Technical Bulletin No. 86

Success Stories:

AICRP on Irrigation Water Management

S. Mohanty, A. Sarangi, P. Nanda, P. Dasgupta

ICAR - Indian Institute of Water Management
Bhubaneswar – 751 023, Odisha
2023

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Contributors

All the scientists of twenty-six network centres of AICRP on Irrigation Water Management

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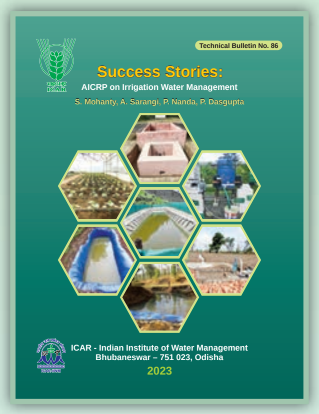

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Message

All India Coordinated Research Project (AICRP) on Irrigation Water Management (previously known as AICRP on Water Management) came into existence during the year 1967. In 2014, during the twelfth Five Year Plan, two separate schemes namely, AICRP on Water Management and AICRP on Groundwater Utilization were merged to form AICRP on Irrigation Water Management (IWM) with total 26 network centres located in 14 agro-ecological regions of India.

Since inception, AICRP on IWM scheme has developed several location-specific surface and ground water management technologies for different agro-ecological regions of the Country leading to optimum utilization of available water resources. Majority of these technologies are being adopted by line departments of State government, KVKs, extension personnel of SAUs and ICAR besides farmers trained through seminars, trainings, workshops and demonstrations. Further, the package and practices of developed technologies have been published by SAUs pertaining to advanced agricultural water management practices including fertigation schedules.

Dissemination of technology and its adoption by stakeholders is imperative for proper evaluation of developed technologies. In this context, success story plays a crucial role in portraying the effectiveness of any technology or intervention in farmers' fields. In this publication, some of promising success stories pertaining to the technology developed by AICRP on IWM Centres under ICAR-IIWM is reported, which have significantly improved livelihood of farmers in different agro-ecosystems of the Country. I expect that such publication highlighting the success stories of water management technologies will assist stakeholders for its replication for enhancing agricultural water productivity.

8th May, 2023
New Delhi

(Himanshu Pathak)

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Dr. Suresh Kumar Chaudhari
Deputy Director General
(Natural Resources Management)

Message

AICRP on Irrigation Water Management scheme played a pivotal role in addressing surface and ground water issues in some of the major and medium irrigation commands, hilly regions and high rainfall areas of the Country. Sustainable water management technologies are being developed by 26 Centres to improve water use efficiency in canal command, tubewell command, rainfed areas of plains and hills besides waterlogged regions. Scientists and staffs working under the scheme actively participate in field demonstration and extension of the technologies to address water management issues faced by stakeholders of the region.

The bulletin with compilation of success stories is a portrayal of successful extension of some of the water management technologies, concepts, methods and protocols that have benefitted the farmers. The bulletin also presents some successful region-specific interventions in water stressed and economically backward farming community especially in tribal areas. Overall, this bulletin is a compilation of 23 success stories addressing diverse issues faced by farmers *viz.* decline of water table, groundwater contamination, recharge in hard rock areas, waterlogging and drainage issues, water scarcity in high rainfall areas, etc. The success stories also demonstrate improved technologies leading to enhanced crop and water productivities besides increase in income by the farmers. This bunch of success stories will enhance visibility and subsequent upscaling of the sustainable technological solutions developed by AICRP on IWM centres to address diverse issues faced by farmers.

I congratulate all the contributors for this extremely important bulletin.

(S. K. Chaudhari)

8th May, 2023
New Delhi

Preface

The AICRP on Irrigation Water Management (IWM) scheme operates through 26 network centres spread across 14 agro-ecological regions in India. The scheme has been instrumental in research and extension of site-specific water management technologies in canal command, tubewell command, high rainfall zones, hard rock areas and hilly regions of the country. Research activities mainly focus on assessment of availability and quality of surface water and ground water, designing surface and micro irrigation schedules for small and marginal landholders to enhance water use efficiency of crops, rainwater management, developing groundwater recharge technologies, strategic planning for conjunctive use of surface and groundwater for sustainable crop production. Efforts are also made to bring additional area under irrigation through crop diversification, introduction of micro irrigation, construction of rainwater harvesting structures, etc. Most of these technologies are put through multi-locational trials in farmers' fields, and promoted through Krishi Vigyan Kendras (KVK), and line departments for farmers' adoption and inclusion in package of practices. The AICRP centres also undertook capacity building activities to improve livelihoods of tribal farmers.

The present bulletin is a documentation of successful dissemination of technologies and interventions to farmers in form of success stories. Every success story depicts the background situation that prevailed in farmer's field before technological intervention by AICRP on IWM scientists. This is followed by the developmental aspects and successful testing of the technology. Testing showed how a particular technology can be beneficial and the impact it had in uplifting the farmer's livelihood through higher crop production, covering additional area under irrigation, generating higher income, etc.

The success stories include improved irrigation management strategies using surface and micro irrigation systems, polycement tank technology and multiple use of water for hill farmers, micro water harvesting structure named Konkan *Jalkund*, temporary check dam structure named Konkan *Vijay Bandhara*, mini portable sprinkler irrigation system, community based solar lift irrigation system for remote tribal village, boat borne solar lift irrigation system for flood prone regions, groundwater recharge technology using tubewell, low cost groundwater recharge technology, mitigation strategy against heavy metal contamination in edible parts of crops, irrigation and drainage technology for waterlogged areas, drip irrigation in protected condition of polyhouse for growing high value off-season horticultural crops in hills, etc. A patented technology of organic fertigation unit has also been disseminated to farmers.

We hope that these success stories will be helpful for extension workers and progressive farmers for adoption and popularization of such technologies among stakeholders.

Authors

Contents

Community based solar powered lift irrigation system

(Morena Centre)

Y.P. Singh, S.S. Tomar

Background

Saharia tribe of Dangpura village, Vijaypur tehsil, Sheopur district, Madhya Pradesh was chosen for the intervention of community based solar powered lift irrigation system. The farmers have small and marginal land holdings in undulated topography. The farmers mostly depended on rain for crop cultivation; sometimes irrigation was provided through small diesel operated pump from a dam built on nearby Kuwari River. Due to poor economic condition of the farmers, they could not afford the pump cost. Thus only 8% of 26 ha cultivable land was irrigated, which resulted in poor crop productivity. Also, there was no electricity in the village.

Technology Development and Testing

The intervention involved increasing the height of an existing dam by 1.5 m to increase water level, and installing community based solar powered water lifting system near the dam. Forty solar panels were installed that could generate a power of 10000 W. Water in the dam was lifted through solar powered submersible pump of 10 hp with pumping capacity of about 50,000 litre per hour. Irrigation pipeline was laid in 26 hectare cultivable land with one outlet for every 4 acre to minimize conveyance and application losses. Provision was made for drip and sprinkler irrigations in about 4.0 hectare for *rabi* vegetable cultivation. Total cost of the intervention was about ₹ 18,00,000 including solar panels, drip system, sprinkler system, pipelines and installation works. Payback period is 1.5 years. Life of the solar system with the pipelines is 15 years.

Benefits of Technology

Total 85 farmers (62 families) were benefitted from the intervention. Different crops *viz.*, pigeonpea, sesame, pearlmillet were grown in *kharif*, whereas wheat, mustard, chickpea, and vegetable crops were grown during *rabi* season.

Greengram was grown in summer season. It was found that cropping intensity increased from 101% before intervention to 205% after the intervention. There was increase in yield of *kharif* and *rabi* crops by 39-92 and 10-108%, respectively. Income from crops increased from ₹ 6165/year/family before the intervention to ₹ 32,440/year/family after the intervention. Annual income of 85 farmers increased from ₹ 3,82,265 to ₹ 20,11,329 and benefit-cost ratio increased by 61%.

Impact of Technology and Feedback

Employment in agricultural activity increased from 1161 to 2248 man-days/year. The system is eco-friendly and a cleaner option for irrigation. There is no expenditure on fuel and maintenance cost is low besides low operational expenditure compared to electric motor and diesel engine. Thus, there is saving of energy, time and labour. The intervention also led to increased availability of drinking water and fodder for the livestock. Living standard of the tribal families of Dangpura village has improved significantly and migration to cities has reduced.

