

2017 | FIRST QUARTER

ICID NEWS

MANAGING WATER FOR SUSTAINABLE AGRICULTURE



MESSAGE FROM THE PRESIDENT

Dear Colleagues,

The United Nation General Assembly designated 22 March as the World Water Day in 1993. Throughout the world UN water entities and national governments organize events around this day every year, encourage interaction among various stakeholders and facilitate public debates and discussions highlighting specific aspects of water in order to improve public awareness. The theme of 'Water and Wastewater' was chosen as the main topic to be focused by the member countries for the year 2017. Water and sanitation are at the very core of UN Sustainable Development Goals (SDGs 2015- 2030) that are critical for the survival of people and the plants.

Wastewater is perceived as a valuable resource in the production economy and its safe management considered efficient investment for healthy societies and ecosystems. Treated wastewater can be considered as a new source that can help decrease the present stress on water resources in many sectors particularly in agriculture.

In regions with high water stress, use of brackish and saline water and the wastewater recycling are considered viable options to address the growing water crisis. Drainage water as a non-conventional

water resource can also play roles in such endeavors, if properly managed to minimize environmental and health risks.

The 13th International Drainage Workshop (IDW13) under the theme of "Drainage and Environmental Sustainability" was successfully organized by Iranian National Committee on Irrigation and Drainage (IRNCID) in Ahwaz, Iran, March 2017. My sincere thanks go to Khuzestan Water and Power Authority (KWPA) for their excellent hospitality and management of the Workshop with full professionalism and the highest standards of any scientific gathering. The main message of the Workshop, inter alia, was to acknowledge the importance of drainage water safe disposal and reuse which could otherwise damage the environment and ecosystem tremendously.

IDW13 witnessed stimulating discussions powered by excellent keynote addresses. The gist of the Keynote addresses of President Hon. Prof. Bart Schultz and Vice President Hon. Dr. Willem F. Vlotman are covered as an article in this issue.

Modern Land Drainage (MLD) management implies making drainage environmentally sustainable which includes enhanced water balance assessments at regional and field scale, prevent excess water except for leaching salts, support ecological water requirements, and then if any excess water remains design a drainage system. At IDW13, a new paradigm for sustainable, integrated, water resources management 'Beyond MLD', was presented that has been emerging from international conferences around the world. Beyond MLD, in addition to the above essential elements, incorporates a Triple Bottom Line (TBL) - the trilogy that considers interactions between social, environmental (or ecological) and financial aspects - and extends drainage within the water-food-energy nexus.

ICID with its technical working group dealing with non-conventional water as "Working Group on Use of Poor Quality Water for Irrigation (WG-PQW)" within the last 20 years has vastly contributed to the knowledge development in this regard. It is deemed to be a very appropriate time for us

to review our activities in this important topic participate in such a global campaign to proceed towards implementation of SDGs.

This requires exploring collaboration with other global professional organizations through research programs, at the country level and to establish a wastewater reuse network in agriculture and urban purposes, including urban agriculture. A Memorandum of Understanding (MoU) was signed and exchanged between ICID and International Water Association (IWA) and I was honored to host the IWA President in Tehran in mid-September 2016. This program is sponsored by the Iranian National Water and Wastewater Engineering Company, conducted by IRNCID and the Iranian IWA Committees. The process will be supervised and monitored by two related work bodies (WG-PQW, Working Group on Water and Crops (WG-WATER & CROP) of ICID.

I would like to see these issues within the mandate of WG-PQW and should provide a knowledge based guidelines for the use of such potential water resources in that minimizes negatives environmental impacts.

The 23rd ICID Congress on the theme "Modernizing Irrigation and Drainage for a New Green Revolution" scheduled from 8-14 October 2017 at Mexico City, Mexico is picking momentum. Around 300 papers were received for two Questions, which is very encouraging. The theme that addresses modernization, has lot of potential for private sector to explore. I expect the private sector to make full use of this opportunity of participating in the discussions and display their products and services by participating in the International Exhibition.

