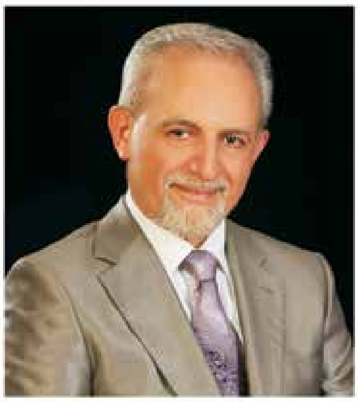
2015 | Third Quarter

ICID NEWS

MANAGING WATER FOR SUSTAINABLE AGRICULTURE



MESSAGE FROM
THE PRESIDENT

Dear Colleagues,

During the last one year since my election as the President of ICID, I have visited a number of countries that gave me the opportunity to interact with members of their National Committees. I discussed various challenges they were facing in tackling food and water security, the effectiveness of ICID activities, usefulness of the technical outcomes acquired by our fraternity and whether these outcomes were reaching their targeted audiences. I had also the pleasure to meet honorable Ministers, top officials, and policy makers of water, food and in some occasions energy sectors in these countries, including, Russia, India, Italy, Germany, Japan, South Korea, China, Tajikistan, and by all means Iran.

Through these interactions, I was able to gauge their expectations from ICID, the Office Bearers and the WGs and their technical outcomes. I was delighted to receive their appreciations to ICID's contribution to the global knowledge in the field of Irrigation and Drainage. At the same time their general expectation, particularly in developing countries, was to see ICID get more involved in supporting the real world problems of irrigation and drainage and contribute to the implementations of potential solutions.

I also had the chance, as the member of task force assigned by WWC, to provide inputs in the process of finalizing the proposed global sustainable development agenda, beyond 2015. The Sustainable Development Goals (SDGs) have very recently been approved by UN General Assembly. What struck me is the fact that the Goal "world with no poverty and hunger" remains at the top of the agenda of global development since the efforts at eradication of poverty through various programs implemented in the past by the concerned agencies, supported indeed by various international organizations, have fallen short of expectations.

Agricultural Water Management is one of the powerful tools to end hunger, eradicate extreme poverty, boost health and hygiene, and enhance shared prosperity among all people around the world as their number reaches 9 billion by 2050. Rural development is a corollary to sustainable development as 75% of the poor who live in rural area. They depend largely on farming to make a living. Efficient management of agriculture water is a crucial factor to achieve the objectives of sustainable development and therefore, should be considered as top priority within ICID agenda.

ICID enjoys a unique position as a network of irrigation and drainage professionals aggregated through National Committees bringing together various stakeholders within the water and agriculture sectors to provide appropriate platform for the exchange of knowledge and information among the member countries. At the national levels NCs have to broad base its membership to involve different government and non-government organizations. The National Committees should further integrate their activities with other water related issues in their countries while providing appropriate solution and approaches to address water and food security. It is very important to strengthen the capability of this network by defining and putting into practice a direct and concrete relation between ICID and its work bodies and the NCs. WGs and ICID experts by sharing the tools and experiences gained can play a crucial role in assisting the NCs deliver the relevant solutions to tackle hunger and poverty in their countries. Such coordination and collaboration would empower the NCs. It provides opportunities for ICID work bodies to get involved in the prevailing irrigation and drainage problems facing the world.

Under this background, I thought it appropriate to establish a Consultative Group (CG) consisting of dedicated and high level experts of ICID drawn from different NCs to set out a clear mission for the ICID, duly considering what the network represents and whom it intends to serve under the sustainable development paradigm for the next 15 years. This document prepared through long deliberations and consultations is intended to communicate a common understanding of the shared vision of the network.

The draft ICID Vision 2030 document will be deliberated upon during the 66th IEC. I very much hope with your active participation at the 66th IEC and your interest in the future of our fraternity, the document would generate discussions so as to capture your views from which the essence of the future role of ICID and its members could be put in an appropriate perspective. I would like to give my sincere appreciation to the CG members particularly its convener VP Dr. Hüseyin GŰNDOĞDU and Secretary General Avinash Tyagi and indeed the Central Office technical staff who contributed in preparation of the draft of ICID Vision 2030.