Relaying of berseem: Possibilities to double the yield and income of mustard based cropping system

(Morena Centre)

S.S. Tomar, Y.P. Singh

Background

Pearlmillet-mustard cropping system is popular among farmers in Madhya Pradesh. Stovers of pearlmillet are used as fodder for animals and mustard stovers are disposed for firing the brick kilns or used as fuel in the rural households. So very little organic matter is returned to the soil for building soil organic carbon, support microbial and other biotic activities in the soil to replenish nutrients removed by the two crops. As a consequence, soil organic carbon reported a decline that caused problems of soil erosion and deteriorating soil health. It also affected crop and water productivities of the cropping system. In order to improve productivity of the cropping system and make it profitable for farmers, it was considered necessary to diversify through a legume crop based relay cropping system.

Technology Development and Testing

Demonstration of relay cropping was conducted for three consecutive years in two farmers' fields in Santa village, Joura block, Morena district, Madhya Pradesh. After harvest of *kharif* crop of pearlmillet (hybrid), zero tillage was adopted followed by sowing of mustard (var. RH-749) in *rabi* season. Leguminous fodder crop of berseem (var. Wardan) was introduced as a relay crop in pearlmillet-mustard cropping system. After establishment of mustard crop for 30-35 days, seeds of berseem var. Wardan were broadcasted @ 20 kg/ha before the first irrigation to mustard crop. After harvesting mustard crop, three irrigations at tillering, head formation and seed filling stages were applied to the berseem crop. Mature berseem fodder crop was harvested from 3rd to 4th week of May every year. Average yields of 2.83, 2.28 and 0.59 t/ha were obtained for pearlmillet, mustard and berseem fodder, respectively.

Benefits of Technology

Results of this innovative demonstration showed that 2nd year onwards the yields of pearlmillet and mustard with relay cropping increased by 14 to 27% and 11 to 26%, respectively compared to field without relay cropping. Pearlmillet equivalent system yield increased by 50 to 73% with relay cropping as compared to 7.2 t/ha without relay cropping. Costs of cultivation in the demonstrations of without and with relay cropping were ₹ 57,220 and ₹ 76,740/ha, but net returns were ₹ 63,170 and ₹ 1,00,670/ha, respectively. Benefit-cost ratio of 3.48 was highest with zero tillage after harvest of pearlmillet followed by berseem relay cropping in standing mustard crop.

Impact of Technology and Feedback

Relaying of berseem legume in mustard crop improved soil fertility through nitrogen fixation. Soil organic carbon got enhanced due to crop residue as a substrate for microbes to thrive. Availability of macro and micro nutrients increased (1.8-2.2 kg/ha/year) due to berseem residue retention or incorporation in soil with tillage operations. Deterioration of soil health was a great concern for the local farmers. But the modification in their traditional cropping system turned out to be a better alternative for them to replenish soil health. The farmers accepted the technology whole-heartedly as it improved crop yield, water productivity, quality of the produce with increased soil organic matter, and fetched higher income.

Low cost water harvesting structure for groundwater recharge

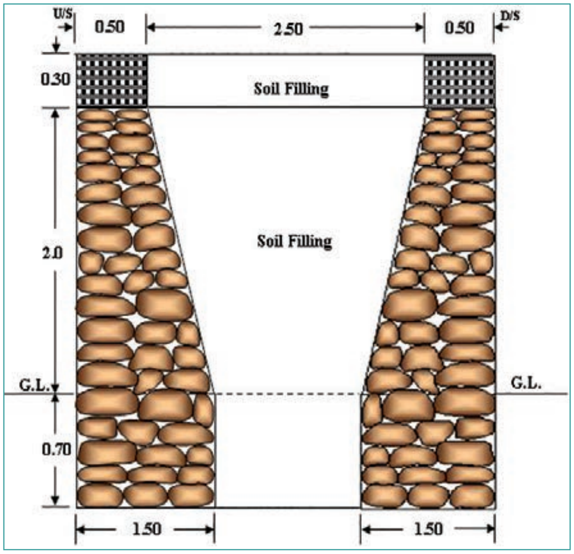
(Udaipur Centre)

P.K. Singh, K.K. Yadav, M. Singh

Background

Districts of the southern Rajasthan have hilly undulated topography. As a result, major part of surface runoff resulting from rainfall flows through the valleys. The selected project area *i.e.* Shishvi village is a narrow section of the valley. The village has a catchment area of 4.25 hectare.

Technology Development and Testing



Dry stone masonry type low cost rainwater harvesting structure for groundwater recharge was developed for hard rock regions of southern Rajasthan region. The structure was constructed using local stone and locally available skill. The structure is most suitable to harvest rainwater upto catchment area of 50 ha and also for augmenting the groundwater table in wells located in the downstream area of the structure through continuous recharge. The structure can be constructed by the community themselves as it requires little technical skill. A cross-sectional view of the low cost dry stone masonry structure is shown in the figure.

Benefits of Technology

The structure ensured availability of water to the farmers in the village and enhanced the livelihood of the community through increased productivity of both *kharif* and *rabi* crops. The cost analysis of dry stone masonry type structure revealed that it is six times cheaper than the masonry water harvesting structure. This technology is widely used by the State government and NGOs for groundwater augmentation in semi-arid regions of Rajasthan. The average recharging rate and recharging volume was 7.63 cm/day and 5303 m^3/year, respectively. Net return to the farmer through construction of the recharge structure was ₹ 18,936 per year and the benefit-cost ratio was 1.82:1. The structure proved to be economically feasible and very effective in augmenting groundwater level in hard rock regions of Rajasthan.

Impact of Technology

The low cost dry stone masonry structures were constructed in various parts of southern Rajasthan. Groundwater recharge was reflected by rise of water level in the open dug wells located at the downstream side of the structure. Government of Rajasthan has accepted this technology and has widely constructed such structures under watershed projects and MGNREGA. The NGOs *viz.*, Sahyog, ALART, and Vikash Seva Sansthan have also constructed such low-cost structures in the State.

Feedback

Over 150 structures have been constructed in southern Rajasthan for the benefit of farmers. The technology has been widely disseminated within the village community and among governmental and non-governmental organizations working in the area of natural resources management. Farmers are using the recharged water to provide irrigation to wheat and other crops.

Adoption of farm pond based drip irrigation technology in Malaprabha command area

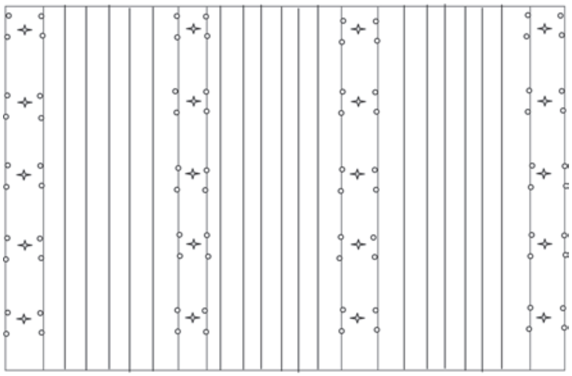
(Belavatagi Centre)

Punitha B.C., P.S. Kanannavar, Shivanand N. Honnali

Background

Most farmers in Malaprabha command cultivate crops with canal water during *kharif* and *rabi* seasons. Canal water is released during last week of August to first week of November. Due to insufficient supply of canal water and acute water shortage during crop growth period, options to adopt different methods to conserve water and modern irrigation methods like drip irrigation systems are desirable. Technologies developed at IWMRC, Belavatagi, Karnataka have shown that crops *viz.*, maize, sunflower, chilli, onion during *kharif* and wheat, chickpea, field bean, groundnut during *rabi* can be grown successfully under drip irrigation while enhancing water use efficiency.

Technology Development and Testing



Diagrammatic representation of Guava plot based drip irrigation system

The intervention was done in the field of the farmer Shri. Satya Saibaba Anegundi from Navalgund village, Dharwad district. Scientists from IWMRC visited the farmer's field, found suitable site for construction of farm pond and suggested the farmer to take up the same. Farmer constructed a farm pond of 80 lakh litre capacity and installed a pump operated by solar energy. Scientists designed a layout for drip irrigation system for guava plantation in an area of 0.5 ha with two laterals of online drip with 4 emitters per tree with application of water at 60% PE during *kharif, rabi* and summer @ 5, 9 and 12 L/day/tree through drip, respectively. During the initial three years, arable crops were grown as intercrops in guava plantation, with a lateral spacing of 60 cm, dripper spacing of 40 cm, dripper discharge of 4 lph, operating pressure of 1.2 kg/cm^2, with operation once in 4 days for *kharif* season crops and once in seven days for *rabi* crops. Farmers' trainings were conducted in Navalgund village emphasizing on judicious use of irrigation water, crop diversification and

integrated crop management practices for higher water productivity and soil health. With timely visits and suggestions of the scientists, Mr. Anegundi could grow improved varieties of greengram (var. DGGV-2), chickpea (var. JG-11) and papaya (var. Taiwan Red Lady) in his guava (var. L-49) plantation using harvested rain and canal water from the farm pond.