With regards,

Dr. Saeed Nairizi
President, ICID



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Agricultural Water Management and Food Security in a Sustainable Environment

Bart Schultz*

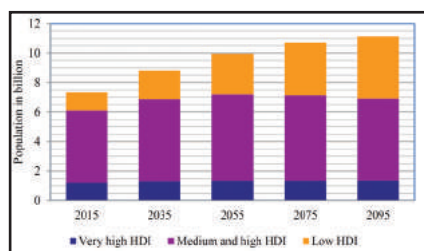
The Worlds' population is expected to grow from 7.4 billion at present to 10.0 billion by 2055. So far, irrigation and drainage has played a significant role in ensuring food security. Agriculture Water Management that encompasses irrigation, drainage, flood risk reduction in agriculture areas, building drought resilience and rain-fed agriculture will need to be made more sustainable.

This article is an extract based on the Keynote address delivered by President Hon. Prof. Em. Bart Schultz during the 13th International Drainage Workshop (IDW13) held at Ahwaz, Iran, March 2017.

In the framework of rural reconstruction irrigation and drainage will have to play a major role in achieving the required increase in cereal production. This implies a focus on approaches and solutions that on the one hand will result in the required increase in cereal production and on the other hand are environmentally sustainable. In light of this upgrading, modernisation and expansion options for irrigation and drainage schemes will be presented with special attention to the role of drainage in the arid and semi-arid zone. This will be done with due attention for the Sustainable Development Goals (SDG) and the draft ICID Vision 2030 <http://www.icid.org/vision_2030.html> .

Population growth, urbanisation and World food situation

The World population is expected to reach 11.2 billion by the end of the Century. In addition the standard of living in countries with a medium and high human development index (HDI) - almost 75% of the World population - is rapidly rising, among others resulting in changes in diets that require more and diversified food per person and in general more water to be produced. A third development is the significant improvement in life expectancy from 46 years in the 1950s to 71.4 years by 2015. Present cereal production has been in line with the increase in utilisation and the global cereal stock even increased in the past years. The overall consequence



Population and population growth (updated after Schultz, 2012; based on data of the United Nations Department of Economic and Social Affairs, Population Division, 2015)



will be that farmers will have to produce significantly more food for urban people in a competitive environment. This will require an increase in farm sizes, transfer to higher value crops and mechanisation. Nevertheless, smallholder agriculture will retain an important place.

Agricultural water management

In the last fifty years, agricultural water management has helped to meet the rapidly rising demand for food, and has contributed to the growth of farm profitability and poverty reduction as well as to regional development and environmental protection. The Green Revolution has enabled many countries with a medium and high HDI to transform from agrarian to industrializing economies. The technology of high inputs of nitrogen fertilizer, applied to responsive short-straw, short-season varieties of rice and wheat, often required irrigation to realize its potential.

When growing food crops, the timing and reliability of water supply and drainage is crucial. In the arid and semi-arid zone, as well as in the humid tropical zone irrigation allows cultivation of crops when rainfall is erratic or insufficient. In the temperate humid and the humid tropical zones drainage is generally required to

prevent waterlogging during the winter or monsoon seasons. In the arid and semi-arid zone drainage may be required to prevent waterlogging and salinisation, especially in irrigated areas.

The irrigated area of the World increased significantly during the early and middle parts of the 20th century. Production and average yields of irrigated crops in these countries have responded to this demand by increasing two- to fourfold. Irrigated agriculture now provides approximately 45% of the Worlds' food, including most of its horticultural output, from an estimated 20% of the agricultural land. Irrigated agriculture accounts for about 70% (2,850 km³ per year) of the freshwater withdrawals in the World, and up to 85% in countries with a low, medium and high HDI.

The challenge is how to meet the ever-rising demand for food in the context of the above mentioned processes and expected developments, while at the same time increasing farmer incomes, reducing poverty and protecting the environment. While the major part of the increase in food production will have to be achieved at the existing cultivated area the focus will have to be on a higher yield per hectare, and where possible on double or triple cropping. A significant part of the increase can already be achieved by improved

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operation and maintenance of existing schemes. As far as the contribution of improvement options of water management schemes is concerned the increase can be achieved by:

- modernization of existing irrigation and drainage systems;
- installation of drainage in irrigated areas;
- installation of irrigation in rainfed areas with drainage; and
- installation of irrigation and/or drainage systems in areas without a system.