Best regards,

Dr. Saeed Nairizi
President, ICID

SUSTAINABLE DEVELOPMENT GOALS

Adopted by 70th UN General Assembly on 25 September 2015

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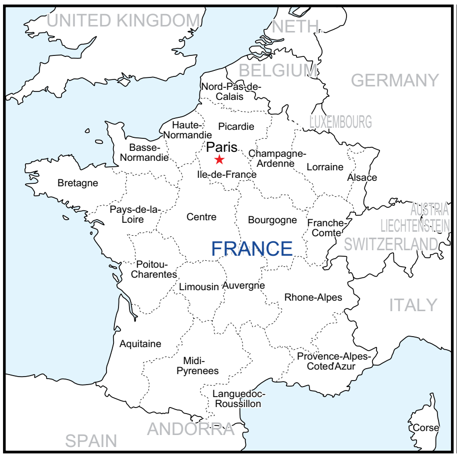
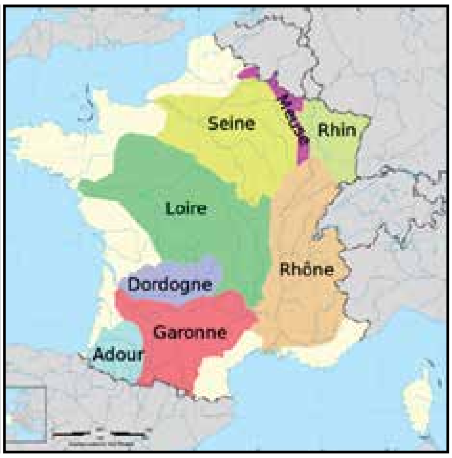
Inside

Country Profile – France

Caroline COULON*

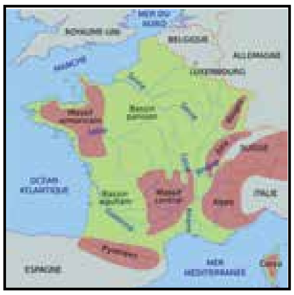
France is the largest country of Western Europe in terms of area. It has more than 90 per cent of total land area as fertile. Agriculture and food production is diversified.





Water resources

Divided into ten main land regions it lies in the northern temperate zone with widely varying weather among the various regions of France and the differences in climate are closely related to the distance of the land from the Atlantic Ocean or the Mediterranean Sea. The mountainous regions receive the most precipitation mostly in summer. Along the Mediterranean Sea, the lowlands have hot, dry summers and mild winters with some rainfall. The average annual precipitation is 867 mm of which 547 mm is annual evapo-transpiration and 320 mm is river flow produced within the territory.



There are 7 major rivers (with flow over150 m^3/s) flowing in France. The total mean precipitation volume is 478 km^3 of which 150 km^3 is runoff. Total renewable water resources is 203.7 km^3 of which total renewable surface water is 103.7 km^3 and total renewable ground water is 100 km^3. There are 572 large dam in operation. The total storage capacity of all dams is about 7.5 km^3.

Status of agricultural and irrigation development

The country is one of the world's leading exporters of farm products. All the farms have electricity, and most have modern farm machinery with an average holding of 28 hectares. Nearly two-thirds of French farm income comes from meat and dairy animals. In dairy-farms most of the milk is used in making butter and cheese. One-third of France's land is crop growing. Wheat is the major single crop grown at large farms in the Paris Basin and in the north. In southern France, olives, grapes and wheat are the typical Mediterranean triptych. In the south west, a large area is dedicated to corn. Elsewhere vineyards and polycultural farms are found, but also apple, potatoes, sugar beet, beans, carrots, cauliflower, cherries, flowers, peas, peaches, pears, sunflower seeds, and tomatoes, while livestock-feed crops are barley, maize, oats, and rape-seed.

France has 552,000 Km^2 of geographical area of which 34.9% is the cultivated area utilized to grow cereals crops (94,460 Km^2), oilseeds (22,430 Km^2), protein (2,060 km^2), fodder (47,000 km^2), fallow (47,000 km^2), vegetables crops (3,880 km^2), vineyards and orchards (9,700 km^2), permanent crops (108,800 km^2) and other crops (6,980 km^2). Of this the total irrigated area in 2011 was 2.90 Mha. The crop Irrigated area covers corn, wheat, Horticultural products, fodder and grass land and potato.

For main system management (storage, transport and distribution infrastructure), important progress has been recorded during the last forty years or so, in methods of regulation and in the automatic control of structures (dynamic regulation, remote control, and telemetry).

Feasible under certain socio-economic conditions, automation of the management of irrigation (water distribution from resource to the farmer's water intake) can improve the efficiency of the system and the satisfaction of the users. There are several levels of automation, from supervisory, remote control or automate monitoring of hydraulic status of the channel and of the structures (flow, water height, opening of the valves....), with mechanical dispositions, instruments, and more or less complex algorithms.

Such installations are proved to procure a better water services, with a rapid response adapted to the farmers' needs and demands (no water turns), a better maintenance with the possibility to better detect dysfunctions, water savings (when the farmer with the water turn does not use it), money savings (functioning costs).

These methods have proved their effectiveness in improving the management of water supply in situations with fluctuating demand. They have also enabled management to minimize water losses. These modern and efficient operation and management methods were developed by the Sociétés d'Aménagement Régional (SAR) and are today widely used by them on basins with important irrigation schemes in the south of France.