Benefits of Technology

Due to timely irrigation and improved crop and water management practices suggested by the scientists, Mr. Anegundi could obtain greengram yield of 7.10 q/acre, chickpea yield of 6.75 q/acre, papaya yield of 280 q/acre, and guava yield of 98.0 q/acre. Guava and papaya were sold by the farmer near the highway adjacent to his field, that fetched him good income.

Impact of Technology

Horizontal spread: The technology has been replicated as a model in 15 farmers' fields in different villages. In every village, the fellow marginal farmers accepted the technology and there was significant change in their livelihood. With regular field visits and trainings to farmers, the technology has been successfully spread to more than 200 acres of farmers' field.

Economic gains: With judicious use of irrigation water through drip system along with improved crop varieties and crop management practices, Mr. Anegundi earned a total net return of ₹ 6,62,132/ha with benefit-cost ratio of 3.63 compared to his conventional practice (₹ 1,79,500/ha; 2.59).

Feedback

The farmers opined that with availability of irrigation water, area under crops can be increased by 2-3 times and drip irrigation may be adopted over surface irrigation. The farmers reported that weed infestation was low in their fields, and labour requirement for irrigation was reduced. Irrigation could be given during night also. There was efficient supply of nutrients to plants with the help of drip fertigation. Although adoption of the technology increased crop yields, but the farmers reported that the initial investment was high.

Tubewell recharge technology

(Belavatagi Centre)

P.S. Kanannavar, Punitha B.C., Shivanand N. Honnali

Background

Soils in Northern Karnataka are mostly clayey in texture, medium to deep in depth, calcareous in nature, with moderate to poor drainage. Water table is very deep (about 100 feet) and groundwater is saline. There is need for groundwater recharge; however due to clayey nature of soil, natural groundwater recharge is very slow.

Technology Development and Testing

Technology for tubewell recharge through rainwater harvesting was developed by AICRP on IWM Belavatagi centre. The recharge unit has a pit of $12 \times 5 \times 8$ cubic feet and farm pond of 150 m^3 capacity and silt trap. Tubewell recharge unit cost was around ₹1,00,000 for installation (including farm pond and silt trap). From year 2020 to 2022, twenty-two demonstrations and trainings have been imparted to 655 farmers, students and visitors on "Tubewell/ borewell recharge technology through rainwater harvesting". Groundwater recharge units has been installed in three farmers' fields in the districts of Dharwad, Koppal and Bagalkot with technical guidance from IWMRC, Belavatagi.

Benefits of Technology

The new technique of tubewell recharge through rainwater harvesting improved groundwater recharge and water quality *viz.*, electrical conductivity (EC), well yield and depth of water table. The technology was helpful in harnessing runoff water generated from rainfall events and using it for groundwater recharge. Farmers having low performing or defunct borewells can adopt this technology. This will also serve as an assured irrigation facility. Energy consumption to pump groundwater for irrigation is reduced due to rise in water table depth.

Impact of Technology

Three years of performance analysis of the recharge unit showed that EC of groundwater extracted through tubewell decreased from 10 to 2 dS/m, static groundwater table increased from 100 to 25 feet below ground level and tubewell yield increased from 0.5 to 1.75 litre per second.

Feedback

All farmers, students and other visitors were convinced and satisfied about the technology for rainwater harvesting and groundwater recharge.

Portable drip irrigation technology for turmeric

(Parbhani Centre)

A.S. Kadale, U.M. Khodke, G.D. Gadade

Background

Tribal farmers of Hingoli district of Maharashtra face water scarcity and low crop yield. This forces farmers and their family members to migrate to sugarcane growing areas for livelihood. It was planned to introduce drip irrigation system to tackle the problem of water scarcity and low crop productivity.

Technology Development and Testing

Field demonstrations on portable drip irrigation were conducted by AICRP on IWM Parbhani centre in tribal farmers' field. Portable drip irrigation consisted of portable HDPE main line and sub main with inline drip laterals and control head consisting of HDPE disc filter and control valves. This technology was demonstrated on two tribal farmers' fields. Shri Kamaji Maneji Dudhalkar and Shri Anandrao Girjaji Khude are residents of Wai village, Kalamnuri taluka, Hingoli district, with land holding size of 1.6 and 2.0 ha, respectively. Demonstration was conducted for turmeric crop on an area of 0.4 ha for each farmer. Turmeric rhizomes were dibbled at a spacing of 45 cm × 15 cm and one 16 mm inline lateral irrigated two rows of turmeric. The farmer was guided regarding fertilizer dose of turmeric, its fertigation and irrigation schedules. Additionally, chickpea crop was demonstrated under sprinkler irrigation on 0.4 ha land of Shri Khude. Chickpea was sown at a spacing of 45 cm × 10 cm. Timely monitoring of the demonstrations was undertaken by scientists of Parbhani Centre.

Benefits of Technology

Shri Dudhalkar and Shri Khude harvested average dry turmeric rhizome yield of 24.0 quintal from 0.40 ha amounting to gross income of ₹ 1,68,000 and net income of ₹ 1,23,000. Shri Khude earned net income of ₹ 40,000 from an area of 0.4 ha by harvesting 11 quintal chickpea. Rhizome yields were higher with 15-20% fertilizer saving and 30-40% water saving.

Impact of Technology

Due to the interventions, the farmers could sustain their families of eight and five members, respectively. Eventually migration of their family members to sugarcane belts was stopped completely. Portable drip irrigation technology for turmeric also saved water, fertilizer, labour and time.

Feedback

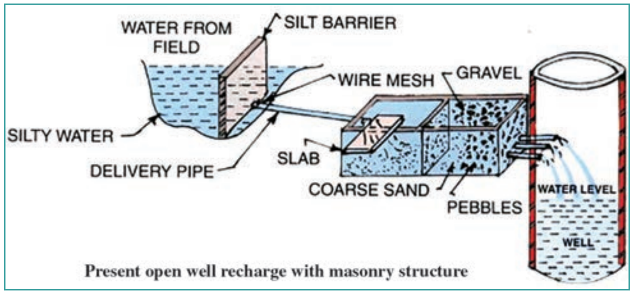
Intervention of sprinkler irrigation method on tribal farmers' field saved 30-40% water in comparison to traditional irrigation method. Tribal farmers used sprinkler irrigation for applying protective irrigation during dry spell in *kharif* season. By arranging field visit, field days and training at the demonstration plot on farmer's field, the technology of portable drip and fertigation was popularized among the other tribal farmers.

Horizontal roughing filter technology for open well recharge

(Coimbatore Centre)

Ravikumar Veerabadran

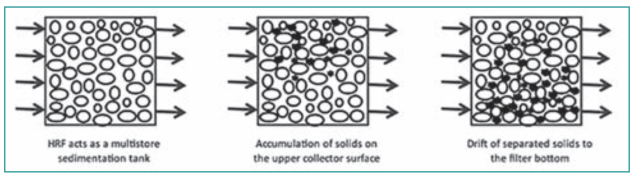
Background

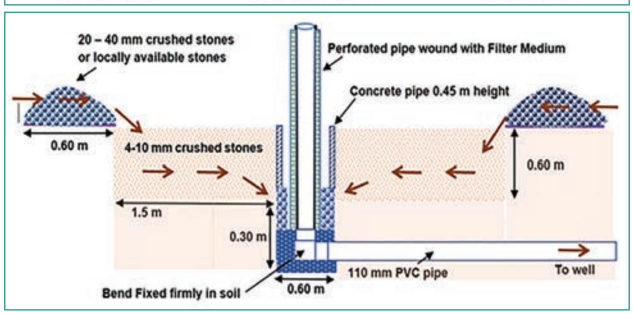


Present open well recharge with masonry structure

With over exploitation of ground water, the water level is going down in different parts of Tamil Nadu. Hence, there was a need to check over exploitation of groundwater and reclaim overexploited areas with suitable artificial groundwater recharge techniques. Artificial recharge of groundwater through abandoned open wells is one of the best ways to improve the groundwater potential. Presently, farmers of Tamil Nadu recharge open wells using brick masonry recharge structure with vertical filtering process. Cost of the recharge structure and filtering unit with pipe outlet having diameter of 110 mm is ₹ 40,000. Major part of the cost goes into construction of the masonry structure. Another big disadvantage with this recharge structure is that seepage of water to the surrounding soil does not occur in the filtration unit because of the masonry wall. Therefore, a new technology called "Horizontal roughing filter technology" was developed for groundwater recharge.