In light of this it is expected that the amount of water withdrawn by irrigated agriculture will have to be increased by 11% by 2050. This will be a considerable challenge in water-constrained areas. An increasing number of regions are already reaching the limit at which reliable water services can be delivered. The situation will be exacerbated as demands of fast growing urban areas place increased pressure on the quality and quantity of local water and land resources.

Role of drainage

The drain depth and spacing determine the capacity of the system. The best capacity can be formulated in economic terms as that capacity where the net benefits of drainage are maximal. This economic criterion for design purposes is to be translated into hydrological criteria: the design discharge which is the quantity of water the system should be able to discharge during peak periods and the depth at which the groundwater table is to be controlled in those periods. The design discharge is



Field research on the discharge of chemicals through subsurface drains under apple trees in relation to the application

commonly expressed as the required discharge rate in mm/day or l/s/ha. The criteria are different for: off season, crop season and salt drainage.

In many cases drainage systems are installed in lowland areas. This implies that the discharge of drainage water by outlet structures, or pumping stations and flood protection provisions may be of importance as well. In such cases the possible impacts of changes in land use, land subsidence and climate change will have to be taken into account.

In quite some countries with a low, medium and high HDI drainage has been neglected in irrigated areas. This is especially the case in the arid and semi-arid zone, where the drains only may have a role in the control of waterlogging and salinity development. When in such regions irrigation systems are installed, sooner or later a certain amount of leaching will become required in order to prevent the development of waterlogging and salinity in the root zone. Generally in such cases subsurface drainage at a relatively deep level becomes required. There has been quite some discussion on the preferred depth of such drains.

All in all agricultural water management has played and will play a central role in reducing the risk of food insecurity in countries with a Low, Medium and High HDI. To a large extent solutions to facilitate expansion of efficient irrigation and drainage through improved infrastructure and increased water productivity are known and available. Crucial question is what is best applicable under the local conditions.

Sustainable Development Goals and the draft ICID Action Plan 2030

The Sustainable Development Goals (SDG) as adopted by the United Nations in September 2015 came into force. Six of the seventeen SDGs are of special importance for agricultural water management. These are:

- **Goal 1.** End poverty in all its forms everywhere;
- **Goal 2.** End hunger, achieve food security and improved nutrition and promote sustainable agriculture;

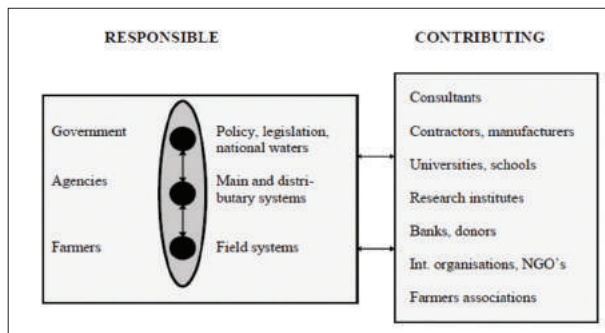


Figure. Actors in agricultural water management (Schultz, 2001)¹

- **Goal 6.** Ensure access to water and sanitation for all;
- **Goal 12.** Ensure sustainable consumption and production patterns;
- **Goal 13.** Take urgent action to combat climate change and its impacts;
- **Goal 15.** Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss;
- **Goal 17.** Revitalize the global partnership for sustainable development.

To achieve these goals, it is important that all the stakeholders are enabled to participate and contribute. An important point is who real actors are in the agricultural water management. This is shown in Figure. A distinction has been made in those who are responsible and those who are contributing. Key issue in this simple scheme is that when the three parties that are responsible have an agreement on their roles and responsibilities, the water management schemes will generally be operated and maintained in a proper way. If they cannot reach such an agreement there will generally be under performance of the water management scheme, resulting in lower yields.

In this context, ICID is developing its ICID Action Plan 2030 to facilitate all these stakeholders to play their respective roles. The intention of the plan is to show the results of reviews and to propose planning principles, design criteria, operating rules, contingency plans and management policies for new water management systems.