National governance and legislation

In France, two major laws have recently modernized the legal framework; one is on water, the other on agriculture. The 1992 water law modified and complemented the 1964 water law. A decentralized and participatory management of water and land use basin institutional bodies, basin committees and water agencies, established by the 1964 water law in France, have improved and adapted with the times, and particularly as a result of the 1992 law. Furthermore, the 1992 law favors, all users, in a decentralized manner, at small basin and watershed levels. Nowadays, the tendency in France is to go further in the way of a more decentralize water management, with a consolidation of the role of Regional Council as regards water management. The Common Agricultural Policy (CAP) is a pillar of the construction of the European Union.

As many watersheds or resources are in a chronic deficit in water, a disposition ZRE (stands for Water Repartition Zone)

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has been established to manage water with specificities inside these areas of scarcity. Since 2006, the Law on Water and Aquatic Environment 2006 (LEMA) identifies organizations responsible for the management of water resources from a quantitative point of view: the so called unique organizations, or OUGC. The law specifies that the distribution and management of volumes of water for irrigation in a particular territory will be assigned to this organization, as the unique holder of a global permission on behalf of all irrigators on the territory.

OUGC are not compulsory but strongly impulse its creation in ZRE areas. The OUGC provides each year a management plan, approved annually by the Board, based on "volumes that can be withdrawn" defined to ensure compliance with the Low Flow Objective (DOE), the goal being to satisfy all users on an average of eight out of ten years, without need to use the provisions of crisis management.

Irrigation management models

There are three main modes of management of irrigation infrastructure in France i.e. Associative Management, Regional Development Companies (Societies Aménagement Regional (SAR)) and individual irrigation schemes as detailed below

Associative management

This management mode has about 1800 associations with collectively 134 000 members and covering an irrigated area of 450 000 ha. Their legal status allows them to act on behalf of the general interests to equip irrigation schemes, build structures and to raise fees among their members. The success met by this type of management (⅓ of the total irrigated area in France) is due to the strong link between the membership of the association and the land ownership, and to the reliability of the fees collected.

Regional development company

The agricultural department created SARs between 1956 and 1964. There are 5 regional companies in France, 3 of them directly manage equipment for irrigation totaling 275 000 ha within their own concession, and another 90 000 ha for which distribution is the responsibility of others (support supply to associations and to individual irrigating farmers). The SARs have been involved in the development of new resources, and/or in projects aiming to better use of existing resources. Generally the infrastructure is well developed and the management efficient, compared with the other regions in France.

Initially SARs were a direct creation of the state, mainly governed and supported by the state. They have now evolved, with reduced state influence, towards a function aimed at the benefits of the local territorial political bodies and water users. The system is operated under the following principles: equity (for all users), high quality of service (guaranteed by a contract with customers), continuity and sustainability (perennial maintenance and adaptation of the structures), transparency and responsibility. Farmers are represented on the board of the SAR.

Collective management of individual irrigation schemes

An important part of the recent development of irrigation is based on individual initiatives. These may be the creation of new resources using a farm reservoir or more often the withdrawal from shallow groundwater or direct off takes from rivers. In terms of cultivated area, this type of organization is in 1.2 million ha.

The collective management of these individual irrigation initiatives is an important challenge for the integrated management of multiple uses of water. In summer the crop demand for water is at its highest, whilst inversely the surface natural streams are at their lowest levels. Maintaining an acceptable water quality in these streams requires that nearby shallow groundwater withdrawals and direct river off takes are planned and controlled. The collective management of individual irrigation schemes therefore became a very important challenge by the end of the eighties, particularly in those areas presenting high quantitative deficits, for example in the South West of France.

The focus in France is in controlling the demand and the uses of water. There are still situations and specific cases for which rural development and regional re-equilibrium will require the mobilization of new water, including water for agriculture. However, these situations will be limited. In general, the water supply will not see any increase and if there are changes they will be moderated in a prioritised way, to satisfy other uses than agriculture. The challenge for agriculture today is to manage the demand for water, in the most equitable manner within the farms, to increase the efficiency of the water use, to improve agricultural practices and to minimize the impacts on the natural environment.

About AFEID

France became the member of ICID in 1953 and since then has been actively participating in the activities of the Commission. Two of its members from French National Committee on Irrigation and Drainage (Association Francaise pour l'Eau, le Irrigation et Drainage), AFEID have been the President of ICID. They are Mr. P. Danel (1963-66) and Mr. R. Darves-Bornoz (1978-1981). At present, Mr. François Brelle is the Vice President of ICID. Six of the members of the French National Committee have been the Vice President of ICID in the past. They are Mr. G. Drouhin (1955-57), Mr. R. Darves-Bornoz (1974-77), Mr. M. Delavalle (1983-86), Mr. G. Manuellan (1988-90), Dr. H. Tardieu (1994-97), and Dr. Alain Vidal (2003-2006).