Technology Development and Testing





In the horizontal roughing filter (HRF) technology, water flows horizontally and sediments deposited on the stones gradually drift down. Hence, cleaning intervals are significantly larger for these filters. In the horizontal filtering technology for groundwater recharge developed by Coimbatore centre, runoff water successively passes through two layers of crushed stones. Upper layer of the filter which is laid on the ground has 20-40 mm crushed or locally available stones and lower layer of the filter inside a pit of 0.6 m depth has 4-10 mm crushed stones. At the centre of the filter, nylon screens are wound over a vertical collection pipe, through which water passes. The filtered water is then conveyed to the open well for recharge. The filter is 1.8 m in radius and 60 cm in depth. Depth at the centre of the filter is 90 cm. The filter is installed in bare soil. The filter was tested in the farmers' fields in upper Bhavani river basin.

Benefits of Technology

The recharge filter does not have any masonry structure. There is no need of any specific design based on runoff rate. Any number of structures can be installed depending on the local site conditions. As the filter can be installed in bare soil, recharging process occurs within the filter also.

Impact of Technology and Feedback

The project for installation of the recharge filter was implemented by ITC Limited, Coimbatore. The filter was installed in 104 farmers' fields in upper Bhavani river basin. The farmers were satisfied with functioning of the filter which showed an average filtration efficiency of 70%. After receiving farmers' feedback, the World Wild Life Fund (WWF) branch at Coimbatore has agreed to sign a MoU with AICRP on IWM Coimbatore centre to extend the technology in farmers' field.

Alternate wetting and drying method of irrigation for rice in Sharda Sahayak command

(Ayodhya Centre)

R.C. Tiwari, Ved Prakash, A.K. Singh

Background

Awanpur distributary system (ADS) of Sharda Sahayak canal has a command area of 2725 hectare of which only 31.45% area is irrigated during *kharif* season. Rice is cultivated in 394 hectare within ADS. Farmers' practice in the tubewell and canal command areas under the distributary involves field-to-field flood irrigation to grow rice crop during *kharif* season by applying 10-12 cm water per irrigation. This results in water deficit that affects growth and yield of rice in the region.

Technology Development and Testing

Improved water management technology of alternate wetting and drying was standardized for *kharif* rice grown in silty loam to silty clay loam soil. It is comprised of application of 7 cm water per irrigation at 1-4 days after disappearance of ponded water in 10 m × 10 m check basin. The technology was tested in farmers' fields within the ADS, that includes Awanpur distributary and four minors namely Madhupur, Panapur, Narayanpur and Alwapur having command area of 1207, 386, 208, 495 and 429 ha, respectively. During 2017 to 2022, 15 farmers' fields each at head (Awanpur village), middle (Narayanpur village) and tail (Alwalpur village) reaches of Awanpur distributory system were chosen for demonstration of the improved water management practice. Rice varieties NDR-359 and Sarjoo-52 were grown by the farmers in participatory mode.

Benefits of Technology

Alternate wetting and drying led to higher rice grain yields of 5.16, 4.84 and 4.80 t/ha at head, middle and tail reaches of Awanpur distributary in comparison to local farmers' practice which resulted in yield of 4.04, 3.95 and 3.82 t/ha, respectively. There was 22.5-27.7% higher rice yield under the improved practice against farmers' practice. Increase in yield was more at head end compared to middle and tail ends of the distributary. Average water saving was 37.7% with the improved technique over farmers' practice. Water use efficiency (WUE) was highest (6.42 kg/ha-mm) at the head end followed by middle (6.03 kg/ha-mm) and tail (5.97 kg/ha-mm) reaches. WUE was lowest with farmers' practice i.e. 3.51, 3.43 and 3.31 kg/ha-mm at head, middle and tail reaches of the distributary, respectively.

Impact of Technology

The demonstration resulted in higher rice yield of 4.80 t/ha compared to 3.75 t/ha before intervention. Higher yield may be attributed to cumulative effect of several factors such as favourable environment in root zone for plant growth, minimized leaching of nutrients and reduced occurrence of diseases with the improved irrigation technique. Enhanced crop yield and irrigation water saving helped in bringing additional 348 hectare of land under irrigated rice cultivation in Awanpur distributory system. Cost of cultivation was lower with the improved irrigation technique, i.e. ₹ 29440/ha compared to ₹ 31454/ha with farmers' practice. Additional income of ₹ 18,270/ha was generated over farmers' practice. The technology is being widely adopted in Awanpur distributary.

Feedback

According to farmers, the technology is helpful in efficient utilization of canal as well as tubewell water in Awanpur distributary.

Higher crop and water productivity in sugarcane through dual row trench planting

(Pantnagar Centre)

Gurvinder Singh

Background

In plains of Uttarakhand, sugarcane is one of the most important commercial crops grown in an area of 88022 ha approximately. This area is witnessing water scarcity due to increased popularity of summer rice cultivation. Further, flat planting and surface irrigation is most commonly used which accounts for 30-35% lower germination and 30-40% irrigation efficiency in sugarcane.

Technology Development and Testing

In order to overcome the problems with the conventional flat planting of sugarcane and to make cane cultivation more water efficient, experiments on water efficient crop establishment methods in sugarcane were conducted by AICRP on IWM Pantnagar centre and demonstrations were made at farmer's field. The team provided technical backstopping throughout and demonstrated the successful cultivation of sugarcane with trench planting and scientific interventions. Under the intervention, 135 cm wide trench (80 cm wide bed top, 30 cm wide trench bottom) of 25 cm depth were made and 3 budded sets were diagonally planted in dual row trenches. Planting was done in autumn (October). Irrigation water was applied only in the trenches and about 4.5 cm ponded depth was maintained.

Benefits of Technology

The cane productivity under this technology increased from 82 t/ha to about 100 t/ ha in farmer's field. There was 20-25% saving of irrigation water.

Impact of Technology

On seeing the benefits of the technology and advice of scientists, many farmers were convinced with the dual row trench planting of sugarcane. One such farmer was Mr. Gurdeep Singh who had a land holding of 4 ha, and about 8 ha land was taken on lease. He adopted trench planting to grow sugarcane in 2 ha land.

Feedback

The farmer was convinced with the trench planting technique as it led to 20-25% irrigation water saving, and improved crop and water productivities. Since last five years Gurdeep Singh is using the improved technique to grow sugarcane. He has also incorporated new interventions like intercropping of wheat and chickpea in sugarcane crop. Other farmers in the village are slowly adopting the technology. Adoption of the technology is changing the mindset of the farmers. Many farmers from neighboring villages often visit their fields and get motivated.

Improving water productivity in a minor irrigation project

(Jabalpur Centre)

R.K. Nema, M.K. Awasthi, Y.K. Tiwari

Background

The study was conducted in command area of Khapa Tank Minor Irrigation Project in tribal district of Mandla, Madhya Pradesh. The live storage water of the tank as per the report of water resource department is 249.79 ha-m with command area of 716.29 ha in three villages *viz.* Magardha, Dhundhwa, and Khapa. The existing cropping pattern is paddy, maize, kondo and arhar in *kharif* season followed by wheat, gram, pea, linseed and mustard in *rabi* season. The average water productivity of 90 farmers in the study area ranged from 0.5 to 0.6 kg/m^3 for *rabi* season.

Technology Development and Testing

A comprehensive approach was followed for increasing water productivity in the command area. They included use of double mould board plough to provide deep ploughing in summer season followed by operation of rotavator, introduction of improved irrigation methods such as border and sprinkler irrigation, introduction of line sowing in the study area through seed drill, and introduction of improved wheat varieties GW-273 and HD-2851. There were 36 adaptive trials conducted on farmers' fields of Khapa and Magardha command areas to inculcate the improved technology for enhancing yields of crops and reducing the water requirements in various seasons.

Benefits and Impact of Technology

Average water productivities with sprinkler irrigation, border irrigation and flood irrigation were 1.46, 0.67 and 0.59 kg/m^3, respectively in Khapa minor command. There was twofold increase in wheat productivity with developed package of practices, i.e., summer deep ploughing, line sowing, high yielding wheat varieties, and adoption of sprinkler irrigation over flood irrigation. Water productivity increased by 117.91% when border irrigation system was replaced by sprinkler irrigation system. There was 147% higher water productivity when flood irrigation system was replaced by sprinkler irrigation system. About 14% increase in water productivity was found if flood irrigation system was replaced by border irrigation system.

Feedback

After successful demonstration and implementation of holistic water productivity improvement programme in tribal area of Khapa Minor Irrigation command, a number of requisitions were made to State Department of Agricultural Engineering for deep summer ploughing. The myth of farmers regarding high cost of HYV seed was somewhat broken after seeing its production in their own fields.

Boat mounted solar photovoltaic pumping system

(Pusa Centre)

R. Chandra, S.K. Jain, S.P. Gupta, R.C. Srivastava

Background

Diara and *Dhab* lands lying in riparian zones of Bihar are prone to flood. Thus farming can be done for only few months in a year. During flood events during rainy season, pumps and other equipments installed on land get submerged.