The full version of the keynote is downloadable from http://www.icid.org/idw13_schultz.pdf



¹ Schultz, B. 2001. Irrigation, drainage and flood protection in a rapidly changing world. Irrigation and Drainage, vol. 50, no. 4

Beyond Modern Land Drainage

Willem F. Vlotman*

No matter how efficiently crops are watered, sooner or later a well-functioning drainage system for complete in-field water management is needed. Modern Land Drainage (MLD) management implies making drainage environmentally sustainable which includes enhanced water balance assessments at regional and field scale, prevent excess water except for leaching salts, support ecological water requirements, and then if any access water remains design a drainage system. The article presented here is based on this concept of 'Beyond MLD' articulated in the Keynote address delivered by Vice President Hon. Dr. Willem F. Vlotman during the 13th International Drainage Workshop (IDW13) held at Ahwaz, Iran, March 2017.

MLD is an extended approach to the traditional drainage design methods for a rain fed agriculture in the humid temperate zone. It includes extensive consideration of salinity control of irrigated land in (semi-) arid zones and advocates controlled drainage in the framework of integrated water resources management (IWRM) duly incorporating institutional, management and maintenance in addition to the mitigation of adverse impacts of drainage interventions on the environment.

Green economy aims at achieving the optimised supply chain objectives in a manner that espouses the sustainability principle, gives due attention to environmental concerns and thereby helps with eradication of poverty and hunger. In recent years, the concept of 'water-food-energy nexus (WFEN)' has emerged as the way forward for a green economy, which aims at the most efficient, best practice principles applied throughout the full food supply chain including consideration of reducing wastage of the food caused for various reasons. Food wastage alone equates to an average loss of 243 litres of water a day/person, which amounts to 1.5 times the daily water use per person. The concepts of virtual water and water footprint are used to help identify opportunities of saving water by targeting reduction of wastage of food that has the highest virtual water content. At the same time, energy efficiency occurs when we consume where we grow and do not transport food unnecessarily.

At IDW13, a new paradigm for sustainable, integrated, water resources management 'Beyond MLD', was presented that has been emerging from international conferences around the world devoted to the global development agenda. Beyond MLD, in addition to the above essential elements, incorporates a Triple Bottom Line (TBL) - the trilogy that considers interactions between social, environmental (or ecological) and financial aspects - and extends drainage within the water-food-energy nexus.

Artificial and natural drainage systems are an essential part of the agriculture water



management. For instance, managing salinity and waterlogging essentially requires artificial or natural drainage to be in place. In fact, many irrigated agriculture lands would not be sustainable without it.

Over the years, it has become clear from worldwide experiences that economics and technical expertise are not the only key drivers of drainage development and that care for the natural physical and social/cultural environment requires sustainable water management and sustainable drainage systems.

A major change in paradigm in MLD design, construction and operation is that we not only concentrate on technical solutions, and not only consider the location of the problem, but take a much wider perspective in time, space, environment, and ecology through stakeholder involvement. Look what can be done upstream of the location, look how a change in water management upstream can prevent the problem occurring downstream, look what alternatives there are for the farmer such as re-locate, train, re-skill and change job, where required. If the solution is not found upstream look at minimising or eradicating the negative downstream impacts and turn them into opportunities to enhance water schemes everywhere.

The drivers of sustainable environments are, amongst others, the Key Performance

Indicators (KPIs) of Triple Bottom Line (TBL) frameworks that inform us how well we are doing. These KPIs are either oriented towards internal business performance or towards external impacts of water management organisations, incl. business by government departments. It is important to keep the internal and external KPIs separate such that mission, strategies and operational objectives of the organisation that is responsible for the drainage system are clear in the mind of all stakeholders. Drainage environmental KPIs are related to salinity, waterlogging and water quality while many others relate to the IWRM more generally.

Beyond MLD design uses the latest science, technology and socio-economic insights considering the interaction between water, food and energy for the best outcomes for all stakeholders within a green economy. It espouses the use of new materials. For instance, the Capiphone drain (www.greenability.com.au) uses the capillary action of the drain to both drain and supply water to the root zone; a new form of controlled drainage and irrigation. This type of drainage is also known as wick drainage although this is different in its applications and configurations.