AFEID has successfully organized various ICID events which includes: 32nd IEC and 11th Congress held in Grenoble, France in 1981, 8th European Regional Conference, Aix-en-Provence, France in 1971, 54th IEC Meeting, Montpellier, France in 2003 and 24th European Regional Conference, Orleans, France in March 2011.

Now, the 66th International Executive Council Meeting and 26th European Regional Conference will be held at Montpellier, France from 11-16 October, 2015.

Nano Technology for Delivering Plant Nutrition

Nutrient Deficiencies in Plants

Plants need the right combination of nutrients to live, grow and reproduce. When plants suffer from malnutrition, they show symptoms of being unhealthy. Because human nutrition is directly linked to that of plants, the production of nutritious foods requires a balanced content of essential macro-, meso- and micronutrients. Too little or too much of any one nutrient can cause problems. Both macro- and micronutrients are naturally obtained by the roots from the soil. Plant roots require certain conditions to obtain these nutrients from the soil.

Macronutrients are required in large amounts and include nitrogen (N), phosphorous (P) and potassium (K). The meso- or secondary nutrients include calcium (Ca), magnesium (Mg) and sulfur (S). Micronutrients or trace elements are required in smaller amounts and include iron (Fe), zinc (Zn), copper (Cu), manganese (Mn), boron (B), chloride (Cl), molybdenum (Mo) and nickel (Ni).

Nutrients are required by all plants for growth and productivity which are picked up from the soil. If the nutrients are not present in the soil then deficiencies are caused, leading to lower crop yields. Two main reasons help explain MN deficiency in cultivated soils of the world: (1) Farm soils have been cropped over long-periods (i.e., hundreds to thousands of years). In comparison, few long-term research plots have a soil-crop management and production history of less than two hundred years in which to base agronomic decisions. (2) As higher yielding varieties and hybrids have been developed starting last century, crop yields and nutrient removal through harvest have continued to increase, but inputs of fertilizer-MNs have not kept pace with their rates of crop removal.

If the nutrients are not present in the soil or plant utilization is inefficient, then deficiencies are caused, leading to lower crop yields.

- About 90% of Fertilizer added to the soil is wasted.
- Loss of ion-exchange capacity of soil.
- Excessive use of expensive nutrients and water.
- Difficulty in delivering complete package of nutrients to the leaf due to poor soil characteristics, and using inorganic / chelated nutrients.
- Photosynthesis efficiency varies 0.1% to 8%

Nano-technology in Agriculture

Nanotechnology is the manipulation of matter at the atomic or molecular level. The application of nanotechnology in agriculture is nascent. The agricultural applications of bio-nanotechnology has the potential of breaking yield barriers by improving the efficiency of nutrient use by crops; through pests and disease surveillance and control; greater understanding of molecular level mechanisms of host-parasite interactions and the development of next-generation pesticides and their carriers (Sekhon, 2014). Nano nutrients have small particle size (3-50 Nano metres) with large surface area. When sprayed onto leaves it delivers all nutrients directly to the Chlorophyll.

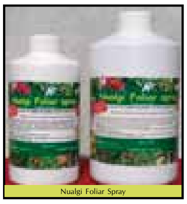
Nualgi Research

Against this backdrop, Nualgi Nano Biotech Co, has carried out focused research on an integrated plant nutrition product that could deliver a stable integrated package of all the 13 nutrients (including P,K, Ca, Mg, S, Zn, Fe, Mn, B, Cu, Mo, Co and Si) required by plants. The research also investigated into how nutrients could mitigate or eliminate pest and disease in plants by building up intrinsic strength and found that addition of Silica in the nutrient complex can play a dominant role in enhancing plant strength. The scope of research also included on what nutrients at what scale of delivery could boost photosynthesis in plants and as a corollary, lack of which nutrients could cause a drop in photosynthesis efficiency?

Nualgi increases quality and secures crop yields by delivering all micronutrients into the leaf; delivering them as nano particles for increased absorption; increasing pest resistance with the inclusion of nano silica for pest resistance; thereby collectively increasing photosynthesis efficiency and healthier and higher crop yields

Nualgi Foliar

After 15 years of research, development and trials, Nualgi Foliar, a nano scale integrated liquid nutrition that remedies the problems has been successfully developed. It is a nanotechnology product patented in India and USA since 2009 for use in Agriculture and contains all plant growth micronutrients biologically made available in nano form for enhanced plant absorption.



Nualgi Foliar Spray

Its use does not leave any residue or wastage and makes the plant better drought tolerant as osmotic processes are enhanced. It contains Nano Silica, enhancing pest and disease resistance. It lowers overall costs by reducing fertilizer, pesticides and fungicides requirements and increases yields per acre thereby increasing profits.