Technology Development and Testing

A boat mounted solar photovoltaic pumping system was designed by scientists of AICRP on IWM Pusa Centre for irrigating crops during *rabi* and summer season in *Diara* and *Dhab* lands of Bihar. Components of the boat mounted solar pumping system are one wooden boat, 2hp DC submersible pump, strainer, pulley, steel framed structure, solar module and controller. The pump is powered by 1800 W solar photovoltaic array. The pump and boat are energized by solar photovoltaic system that discharges water upto 6.0 litre per second. The pump is caged to reduce chances of theft and damage from algal growth. Metallic string is used for lowering of the pump into river water through pulley and lever. Delivery pipe is fitted over the submersible pump. The system was tested where discharge was measured with respect to time and heads. Approximate cost of establishment is ₹ 5.00 to 5.5 lakh. The high establishment cost of the system can be overcome with the help of banks and entrepreneurs in this sector. However, about 90% Government subsidy is being sought.

Benefits of Technology

Irrigation water can be supplied to farmers at low cost of operation, that is ₹ 35 per hour. The system is portable and can cover a considerable area along the river bank. Surface irrigation can be provided to about 2.5 ha, and drip/sprinkler irrigation in 3 to 4 ha area. The system has the advantage of zero air pollution. The system was found to be stable under varying weather conditions. It could sustain wind velocity upto 80 km/h. The system was found useful even during the unprecedented flood in the year 2017.

Impact of Technology

The innovation is recognized and appreciated by International Water Management Institute (IWMI) and published as a case study in Compendium on solar powered irrigation system in India, CGIAR research program on Climate Change in Agriculture and Food Security (CCAFS).

Feedback

Boat based pumping system was given to farmer Mr. Lal Babu Sahini on pilot basis. He is a resident of Dedaul village in Muzaffarpur district of Bihar. The farmer doesn't own any land and he has leased land of 5.5 acre. The farmer successfully completed two months training under Agribusiness Incubation Programme of RKVY. His name was listed as an entrepreneur in the top 50 startups of India in the final list of MoA&Pu FW, New Delhi (RKVY RAFTAAR) conducted by National Institute of Agricultural Extension Management (MANAGE), Hyderabad in the year 2020.

Groundwater recharge cum drainage unit

(Pusa Centre)

R. Chandra, S.K. Jain, A.K. Singh, R.C. Srivastava, A. Kumar

Background

The alluvial plains of Bihar have potential aquifers with ample source of water for recharge, but are witnessing accelerated groundwater draft due to over-exploitation of groundwater over the last couple of decades. With increasing electrification in rural areas, the second aquifer is under water stress during summer. Thus this aquifer was targetted for recharge by AICRP on IWM scientsts. On the other hand, waterlogging and lack of drainage in *Chaur/Taal* lands of Bihar delays *rabi* crop sowing and causes poor crop performance. Thus a groundwater recharge cum drainage unit was needed to help farmers of waterlogged *Chaur/Taal* lands and at the same time prevent the decline of groundwater in the State.

Technology Development and Testing

Keeping in view the importance of groundwater recharge and drainage of excess water, a groundwater recharge cum drainage unit was designed and developed at DrRPCAU, Pusa. Steps involved in development of the structure are as follows: Design, development and fabrication of filter unit; performance evaluation of different filter combinations in laboratory and field conditions; identification of suitable recharging point and depth using well lithology of different location of study area; study of filter clogging; installation; evaluation of the unit. The unit was tested and evaluated in lab and field condition and installed in University mela ground for demonstration. Seven groundwater recharge cum drainage units have been installed in the university campus and five in farmers' fields. Approximate cost of construction and installation of the unit was ₹2.0 lakh.

Benefits of Technology

The second aquifer can be recharged using the recharge unit. Recharge capacity of the unit is 22000-24000 L/h, solid removal efficiency is 80-82%, depth of recharge is 45-55 m. Annual groundwater recharge potential is 2.5 ha-m. Drainage from waterlogged agricultural fields after monsoon season, timely sowing of *rabi* crop, and augmentation of groundwater resources were achieved using the system.

Impact of Technology and Feedback

Field of Shri Rajendra Mahto, a resident of Sukhet village, Jhanjharpur tehsil, Madhubani district was chosen for demonstration. This region is known for recurrent floods due to its river system and bowl-shaped topography that stagnates water for longer time. Flood starts in July and many fields remain submerged till March. Rice is harvested in a waterlogged condition. Sowing of *rabi* crop is limited to very small areas due to waterlogged condition. There is no wheat sowing in most parts with late sowing in some parts of the village. As a result of installing the drainage cum groundwater recharge unit, excess water was drained out in the last week of November and timely sowing of wheat was possible after 20 years in Shri Mahto's field. Over 15 hectares and 10 farmers have been benefitted with this technology so far.

Polycement tank technology: A boon for hills

(Almora Centre)

S.C. Pandey

Background

Himalayan region faces acute water shortage from October to June for agriculture and domestic use. Springs that are major sources of water are drying up due to unplanned construction and deforestation. Irrigation facilities are meager (10% irrigated land) and very costly in hills. One of the effective ways to utilize available water from spring, surface runoff and rainwater for crop production is to harvest water in storage tank.

Technology Development and Testing

Low cost polycement tank technology was developed by AICRP on IWM Almora centre to use harvested water for growing high value and off-season crops in hills. Trapezoidal tanks were constructed with slope 1:1. The tank was lined with LDPE/Silpaulin covered with blocks made of cement, sand and gravel in ratios 1:6:3/1:5:4/1:3:3/1:4:3. Dimension of the blocks was 50 × 25 × 6 cm/ 50 × 20 × 6 cm. The tank was constructed at the experimental farm and farmers' fields. Since year 2012, 23 tanks have been constructed at farmers' fields which are functional till-date. The tank is durable with an expected lifespan of 45 years.

Benefits of Technology

Stored water in the polycement tank ensures assured water supply for cattle, crops and fish production. The technology is resistant to earthquake jolt, landslides and temperature stress. A tank of capacity 100 m^3 can irrigate about 800 m^2 area of crops. If the water is tapped using plastic pipe, then discharge of about 5 L/min can irrigate 3000 to 5000 m^2 of land. If the tank is equipped with drip irrigation system, then 6000 to 10000 m^2 area can be irrigated. The area of irrigation during the peak period of water requirement i.e. 14-15th standard meteorological week (SMW) should be limited to 3000 m^2 so that assured irrigation can be maintained for vegetable crops throughout crop season. It was estimated that consistent supply of irrigation can increase yield of rainfed crop by 30% in hills.

Impact of Technology

The technology has been transferred to 23 farmers through AICRP on IWM project. One NGO namely HESCO has adopted the technology and demonstrated in several villages in five districts of Uttarakhand. The technology is being extended to north-east hilly region of India by the NGO. The technology has also been extended to scheduled caste famers through SCSP.

Feedback

Farmers are satisfied with the technology. They are able to grow vegetables and go for fish production all the year round. Farmers of Jageshwar town under Dandeshwar watershed have constructed the polycement tanks and are able to provide assured irrigation to vegetable crops. The tank can be developed using locally available resources (sand, gravels/stones). The polycement tank is cheaper, durable and efficient unlike *kaccha* tanks, *pucca* cement tanks and polylined tanks available in hills which are vulnerable to landslides, earthquake jolts and temperature stress.

Multiple water use model for hill farmers

(Almora Centre)

S.C. Pandey, M. Parihar, Shyamnath, Tilak Mandal

Background

Land and water resources are limited for hill agriculture. Hills have no groundwater; only sparsely distributed subsurface aquifers called water springs (*Naula*). Additionally, climate and wild animal menace is another challenging situation in hills. Multiple water use model is a framework that considers water availability, water demand, water allocation, water management, water reuse, water conservation, and a participatory approach for efficient and sustainable management of water resources in hill agriculture.

Technology Development and Testing

A multiple water use model was developed by Almora centre to generate constant source of income for farmers and enhance profitability of hill agriculture. The model is composed of several components namely, pisciculture, kiwi cultivation, poultry farming, azolla cultivation, vegetable cultivation in movable polyhouse/ protected condition, hybrid napier on terraces, cattle rearing, and vermicompost/ vermiwash. Polycement tank of capacity 100 m^3 was used for water storage and fish cultivation. Over 35 farmers have implemented the model.