For water quality control, prevention is the most preferred solution. The less water is mobilised through agricultural lands by choosing the right irrigation method,

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Table: Efficiency of various irrigation methods

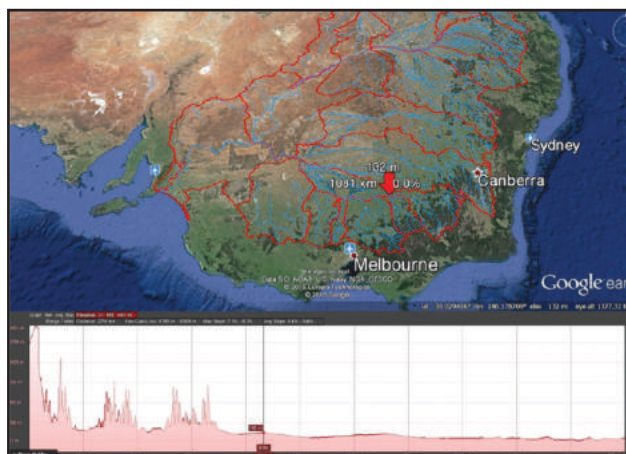
Method	Efficiency (%)	Remarks
Flood irrigation	50 - 85	New water management control technologies
Sprinkler irrigation	65 - 90	From high pressure to low pressure application
Trickle irrigation	75 - 95	Reliability, durability and water management
Sub-surface irrigation	50 - 95	Shallow soil management
Controlled drainage	50 - 85	Maintain and manage high water table as appropriate
State of the art water management	85 - 100	Soil moisture management and delivery system management combined

the better the quality of water that flows back to the water bodies will be. Various irrigation methods provide a range of results to reduce the water applied and attain better irrigation efficiency (Table). Precision agriculture, including the type of application such as advocated by the company using swarm farm robots present exiting new opportunities (Figure).

For salinity control, there is a need to become a bit more innovative and think out of the box. For instance, a farmer who sees the land becoming increasing saline over time and looks at the government to provide a solution can actually do something himself. By taking part of the farm out of production and assuming (s) he has access to the same amount of water as before, (s)he can irrigate the remainder of the fields with adequate water, including meeting leaching requirements. It is important that in fields affected by salinity a net downward water movement through the root zone is maintained on seasonal basis! This assumes that the government cannot give more water due to a number of constraints, and assumes that the farmer can still make a living of the remainder of the farm. It may be that the farmer needs some financial support in the form of government guarantees of income, while he or she experiments with concentrating the water available to recover sections of the farm and make them salinity free.

Consider solutions that reduce the upward movement of water (and salts) in the root zone; can we cover the ground with plastic during part of the growing season and thus minimise direct soil water evaporation? Unfortunately, in areas where plastic has been used in agriculture, the operation, management and maintenance (OMM) was observed to not be very effective in removal of the plastic afterwards and severe visual and possibly ecological damage results.

In the foregoing a number of solutions were described to use the advances in science and technology combined with active stakeholder involvement from top to bottom and from beginning to ... no not the end, but to the stage of OMM. The continued advances in remote sensing in the last couple of decades have been significant and will continue to evolve at a rapid pace.



The emergence of drones with cameras at retail outlets, has opened a whole new avenue of reconnaissance during operation, management and maintenance stages of the life cycle of a drainage system. Swarm farm robots are used for precision application and control of drainage water quality (Figure) where instead of farmers a swarm of autonomous robots are used that can spray with accuracy and in the right quantity when via GPS and satellite linkage other farm inputs such as soil type, moisture content, etc. are fed into the software controlling the swarm bots and adjusting the intensity and concentration of the spraying.

Such new technologies will make drainage design more effective and sustainable in the long-term. It is suggested that prevention is the solution to many problems and that a holistic approach in describing the water-food-energy nexus for a green economy is necessary for a sustainable triple bottom line development. It is also imperative that the scale of intervention is extended beyond the mere location of the drainage system and that by considering carefully what is happening upstream and downstream of the location, it may be concluded that other solutions to the problem are more effective and guarantee long-term success. There are many opportunities to save water, energy and food beyond the realm of consideration of a drainage system in isolation. The involvement of stakeholders from beginning to end, from farm to fork, from minister to manager, and from preserving and maintaining ecological environments in conjunction with food production is essential in the success of any endeavour including modern land drainage design.