Nualgi foliar is applied as a foliar spray to remedy micronutrient deficiencies and increase crop yield. Nualgi contains Fe, Zn, Mn, Co, S, Mo, Ca, B, Mg, Cl and Silica, elements that all crops require for healthy growth. Nualgi's application in water treatment is to kick start natural bio. Nualgi foliar can also be dosed into normal or waste water channels for irrigation. In such a case foliar application may not be used, unless nutritional deficiencies are being observed in the plants.

Currently 50,000 farmers from 7 countries are reaping the benefits from this product. Since it is made at nano scale, a 500 mL bottle is sufficient for 2.5 acres (1 Hectare) per spray. Usually 2 sprays are required for short duration crops like vegetables and up to 4 sprays for long duration field crops. Nualgi Foliar Spray can be used once a week in diluted form in very small quantities based on the severity of the soil deficiencies. It speeds up photosynthesis, and can be used along with nitrogen and phosphate fertilizers such as Urea, Di-Ammonium Phosphate (DAP), Single Super Phosphate (SSP), and also with liquid nitrogen fertilizer for better results.

Use in Waste Water

Besides providing the trace nutrients to the plants, Nualgi Foliar also cuts down BoD and CoD levels, enhances levels of dissolved oxygen and more importantly reduces fecal coliform levels through the biological route in the waste water. It remediates waste water rapidly and cost effectively and provides plant nutrition at the same time. The field study shows, this product is not only safe for aquatic life but it also promotes fish and other aquatic life. The normal dosage for waterborne application is 500 mL to 4 million litres of water but may vary marginally with water quality.

Nualgi Waste Water Remediation

Nualgi for use in Water Treatment contains the major micronutrients required for accelerating diatom growth, dissolved oxygen levels increase and pollutants are decomposed, thereby cleaning the polluted water. Nualgi can be used as a lakes water purification system, stimulating, regulating, and sustaining continual diatom growth. Simply add Nualgi Lakes to contaminated water. It works on diatoms which are microscopic food power cells (phytoplankton) that convert carbon dioxide, nitrogen and phosphorus into dissolved oxygen and oxygen rich organic compounds and zooplankton which result in a healthy ecosystem, and ultimately a thriving fish population. They play a dynamic role in nutrient conversion and regulation of ecosystems. It can also be deployed for disaster and emergency sites for cleaning water.

Use in Aquaculture

Nualgi Aqua is another product that the Company manufactures for use in fish and shrimp ponds, or for other forms of aquaculture. It enhances DO naturally, controls organic pollution and provides live food as diatoms to copepods and intermediaries. Aqua ponds treated with Nualgi Aqua can also be used as a source of water for irrigation, when discharged.

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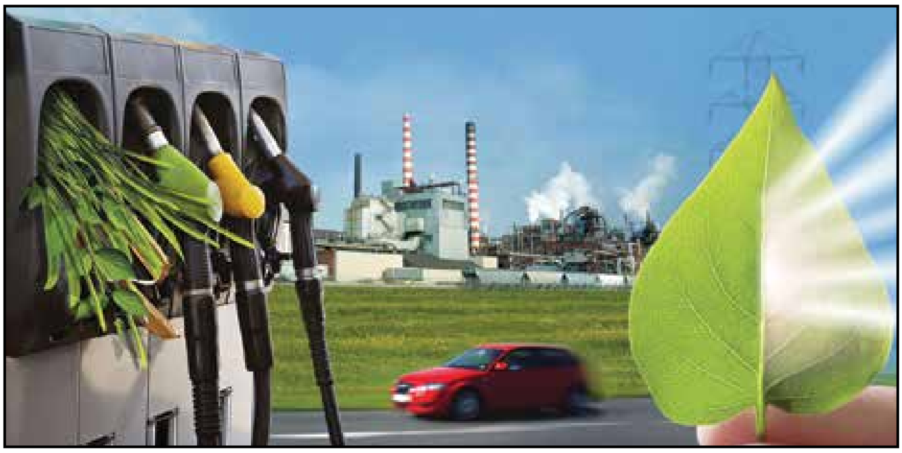
Biofuels in the Context of Agriculture Water Management

Laurie C. Tollefson*

Emerging new challenges for agricultural water management initiated ICID in to establishing a Task Force on Bio-Energy (TF-BIO-ENERGY) in 2010, headed by Vice President Laurie C. Tollefson to evolve its position on Water for Bio-Energy and Food. The task force was renamed as Working Group on Water for Bio-Energy and Food (WG-BIO-ENERGY) in 2013. This article is based on the outcomes of the Working Group on WG-BIO-ENERGY Report.

Background

Global concern about fossil fuel prices and availability, geopolitics and concerns over the impact of greenhouse gas emissions on climate change led to a renewed quest by many countries for energy independence and looking for an alternate energy source both in developed and developing. Bio-energy (mainly biofuels) emerged as an option and offering many new opportunities provided its production is managed properly.