Benefits of Technology

Components of the model were taken up by farmers as per their choice and available resources. Pisciculture was adopted by 10 farmers with fish production of 40 to 60 kg/100 m^3 with net income of ₹ 4,000 to 7,000 per year. Poultry was taken up by five farmers. They earned net profit of ₹ 6,85,200 with an expenditure of ₹ 66,362. Four pits each with dimension 3 × 2 × 0.5 m was made for Azolla cultivation. Gross annual Azolla production was 960 kg and annual net income was ₹10,521 with an annual cost of ₹3,878. Azolla contains 28 to 35% protein. Hence it was used as feed for cattle, fish, poultry, and biofertilizer. It was also used as a nutrient source for rice. Hybrid Napier was planted on risers of the tank and used as feed for fish and fodder for cattle. Cultivation of horticultural crops was done in protected condition in a movable polyhouse (21 m^2) and natural environment (2400 m^2) that fetched net incomes of ₹ 9,981 and ₹ 46,048, respectively. Kiwi crop was cultivated on 200 m^2 of land by 15 farmers who fetched profit of ₹ 45,229. Kiwi has been introduced as an alternative to apple in the region owing to ability to give good yield under changing climatic conditions, protection from wild animals, fetch high income, provide shade for vermicomposting, and prevent soil erosion. Animal rearing (6 nos.) gave annual net return of ₹ 1,58,686. Vermicompost was used for fertilizing fish pond, poultry and crop cultivation. Annual net return of ₹ 91,210 was fetched by sale of vermicompost by 15 farmers.

Impact of Technology and Feedback

The multiple water use model for Uttarakhand hills is a robust instrument to combat climate aberration, threat by wild animals, and ensure livelihood security. There is potential of gross income of about ₹ 6.0 lakh from 4000 m^2 land.

Drip fertigation under protected conditions

(Palampur Centre)

S.K. Sandal, A. Kumar

Background

Fertigation refers to the application of fertilizer along with irrigation. Fertigation is mostly applied with drip irrigation. In drip irrigation, water is applied in form of fine droplets to plant root zone only, which not only saves water but also matches crop water demand. In the process of fetigation, irrigation and fertilizer application match the phenological stage requirements through proper placement and timing to optimize water and nutrient use. Protected cultivation, an efficient way of using land and other resources, for crops with higher productivity can be best served with drip fertigation. This technology can help the farmers to produce more crops from their land, particularly during off-season when prices in the market are high.

Technology Development and Testing

In this technology, 25 percent of the recommended dose of fertilizer (RDF) is applied as basal through conventional fertilizers *viz.*, Urea, SSP and MOP and remaining 75% is applied through drip line using water soluble fertilizers *viz.*, 19:19:19, 12:61:0 and Urea in splits under protected conditions. This was applied for tomato, capsicum and cucumber crops under protected conditions.

Benefits of Technology

Drip fertigation leads to uniform application and distribution of nutrients during crop growth matching the demand at different crop growth stages, and saves labour. Combined application of water and fertilizer enhances water and nutrient use efficiencies which is need of the hour for doubling farmers' income. There was enhancement in water use efficiency (20-30%) and fertilizer use efficiency (8-26%), thereby saving water, reducing cost of production and increasing income.

Impact of Technology

Due to congenial climate for off-season vegetables and high value crops, adoption of fertigation and polyhouse cultivation by marginal and small farmers of the State can enhance livelihood security and double farmers' income from unit farmland.

Feedback

Adoption of polyhouse cultivation by hill farmers has resulted in round the year vegetable production to meet the local and tourist demands. Use of improved precision irrigation and nutrient management through drip fertigation has resulted in quality improvement along with enhanced productivity besides saving time and labour.

Arsenic mitigation and increasing crop and water productivity of high-valued vegetables in arsenic contaminated areas through conjunctive use of water

(Gayeshpur Centre)

S.K. Patra, K. Bhattacharya, R. Poddar

Background

Arsenic contamination of groundwater is a form of groundwater pollution which is due to naturally occurring high concentrations of arsenic in the groundwater. Arsenic contamination is now a major problem in West Bengal. There is potential health risk in drinking arsenic contaminated water. The irrigated water containing arsenic can enter human bodies through vegetables and food grains and can pose potential health risk. Therefore, there is a need for proper water management in arsenic contaminated areas.

Technology Development and Testing

Schedule for conjunctive use of good quality pond water (PW) and arsenic contaminated groundwater (GW) was developed for high value vegetable crop like broccoli to reduce arsenic accumulation in soil and edible plant parts, minimize human health risk and increase farmers' income. On-farm intervention was done to demonstrate improved water management technique in Ghetugachi village of Nadia district that falls under new alluvial zone of West Bengal. Sources of irrigation were arsenic contaminated shallow tubewell water (STW) and good quality PW. Both sources of water were homogeneously mixed in different proportions in reservoirs and delivered through pipe to plots for irrigating a test crop of broccoli cv. Green magic F1 hybrid in the farmer's field.

Benefits of Technology

Application of 50% GW + 50% PW for irrigation resulted in significantly lower arsenic accumulation in broccoli heads and soil compared to use of 100% GW. This approach provided opportunities to the resource-poor farmers for better irrigation planning according to seasonal availability of water, improved crop management and most importantly, less exposure to arsenic toxicity. Conjunctive use of GW and PW in the ratio 1:1 gave higher crop yield, economic benefit, water productivity, including lesser arsenic intrusion into food and soil thereby attenuating health risk. This water management technique was recommended for large scale adoption in the arsenic prone areas of Nadia district.

Impact of Technology and Feedback

Initially, nearly 0.3 ha of land contaminated with arsenic was brought under this technology. Three farmers *viz.*, Mr. Salam Mandal of Dakshin Panchpota village, Mr. Tapan Mukherjee of Getugachi village and Kalam Mandal of Dakshin Panchpota village adopted this on 0.12, 0.08 and 0.10 hectare, respectively. Many farmers are taking up broccoli as a substitute for brinjal and cauliflower due to high marketable returns with broccoli. The farmers showed interest in the technology because of its economic and health benefits. Consequently, technical advice and encouragement was given to local farmers to grow high value vegetable like broccoli with conjunctive use of STW and PW in their fields.

Irrigation management for toria in Assam

(Jorhat Centre)

C.K. Sarma, B. Deka, K. Choudhury, R.K. Thakuria

Background

Toria (Rapeseed) is the most important oilseed crop covering 2,80,000 hectare area in Assam. But productivity of the crop is lower compared to the other states. Toria is grown as a rainfed crop during *rabi* season with residual soil moisture of *kharif* season. Thus the crop faces moisture stress at mid and later stages of crop growth which is mainly responsible for lower crop productivity in the State.

Technology Development and Testing

Irrigation scheduling in toria standardized at Jorhat centre comprises of single irrigation of depth 6 cm applied by flooding method at flowering stage or early siliqua development stage (in case of sufficient soil moisture during flowering period). From year 2002 to 2010, multi-location trials were conducted at farmers' fields in shallow tubewell (STW) command area in Jorhat district of Assam. Thereafter, frontline demonstration programmes were organized from year 2015 to 2018 in farmers' field of Bongaingaon district through Krishi Vigyan Kendra (KVK) to popularize the technology among farmers.

Benefits of Technology

The irrigation management technology has been found to be effective in improving crop growth and yield of toria in Assam. Demonstration in Jorhat district showed that single irrigation at flowering stage helped in producing 42.9% higher yield over farmers' practice of not applying any irrigation throughout the crop growth period. Similarly, demonstration programme by KVK in Bongaingaon district recorded yield increase of 39% in 2015-16, 38% in 2016-17 and 22% in 2017-18 over farmers' practice with benefit-cost ratios of

3.11, 2.75 and 2.86, respectively. There was an increase in profit in the range of ₹12,300-17,400 per hectare.

Impact of Technology

The technology has been well accepted by the farmers of Bongaigaon district. It is being utilized by farmers for effective utilization of the fallow areas after harvest of rice. There has been gradual increase in the number of villages *i.e.* five villages in 2017-18 to 19 villages in 2020-21 where the technology has been adopted within the district. Double cropping of rice followed by toria has significantly increased farmers' income. Rice-fallow system gave average net income of ₹ 4292/ha, whereas rice–toria sequence helped in improving net income to ₹ 21,792 in 2017-18, ₹ 22,369 in 2018-19 and ₹ 23,992/ha in 2019-20. The technology is gaining popularity in toria growing regions of Assam.

Feedback

Farmers have realized the need for applying irrigation at critical growth stage of toria *i.e.* flowering/early siliqua development stage when sowing is done from mid October to first week of December. Farmers are happy with the technology as it helps in increasing their income compared to the practice of rice-fallow system.

System and method for organic fertigation

(Chalakudy Centre)

Gilsha Bai E.B., Mini Abraham, Shyla Joseph, Brijit T.K., Anitha S, Mariya Dainy M.S.