The full version of the keynote is downloadable from http://www.icid.org/idw13_vlotman.pdf



Swarmfarm robots in action (www.swarmfarm.com)



Improve Performance of Irrigation by Applying A Water Balance

Felix Reinders*

On 1 March 2017, International Commission on Irrigation and Drainage (ICID) under its newly launched “ICID Webinar Services”, hosted the First Webinar on the subject “Efficient Irrigation by Applying a Water Balance”. The presenter of the Webinar was Vice President Hon. Felix Reinders from South Africa. This article briefly summarizes the discussions during the Webinar.

The Webinar was attended by more than 70 participants from across the globe. A couple of National Committees made special arrangements to bring together their members (India 25 and Iran 15) and listened to the discussions during the Webinar. President Dr. Saeed Nairizi inaugurated the Webinar Services from Tehran and welcomed the participants; and the discussions were coordinated by Er. Avinash Tyagi, Secretary General of ICID. Dr Chris Perry (UK) acted as the expert panellist and provided introduction to the topic.

The article of Dr. Chris Perry (UK) titled “Efficient Irrigation; Inefficient Communication; Flawed Recommendations” published in Irrigation and Drainage Journal of ICID, Volume 56, Issue 4, October 2007 <<http://onlinelibrary.wiley.com/doi/10.1002/ird.323/epdf>>, advocated in bringing a common understanding on the term “Water Use Efficiency” among the water policy makers, irrigation managers and wider international water research community. He presented a water balance framework for irrigation efficiency which was adopted by ICID.

Introducing the topic Dr. Chris Perry pointed out that the most important change in the context of water resources management over the last 50 years or so has been the emergence of competition for water at basin scale: what we divert from a river or pump from an aquifer in one location has implications for other users and other sectors. This new reality means that the perfectly legitimate objectives of local water managers will have implications for other users. This in turn means that we need a common terminology for describing the impact of our interventions—terms like “water use”, “efficiency”, and “losses” have quite different meanings, for example to a farmer and a water supply utility. The need for right terminology that is clear for all users in all sectors, so that the analysis of an intervention in one location by one sector is useful and informative to another users at another location.

The term water use efficiency (WUE) is used as a dimensionless ratio of the total amount of water used to the total amount of water applied and it must not be confused with water productivity (WP) that is the yield production per unit of water used. In his presentation, Felix Reinders explained that success with irrigated farming could be obtained by applying and understanding the water balance approach. He informed that through research, South Africa has adapted this framework and developed a South African framework for improved WUE.

The basis of the water balance approach is that any water withdrawn from a source, once diverted for irrigation use, contributes either to storage change, adds to the consumed fraction, or is returns as the non-consumed fraction at a point downstream of the point of abstraction. The water that is consumed is either utilised for the benefit of the intended purpose (beneficial consumption) or not (non-beneficial consumption). Water that is not consumed but remains in the system could either be recoverable (for re-use) or remains non-recoverable (lost to further use). The boundaries are as explained in Figure. The fraction of the water abstracted from the source that can be utilised by the plant, can be called the beneficial water use component and optimised irrigation water supply is therefore aimed at maximising this component.



The water balance approach can be applied at any level, within defined boundaries, or across all levels to assess performance within the whole Water Management Area. Studies and research over 40 years in South Africa on the techniques of flood-, mobile- and micro-irrigation contributed to the knowledge base of applying irrigation methods correctly.

In order to apply this framework to irrigation areas, typical water infrastructure system components are defined wherein different scenarios may occur. In South Africa, most irrigation areas consist of a dam or weir in a river from which water is released for the users to abstract, either directly from the river or in some cases via a canal. Water users can also abstract water directly from a shared source, such as a river or dam/reservoir, or the scheme-level water source could be a groundwater aquifer. Once the water enters the farm, it can either contribute to storage change (in farm storages), enter an on-farm water distribution system or be directly applied to the crop with a specific type of irrigation system.

The developed South African framework covers four levels of water management infrastructure, (as shown in Table): i.e., the water source, the bulk conveyance system, the irrigation scheme and the irrigation farm, and the relevant water management infrastructure.

In order to improve water use efficiency in the irrigation sector, actions should be taken to reduce the non-beneficial consumption (NBC) and non-recoverable fraction (NRF) in all these infrastructure components.

