that nexus approaches do produce better overall results, greater benefits and co-benefits and help manage trade-offs across sectors. Examples from South Asia and Sub-Saharan Africa also indicate that improving cross-sectoral resource use efficiency and avoiding adverse impacts of single-sector development strategies also result in huge benefits for the poor.

Nexus thinking also tells us to examine quick fixes and technological solutions in a broader context, taking into account accompanying, and often complementing, aspects such as management and resource allocation/re-allocation, and indirect as well as direct impacts, such as on the economies and communities.

The implementation of a technology to improve water-use efficiency may not necessarily lead to less water consumption from a broader perspective when it is accompanied by extending irrigated areas and or intensifying crops towards more productive varieties with higher water requirements, for example.

We need to watch if resource savings in one sector can have a non-declining effect on resource use in another sector. Technological innovations emanating from higher energy prices may have adverse impacts on land and water resources and the environment. A climate mitigation effort to increase energy efficiency, e.g. for biofuel crops, may lead to intense water use and a reallocation of land from food production. However, not all examples are about trade-offs. Many technology and management practices that reduce GHG emissions also tend to increase water and land use efficiencies and boost agricultural yields. Examples of this can be extended to the use of solar energy in agriculture, including solar powered irrigation, and to



the innovations in the thermoelectric power and industrial sectors where increased energy efficiency also led to water savings.

Nexus thinking in this context provides a framework to achieve circular economy at large and circular water economy in particular. While the traditional water economies are linear and deplete and pollute water as it travels, circular economies reclaim, re-use and re-cycle (e.g. gray water); invest and enhance basin-wide management; decrease pressures on ecosystems and reduce pollution of sensitive water bodies by synergistically combining economics and conservation, focusing on the service (quality) and performance (conservation) rather than sheer amounts of water used. Likewise, a circular economy for food, which reduces food loss and waste; increases efficiencies in production, processing and service delivery; and enhances eco-effectiveness of the food systems is not only possible but is becoming more and more feasible thanks to the technological advances, incentives and regulation, and increased awareness.

We need to change business as usual towards innovation that includes technology options that integrate across sectors, particularly water, food, and energy sectors, and policy options for the management of the cross-sectoral interconnections are essential if we want to achieve our development goals sustainably and equitably.

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