Background

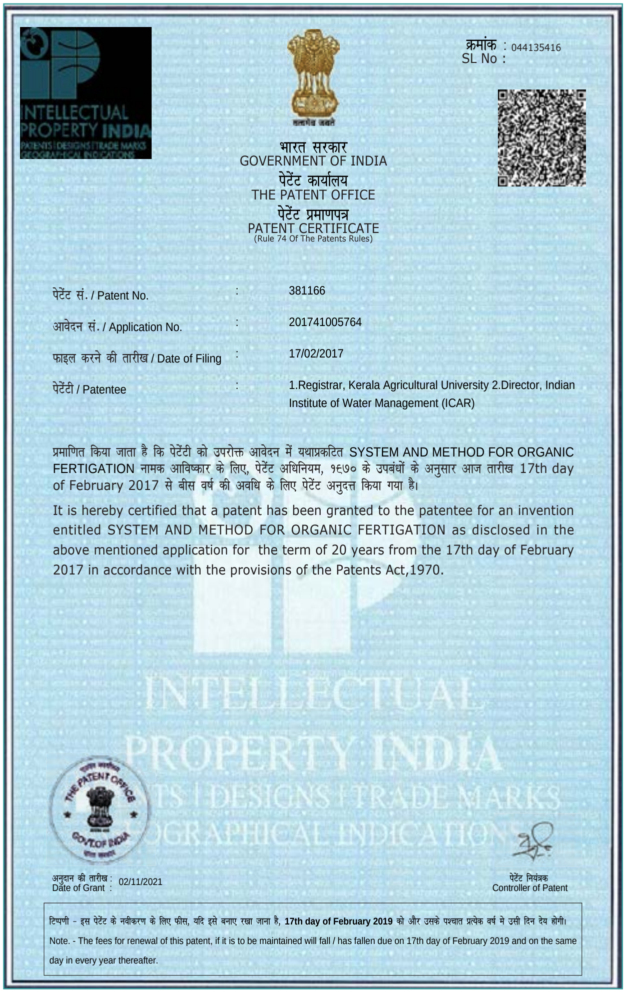
Fertigation using drip irrigation is already a tested and proven technology for increasing fertilizer use efficiency and increasing crop yield. Generally, urea and other water soluble fertilizers are used for fertigation in fruit and vegetable crops. A need was felt to develop a fertigation method using organic manure to maintain soil health.

Technology Development and Testing

An organic fertigation unit (OFU) was developed for use of cowdung and vermicompost filtrates as nutrient source to crops. The filtrate is passed on to a tank from where it is pumped through micro irrigation system to irrigate vegetable crops. Filtering mechanism of the OFU includes a three-tier system consisting of three successive filters of different mesh size. At first, organic manure solution (cowdung or vermicompost) was prepared in a tank by mixing with water in the proportion of 1 kg organic manure: 30 litre water using hand/ power operated agitator. The tank has two valves placed in opposite directions at two different levels of the tank. The manure solution is kept for 24 hours to settle the solid part. Once the solid particles are settled, the supernatant is passed on to the filtering unit through the first valve. The second valve is used for removing the settled solid part and thereby cleaning the tank. The final filtrate is then passed on to another tank from where it is pumped through micro irrigation system. The OFU was tested with pot culture study for analyzing the quality of organic filtrate and evaluating its effects on soil properties and plant growth during three consecutive years using okra as a test crop.

Benefits of Technology

Application of vermicompost filtrate and fertigation with 50% recommended dose of fertilizer (RDF) recorded highest okra yield of 425.3 g per plant, water use efficiency of 265.8 kg/ha-cm and gross return of ₹ 3,14,697. Therefore, the filtration unit was effective in organic manure fertigation. It was recommended that organic manure filtrate along with 50% RDF should be applied to get higher okra yield and improve nutrient and microbial status of soil.



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SL No :

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GOVERNMENT OF INDIA
पेटेंट कार्यालय
THE PATENT OFFICE
पेटेंट प्रमाणपत्र
PATENT CERTIFICATE
(Rule 74 Of The Patents Rules)

पेटेंट सं. / Patent No.	:	381166
आवेदन सं. / Application No.	:	201741005764
फाइल करने की तारीख / Date of Filing	:	17/02/2017
पेटेंटी / Patentee	:	1.Registrar, Kerala Agricultural University 2.Director, Indian Institute of Water Management (ICAR)

प्रमाणित किया जाता है कि पेटेंटी को उपरोक्त आवेदन में यथाप्रकटित SYSTEM AND METHOD FOR ORGANIC FERTIGATION नामक आविष्कार के लिए, पेटेंट अधिनियम, १९७० के उपबंधों के अनुसार आज तारीख 17th day of February 2017 से बीस वर्ष की अवधि के लिए पेटेंट अनुदत्त किया गया है।

It is hereby certified that a patent has been granted to the patentee for an invention entitled SYSTEM AND METHOD FOR ORGANIC FERTIGATION as disclosed in the above mentioned application for the term of 20 years from the 17th day of February 2017 in accordance with the provisions of the Patents Act,1970.

अनुदान की तारीख : 02/11/2021
Date of Grant :

पेटेंट नियंत्रक
Controller of Patent

टिप्पणी - इस पेटेंट के नवीकरण के लिए फीस, यदि इसे बनाए रखा जाना है, **17th day of February 2019** को और उसके पश्चात प्रत्येक वर्ष मे उसी दिन देय होगी।

Note. - The fees for renewal of this patent, if it is to be maintained will fall / has fallen due on 17th day of February 2019 and on the same day in every year thereafter.

Impact of Technology

Application of vermicompost filtrate increased bacterial, fungal and *Actinomycetes* populations in soil, which was higher than application of cowdung filtrate. Available potassium in soil increased significantly with the application of vermicompost. Vermicompost was found to be superior to cowdung in terms of okra produce, nutrient enrichment of soil and gross return, while cowdung was more profitable in terms of net return and benefit-cost ratio due to lower cost of the latter. The technology has been patented (Patent no. 381166).

Feedback

Many farmers from different districts of Kerala are using the technology for applying organic fertigation through drip system. They are selling their farm produce at premium price. The farmers opined that the OFU is easy to fabricate and operate. The technology is farmer friendly, and there is improvement in soil and crop health. Mr. Varghese Thomas from Pariyaram P.O., Chalakudy, Thrissur district has installed OFU in his farm. He observed about 28% increase in crop yield and 25-50% saving in commercial inorganc fertilizer.

KAU micro sprinkler

(Chalakudy Centre)

K.P. Vishalaakshi, Susheela P., Brijith T.K., Mini Abraham, Shyla Joseph, Mariya Dainy M.S.

Background

KAU micro sprinkler (KAUMS) was developed by AICRP on IWM Agronomic Research Station, Chalakudy. KAUMS is an affordable and farmer friendly technology for efficient utilization of irrigation water. It is a simple and clog free system of irrigation, ensuring complete wetting of the basin area of crops.

Technology Development and Testing

KAUMS has a rotating sprinkler head made of 12 mm/8 mm diameter linear low density poly ethylene (LLDPE) pipe of length 6 cm plugged at both ends by end caps. A hole of 4.4 mm diameter is drilled at the center of the pipe to insert a microtube pin connector. Holes of 1 mm diameter are drilled on opposite sides of this hole, oriented at 90^0 and 5 mm away from both ends to serve as nozzles. One LDPE microtube of 6 mm diameter and length of 1 m is attached to the microsprinkler head unit at the center through the pin connector. The other end of the microtube can then be attached to the lateral. The microtube with the sprinkler head is tied to a support, and the unit is fixed near the plant to be irrigated. Sprinkler heads are very light in weight, so energy required to rotate the head with water is considerably less. Pressure required for operation of sprinkler units is 0.3 to 1.0 kg/cm^2, which is easily available even from a domestic overhead tank. Even though a pressure of 0.3 kg/cm^2 is sufficient for its working, a pressure of 1 to 2 kg/cm^2 is required for operation in one acre or more. Costs of installation of KAUMS for coconut and vegetable crops in one acre land are ₹20,000 and ₹26,000, respectively.

Benefits of Technology

Operating pressure of KAUMS is less compared to that of conventional micro sprinkler system. There is uniform distribution of water in the crop root zone, that ensures complete wetting of the basin area and cooling of the microclimate. KAUMS also facilitates application of fertilizers, herbicides and cooling of greenhouses, poultry houses, cowsheds, etc. KAUMS can be fabricated by farmers with minimum initial investment, running and maintenance costs. KAUMS is suitable for all agro-climatic zones of Kerala.