Over the last two decades, biofuel production has increased dramatically. For example, bioethanol output experienced an increase from 16.9 to 72.0 billion liters while biodiesel grew from 0.8 to 14.7 billion liters between 2000 and 2009. At present biofuel production is estimated at 35 billion liters, accounting only for a small part (2%) of the 1200 billion liters of annual gasoline consumption worldwide. But the contribution of biofuels to energy supply is expected to grow fast with beneficial impacts including reductions in greenhouse gasses, improved energy security and new

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income sources for farmers. However, biofuel production and use have both positive and negative environmental and socio-economic consequences. Specifically, biomass production for energy will compete with food crops for scarce land and water resources, which is already a major constraint on agricultural production in many parts of the world.

The Task Force studied various aspects related to biofuels with respect to water management aspects with contribution from its various members and number of national committees. The report presents a holistic review of the-state-of-the-art of bio-energy production and policies in different countries and the intertwined linkage among bioenergy-water-food. Conclusions and recommendation of technical report are given below:

Conclusions

Present world population is about 7.3 billion, estimated to grow to about 9.1 billion by the year 2050. It is estimated that currently 1.2 billion people live in water scarce areas. In order to meet growing food requirement for increased population, it is estimated that agricultural production needs to be increased by an estimated 70% globally and by 100% in developing countries by 2050 and accordingly, present global water demand is projected to increase by 55% with increased competition among various sectors and reduced share for agriculture. To meet the future global food demand by 2050 irrigation withdrawals may have to increase by 20%. With the growing population energy requirement is also rapidly increasing and energy security is becoming one of the great challenge in view of limited availability of fossil fuel. Many countries view biofuels as an alternative renewal resource and a way out of petroleum based energy security troubles.

Diversion of arable land and water for biofuels production is one of the major concerns as it will add pressure on land and water resources that are already stressed and may also impact food security. However, it is not the availability of land but of water that determines the limit of biofuel expansion in a region. The expansion of the biofuels industry is taking place in regions that have encountered an increased energy demand – but not necessarily in the regions that are most suited to sustain the feedstocks.

It is believed that biofuels have an important role to play in meeting the world's energy needs but it should not be at the cost of food security. In the case where increased biofuel usage would leave more people denied of their daily food and water requirement; it may lead to deforestation or to international conflict and in such cases both the short and long-term costs outweigh the benefits. Thus, it is essential to take a balanced and holistic approach to identify and mitigate the risks and concerns for sustainable management of food, water and energy security issues. The countries that have the resources are encouraged to invest in improving biofuels and pushing towards breakthroughs in water-efficient biofuels – or the resources to encourage other countries to do the same – to take full advantage of this opportunity.

Biofuel production will compete with food crops for scarce land and water resources. If all national policies enforce and plans to increase biofuel production; it is estimated that an additional 30 million ha of land will be required with an increase in irrigation water withdrawals. Since impacts for some countries who have initiated programs to boost biofuel production could be significant. It is necessary to study and analyse impact of increased biofuel production on food and water security. For example, India and China, who are the largest producers and consumers of agricultural products, were already facing severe water scarcity.

Recommendations

In order to encourage production and use of bio-fuels in sustainable manner following recommendations are made:

1. Due to complex nature of linkages between biofuels production and food security occurring at different geographic levels (local, national, regional, global), it is essential to adopt integrated, evidence-based and environmentally-sound approach for biofuel policy-making and investments.

2. Biofuels rely on many of the same policy shortcomings that impede agriculture as a route to poverty reduction. Policy requirements at a country level are required rather than on a global basis. A country by country analysis of the potential impacts of biofuels on land and water resources is required.

3. Careful impact assessment (environmental and social) should form the basis of decision making for biofuel production. Life cycle analysis is an important analytical tool. More work is required on a number of potential biofuels.

4. Biofuel crops have the potential to reduce poverty in emerging and least developed countries, where land and water resources are not under stress, through increased employment and economic growth. Further studies are required to determine whether these opportunities really do improve the conditions for poverty stricken farmers.

5. Political intervention is often required to ensure that market forces do not push food prices as a result of reduced food production in association with biofuel production. This is often more acute with developing countries.

6. Some countries face water and land limitations, while others have sufficient capacity provided improvements occur. Global policies should focus on supporting biofuel production in land and water abundant regions.

7. There is need for focussed attention in respect of following areas:

   a. continued and enhanced research into cellulosic conversion processes so as to encourage movement toward second generation biofuels based on ligno-cellulosic feedstock;

   b. encouraging first generation biofuel producers to seek increasingly water-efficient biofuels including better irrigation methods in order to increase their profits, as expansion will come from "smarter" use rather than "more" use of precious land and water resource;

   c. enabling policy environment to encourage public-private partnerships (PPP) to develop infrastructure for the purpose of efficiently irrigating biofuel feedstock including the re-use of water, which may be even more successful with biofuels crops than with typical agriculture.