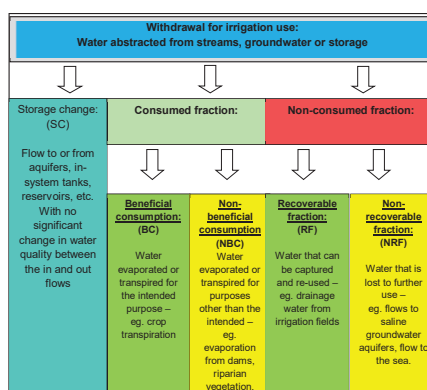


Figure: ICID water balance framework for irrigation water management

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Table. Four levels of water management infrastructure (Reinders et al., 2010)

Water management level	Infrastructure system component	
Water Source	Dam/Reservoir	Aquifer
Bulk conveyance system	River	Canal
Irrigation scheme	On-scheme dam	
	On-scheme canal	
	On-scheme pipe	
Irrigation farm	On-farm dam	
	On-farm pipe / canal	
	In-field irrigation system	

Unfortunately, historically reporting of irrigation efficiencies (such as “application efficiency”, “system efficiency”, “distribution efficiency”, “transportation efficiency”, etc.) have resulted in the diminished understanding and scrutiny of the source or causes of losses. There is a widespread illusion that efficiency is fixed by the type of irrigation infrastructure used rather than to the way a particular system has been designed and managed. In the past, improving performance and efficiency was, incorrectly, only associated with an upgrade in infrastructure (a change in irrigation system, for example).

The framework can also be applied to re-assess the system efficiency (SE) indicators typically used by irrigation designers when making provision for losses in

a system and converting net to gross irrigation requirement. System efficiency defines the ratio between net and gross irrigation requirements (NIR and GIR). NIR is therefore the amount of water that should be available to the crop as a result of the planned irrigation system and GIR is the amount of water supplied to the irrigation system that will be subject to the envisaged in-field losses. The approach makes provision for the occurrence of non-beneficial spray evaporation and wind drift, in-field conveyance, filter and other minor losses.

It should always be kept in mind that a system’s water application efficiency will vary from irrigation event to irrigation event, as the climatic, soil and other influencing conditions are never exactly

the same. Care should therefore be taken when applying the SE indicator as a benchmark, as it does not make provision for irrigation management practices. This can be determined as the ratio between the volume of water lost to non-beneficial spray evaporation and wind drift, in-field conveyance, filter and other minor losses, and the volume of water entering the irrigation system, for a specific period of time. The losses can also be expressed as a depth of water per unit area, rather than a volume. Improvements can therefore only be made by improved management practices and functionality.

In conclusion, it can be said that the water balance resulting approach of “measure; assess; evaluate; improve;”, promotes an investigative water balance approach to improve system irrigation efficiency to assist managers and designers alike to use this developed information and tool that incorporates both detail investigations with the flexibility to be applied at any level to improve system performance.

ICID has recorded the entire Webinar and shared the same on ICID website and social media. Please feel free to visit http://www.icid.org/icid_webinar.html to see the recording of the Webinar posted on ICID Website.



A Zero Till Conservation Agriculture Technique for Rice based Farming

Chandra Shekhar Bhadsavle*

ICID promotes technologies and management techniques that save water through WatSave Awards. The WatSave Farmer Award during 2016 was given to Mr. Chandra Shekhar H. Bhadsavle, a farmer from Maharashtra, India and his team (Mr. Changdev K. Nirguda and Mr. Anil D. Nivalkar) for Saguna Rice Technique (SRT), a proven water saving success story. This article briefly summarizes the methodology used by the author. SRT is a zero-till, Conservation Agriculture (CA) type of cultivation of rice and related rotation crops without ploughing, puddling and transplanting (rice) on raised beds evolved at Saguna Baug, Neral, District Raigad of Maharashtra in India.