Public Private Partnership in Irrigation Management

Avinash C Tyagi*

Increasing variability of rainfall patterns due to climate change and the uncertainty it brings in the financial viability of agricultural enterprises will make the choice of irrigated agriculture more preferable. Wherever the irrigated agriculture already exists, it will have to be made more efficient and less water consuming so that the savings could be released to meet the requirements of other sectors.

It is recognized that the irrigation water services provided by the public sector institutions are highly inefficient. In several Asian countries, the lack of efficient and sustainable management operation and maintenance (MOM) continues to plague the productivity of large scale irrigation systems which are mostly funded from public funds.

Lack of sufficient resources to maintain the infrastructure created and their mismanagement reduces performance of these systems below par. Competition for limited resources from various sectors and section of the society makes it difficult for the planners to allocate resources year after year to the same region since these irrigation systems fail to directly generate sufficient funds through irrigation water charges. The financial arrangement where these water charges are ploughed back into maintaining the irrigation systems, as is the case in France and with other innovative arrangements, irrigation systems can be financially viable.

There is a growing realization that given their respective strengths and weaknesses, the public sector and the private sector can deliver the irrigation services to agriculture sector by joining hands. A public-private partnership (PPP) is a contractual agreement between a public agency (federal, state or local) and a private sector entity through which skills and assets of each sector are shared in delivering a service for the use of the general public. In addition to the sharing of the resources, each party shares risks and rewards potential in the delivery of the service. Although PPP is an old concept and has been practiced in many sectors over the years, in agriculture sector it has made an entry only recently. In irrigation sector it is still struggling to establish as a viable option due to uncertainty in returns from irrigation sector for the investment of private sector time and financial commitments.

In order to make PPP in Irrigation sector viable, following options have been suggested:

- **Commercial farmer as a private irrigation operator:** Smallholder farmers in the command area could be given the option of becoming out growers to the large commercial farmer;
- **Farmers responsible for maintaining the tertiary network:** Farmers, through their water user associations (WUAs), are responsible for maintaining the tertiary network, while the private or public operator be responsible for all aspects of operating the irrigation system up to the farm level, and of maintaining the system up to the tertiary canals;
- **Bundling different farm service agreement:** The private-sector can partner with farmers and communities in provision of irrigation water delivery bundled together with other farm-level services: on-farm services, such as planting and harvesting; or off-farm, such as storing, processing and marketing;
- **Hub farm agreement:** The private-sector can be engaged to undertake commercial agricultural production through a land concession or lease generally on unoccupied land owned by the government or third-parties, or community land held under collective title (or especially consolidated) and leased in return for a fee of share in commercial operations;
- **Operation, Management and Maintenance (OMM) contract:** The private-sector could be engaged to undertake OMM of infrastructure services for defined recipients; and/or
- **Infrastructure concession:** The private-sector could be engaged to raise commercial finance for infrastructure development and then construct, operate, manage and maintain the infrastructure.

However, financial and management commitments from the private sources, will only be forthcoming if private-sector partners can have a degree of certainty that they will be able to recover their investments. For implementation of new projects or improve and modernize existing irrigated agriculture projects, especially those involving smallholder farmers, the lack of ability and willingness to pay (WTP)

for water services makes it difficult to fund irrigation projects on a commercial basis as they fail to deliver short-term predictable financial returns.

However, farmer capacity to pay and uncertainty of agricultural productivity are themselves only one dimension of the private-sector's unwillingness to invest in irrigation projects. End user risk is also significant in irrigation projects, where often the users are not fully defined at the beginning of the project as it depends on how many farmers take up the water from the system. Further, in irrigation PPPs it can be difficult to ascertain which public institution will be responsible for developing the project and will be the signatory to the project agreement. In few cases where PPPs have been used for developing irrigation systems, the national entity in charge of irrigation services have been the counterparty to the PPP contract. The issue enters into another dimension of complexity in case of shared basins at the regional level, there may be limitations on levels of water extraction, both at national and international level.

All these factors make PPP a daunting task. the World Bank, in the past has made efforts and formulated certain concessions inviting PPP in projects such as West Delta Project in Egypt and Pontal Irrigation Project in Brazil, but have found no takers. Recently, another experimental initiative has been taken by the Asian Development Bank (ADB) in Bangladesh [Article at page 8].

The interplay between Food-Water-Energy nexus could be exploited to overcome these challenges. At the same time it might be possible to share end user risk between the public and private parties, for instance with a guarantee on minimum revenue.

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Muhuri Irrigation Project: A PPP Pilot Project

Arnaud Cauchois*

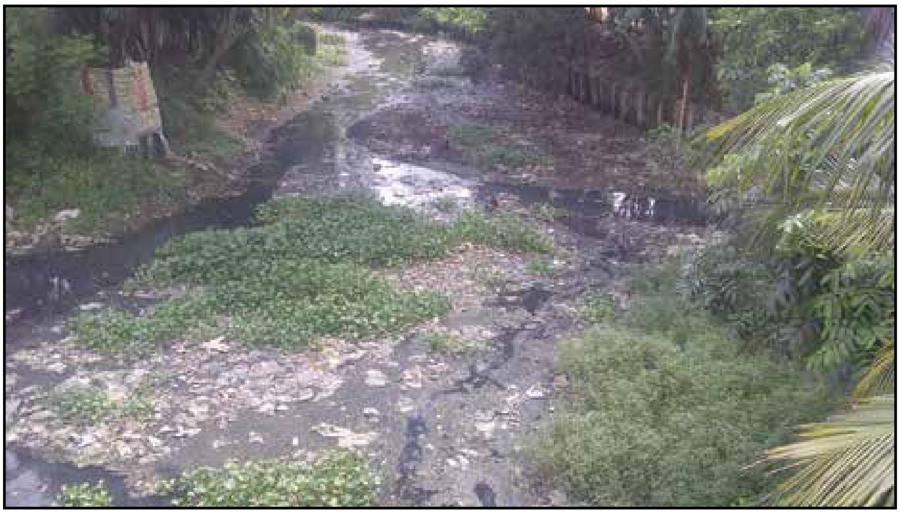
Water resources management remains critically important for Bangladesh's agriculture. For a land-scarce country with a population expected to increase to 175.0 million by 2025, it faces the challenges inherent in intensifying agriculture and maintaining self-sufficiency in food grains. The Muhuri Irrigation Project (MIP) was selected as the first pilot scheme to implement PPP for irrigation.

About 70% of Bangladesh's poor live in rural areas with low agricultural productivity and unreliable food supplies. Promoting agricultural growth is a critical element of the government's strategy aimed at food security and poverty alleviation. Efficient and sustainable irrigation systems are important to boosting agricultural productivity and encouraging crop diversification.

In Bangladesh out of the 550,000 ha of irrigation potential created from large scale schemes in the country, only 46% of this area is currently irrigated during the dry season. Participatory Irrigation Management (PIM) is being implemented for more than a decade to improve Management, Operations and Maintenance (MOM). But, if it brings improvement in small-scale irrigation, the irrigation management transfer approach does not succeed with large scale irrigation.

The National Water Policy, adopted in 1999, sets out a comprehensive framework for the water sector in general and for large surface water irrigation schemes, including a strategic vision comprising private irrigation MOM through leasing, concession, or management contracts.

In 2009, the Asian Development Bank (ADB) provided Technical Assistance (TA) to the Bangladesh Water Development Board (BWDB) to examine alternative approaches of service delivery agreements and management arrangements including PPP for sustainable irrigation MOM in large irrigation schemes. The Muhuri irrigation project (MIP) has been selected as the first pilot scheme to implement PPP for irrigation. Its construction was completed in 1986. The design enabled dry season irrigation to increase from 6000 ha to 20,000 ha and supplemental wet season irrigation through the construction of a Closure Dam and Regulator downstream of the Feni River. The backwater from the barrage enters the natural khals (channels) and canal network by gravity. From there it was to be lifted by about 800 low-lift diesel pumps to irrigate the fields. Initially, farmers experienced major improvements in production.



However due to lack of MOM the dry season command area shrunk to 11,300 ha. The increased cost of diesel fuel combined with low pump efficiency and decrease in rice price contributed to discouraging farmers from cultivating. In 2012, the Government of Bangladesh requests ADB support to design and finance the modernization of Muhuri Irrigation Project (MIP) scheme. The proposed modernization strategy is based on two pillars including: (i) modernization of the irrigation infrastructure; and (ii) transfer of the management operation and maintenance of level 2 and 3 to a private operator.

Infrastructure modernization focuses on improving the scheme efficiency and manageability and includes: (a) development of about 17,000 ha of a modern and highly efficient piped water distribution system to improve timely water access and reduce water losses; (b) provision of prepaid card meters to allow water allocations to be on a volumetric basis and ensure full and transparent payment and accounting; (c) full electrification of pumping to reduce operating costs and increase management flexibility.

The management transfer follows a two stage approach which includes: (a) hiring private Irrigation Management Operator (IMO) under a 5-year performance-based management contract to supervise modernization works, establish sustainable MOM, and provide agricultural support services; and (b) 15 years lease with a new IMO to be paid for by the revenue.

The project preparation required intensive stakeholder consultation and consensus building. The financing was approved in June 2014 and implementation started immediately. The project management consultants were fielded in March 2015. Modernization works tendering is on-going. Fifteen expressions of interest were received for the IMO. The recruitment is under finalization with an association of foreign and national consulting firms.

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