In this method farmers have to till the soil and make the raised beds only once. The same permanent beds will be used again and again to grow various rotation crops after rice in Kharif season. SRT is unique in respect of benefitting the Rhizosphere (natural ecosystem around the roots) and in facilitating the adjustment of moisture to optimum levels by its technique of raised beds thus promoting vigorous, hairy white roots and vibrant, wider leaf lamina resulting crop to grow uniformly and gives considerably higher yield. SRT keeps roots of previous crop in the raised bed forming



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capillaries and earthworm pathways thus facilitating effective recharging of aquifers. It also brings "Vigorous Uniformity" and higher yields in all soil types and that also at lower than recommended fertilizer doses.

This technique is eco-friendly as it promotes the growth of earthworms and also the oxygen content of soil thus making it spongy and preventing methane generation. Avoidance of puddling reduces diesel consumption. The obtained crop faces less pest and disease problems and also gets ready 8-10 days earlier. Non-use of heavy agricultural machinery for tilling in field will prevent compaction & formation of hard pan of lower strata of soil. This could be the best solution in natural calamities such as hail storm, floods, cyclones, untimely rain-storms, etc. because the crop cycle is shortest and it involves multiple choices of short-term rotation crops such as pulses, vegetables, onion, sun-flower, groundnuts, and so on.

The SRT iron forma facilitates planting of crop at predetermined distances enabling precise plant population per unit area thus protecting it from the vagaries of erratic rainfall and also preventing the cracking of land or 'crop kill' immediately. The best time to make these beds is immediately after Kharif paddy harvesting in October. Add desirable and / or available quantity of any organic manure. Finally till it with rotavator or power tiller to make it workable. Draw parallel lines with the help of rope and lime or wood ash at 4.5 ft (136 cm) apart. Use tractor drawn 'Bed maker' or any other means to open furrows at marked lines and make raised beds.



Make depressions / holes with SRT iron forma on the raised beds. Sow / dibble 2 seeds of either Wal beans (Kokan Wal no. 2) or Gram (Vijay), or bush type Cowpea (Kokan Sadabahar) or Horse Gram (Dapoli no. 1) as per recommended variety and distances. Apply fungicides and / or



beneficial microorganisms to the seed as per the agriculture university guidelines. Irrigate plot with best possible available method. After 3 to 4 hours spray the plot with selective weedicide Goal (Oxyfluorfen 23.5% EC) @ 1 ml per litre of water. The crop is ready for harvest till 3rd or 4th week of February. Cut the plants leaving roots and 2 to 3 inches stem on the beds.



It's very important to leave the roots of previous crop in to soil and spray the plot with Glyphoset (15 lit water + 70 ml Glyphoset + about 200 gm of sea salt or 150 gm of Urea) 2 to 3 days after harvesting. Summer moong beans are to be planted after the winter crop on the same beds between 25th February and 10th March. Same raised beds are to be used again without any ploughing or puddling or transplanting for next Kharif rice crop.

Approximately 3-4 days before rain begins, make holes on beds by SRT iron forma and put 3 to 4 treated rice seeds in each hole, press it with mixture of manure or good soil (10 Kg. manure and 400 g. Suphala) Next day after the first rain spray selective weedicide Goal (Oxyfluorfen 23.5% EC) @ one ml per litter of water. Between 25 to 30 days carryout manual weeding without walking on beds and press Urea (DAP) brickets or one tea spoonful of

Suphala in between 4 hills / plants. Farmer need to pay attention for control of crabs (press Gliricidia leaves in holes & plug with mud), Clean bunds, water levels in the plots and so on. After 2 to 3 days of harvesting paddy spray Glayphoset.

SRT has multiple advantages. It reduces loss of silt (about 20%) thus improving land fertility and also reduces cost of production and labour by 50%, eliminating the need for puddling, transplanting and hand hoeing and saves 50% water. Resultantly overall cost of production is reduced by 40%. It also reduces emission of greenhouse gases and effectively does carbon sequestration to improve soil fertility. Above all it brings confidence and happiness to the rice farmer helping in reversing the trend of farmers giving up farming. The technique has been accepted by Government of Maharashtra for their PPP-IAD programme where about 1200 farmers have reported overwhelming satisfaction.



The author received appreciation for using and popularizing SRT by experts such as Dr. M.S. Swaminathan "Indian Father of Green Revolution" and others.

Full version of this article can be accessed at <http://www.icid.org/ws_farmers_2016.pdf>.



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