Impact of Technology and Feedback

The system was popularized among farmers through training programmes through different Krishi Vigyan Kendra across Kerala. The technology has been adopted by farmers for crops like coconut, arecanut, leafy vegetables, ornamental plants, lawn grass, vegetable crops, banana, and medicinal plants. KAUMS kit from Chalakudy station is being made available to farmers through sales outlets of KAU @ ₹ 560 per kit all over the State. A farmer from Thrissur district, Mr. Sivaraman T.A. reported an average of 37% increase in crop yield and upto 25% fertilizer saving using KAUMS.

Surface and subsurface drainage cum irrigation technology

(Navsari Centre)

N.G. Savani, J.M. Patel

Background

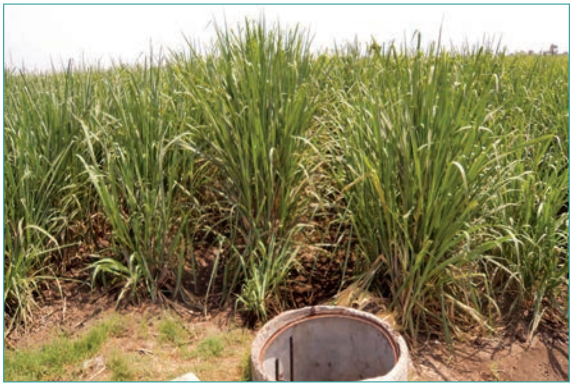
Farmers of Surat district (Gujarat) used groundwater to grow cotton and pigeonpea, but shifted to sugarcane and paddy with the advent of canal irrigation under Ukai Kakrapar irrigation project. The soil was having waterlogging and salinity problems due to flat topography, over irrigation and low permeability. Even though the farmers applied gypsum and biocompost to control sodicity at their own expense, they were not able to get sugarcane yield more than 50-60 t/ha. Shri Arvindbhai Patel of Mulad village of Surat district has his land in the command area of Kosamba branch under Ukai Kakrapar project. He showed interest in adopting the subsurface drainage technology developed by scientists of AICRP on IWM Navsari centre at Navsari Agricultural University (NAU).

Technology Development and Testing

A drainage cum irrigation system designed by the scientists was installed in the field of Shri Arvindbhai Patel. Field is located in the command area of Kosamba branch under Ukai Kakrapar irrigation project. Technical support and guidance were provided by the scientists. Average drain depth for subsurface drainage was 1.0 m placed at 42 m spacing. Five perforated pipes were installed in the field. The drainage system worked by gravity and excess water was disposed into nearby stream, which ultimately got discharged into Tapi river located 700 m away from the farmers' fields. As the stream was far away from the field of Arvindbhai Patel, a small silt basin was provided at a manhole located close to the outlet of the field drain. If there was surface stagnation due to excess rainfall, the surface runoff was passed through the silt basin before entering the manhole. Then the runoff was collected by a collector pipe having 6'' diameter and made of hard PVC. This pipe also served for irrigation. The collector cum irrigation pipe had outlet near the stream/nala. A pump and pump stand were installed near the stream so that fresh water was pumped from the stream and passed into the collector through pump stand. This way the collector line served for draining excess water and supplying lift irrigation to irrigate Shri Patel's field. This innovation of using a connector system between farmer's field and a far-away stream was important to promote the technology among farmers.

Benefits of Technology

The unit solved waterlogging and salinity issues in Shri Patel's field. With successful operation of the system, waterlogging problem was reduced and annual average water table got lowered from 110 to 120 cm. Soil salinity got reduced from 10-12 to 1.27-2.87 dS/m. Sugarcane yield increased from 60 to 127 t/ha in two years.



Impact of Technology and Feedback

Shri Patel said that the dual purpose technology has solved the chronic problem of waterlogging in his farm and reclaimed the soil. He is happy that sugarcane yield in his field has increased by about 110%. He mentioned that his field is being visited by large number of farmers from adjoining areas. Consequently, 115 farmers have adopted the subsurface drainage cum irrigation technology at their own cost covering 228 hectare for reclamation of waterlogged and salt affected lands.

Drip system of irrigation: A great boon to the tribal farmers of Dang district

(Navsari Centre)

S.L. Pawar, J.M. Patel

Background

Dang district of Gujarat having 311 villages and an area of 1764 km^2 is one of the most economically distressed district in India. It falls under Agroclimatic Zone-I of Gujarat that covers south Gujarat heavy rainfall zone. About 75% of the population is living below poverty line and 98% population is scheduled tribe. The district has undulating topography. The soils are shallow in depth with poor fertility and highly prone to erosion. Agriculture is mostly rainfed and farmers predominantly grow maize, rice, ragi, greengram, blackgram, etc. In this district, farmers were not adopting drip/sprinkler irrigation technology due to poor economic condition and lack of knowledge. Four villages in the district *viz.*, Mahalpada, Bijurpura, Jamlapada and Galkund were selected for popularizing drip irrigation.

Technology Development and Testing

Surface drip irrigation system was demonstrated for mango plantation and bittergourd crop in the field of Shri Tulshirambhai Rajibhai Deshmukh of Mahalpada village. The land holding of the farmer is 4.0 ha, out of which 3.0 ha is irrigated and 1.0 ha is rainfed. The drip system was installed for 100 mango grafts grown in 0.25 hectare. The grafts were planted with spacing of 5 m × 5 m. Survival rate of grafts was 90-95%. Bittergourd was grown in 0.4 ha area.

Benefits of Technology

In the bittergourd crop, a net income of ₹12,000 to 22,000 was obtained from 0.4 ha land within 6 to 8 months. There was water saving of 30-40%. Additional area of 0.4 ha was brought under irrigation besides savings on labour and cost of cultivation.

Impact of Technology and Feedback

Demonstration of drip irrigation in mango and bittergourd were visited by large number of farmers from adjoining areas. They are convinced by seeing the benefits of drip irrigation in a vine crop like bittergourd. Shri Deshmukh mentioned that applying drip irrigation to bittergourd crop not only increased yield, but also quality of the produce and the crop was ready for harvest atleast one week earlier than the traditional (surface) method of irrigation. Many farmers came forward and showed interest in adopting drip irrigation system for different crops.

Konkan *Vijay Bandhara*: A temporary check dam structure

(Dapoli Centre)

D. Mahale, H.N. Bhange, P.M. Ingle, R.T. Thokal, B.L. Ayare, M.S. Jadhav, T.N. Thorat, P.G. Ahire

Background

Water scarcity during post-monsoon season, undulated and hilly topography, and percolative nature of soil were major issues that led to development of a technology that would aid in water conservation, extend water storage for longer periods, recharge groundwater, and facilitate irrigation to increase cropping intensity. With these objectives, a temporary check dam technology named Konkan *Vijay Bandhara* was developed by AICRP-IWM Dapoli centre.

Technology Development and Testing

Maximum height of *Bandhara* was restricted up to 1.0 m with a side slope of 1:1 at the downstream side. *Bandhara* was constructed after the monsoon receded, particularly in the month of October by farmers and villagers. Construction of *Bandhara* involved arranging stones and pebbles in stacks, spreading of 250 micron plastic film over the stack of stones, and anchoring the plastic film at the bottom and sides in such a way that the unit acts as a check dam. The plastic film is spread and well anchored at the upstream so as to minimze leakage through the walls. Waste weir is kept at the centre of the check dam to sufficiently pass the overflow to the downstream. Once the water in stream disappears in summer, the plastic film is removed carefully to reuse it next year. The technology was rigorously tested in field and evaluated for strength, effectiveness in water conservation, use of stored water for agriculture, and people’s interest for participation. Trainings were imparted to villagers and farmers under water campaign and people from north to south Konkan were encouraged to construct Konkan *Vijay Bandhara* after withdrawal of monsoon every year. Total 280 *Bandhara* were constructed throughout the region; 40 in Dapoli, 100 in University research farms, and 140 in Sindhudurg and Ratnagiri districts.

Benefits of Technology

Average storage capacity of a bandhara is 1200 m^3. *Bandhara* technology also aids in recharge of wells at the downstream and enhances the period of water availability for farmers. Local people observed rise in water table in the nearby wells, which was used for drinking purpose and animals after the rainy season.

Impact of Technology

Konkan *Vijay Bandhara* facilitates irrigation to crops during *rabi* and summer seasons. Farmers are growing crops like watermelon, clusterbean, brinjal, chilli, tomato, mango, sapota, cashew. Floriculture has been boosted particularly in Jawhar and Mokhada talukas of Palghar district. Water shortage for drinking and domestic purposes was reduced during summer. Many tribal farmers are coming forward for group farming and enhancing their socio-economic conditions by creating employment in agriculture. Migration of tribal farmers to mega cities has reduced significantly.

Feedback

Two *Bandhara* were constructed on the stream near the fields of 15 tribal farmers of Tide village in Mandangad taluka, Ratnagiri district for watermelon cultivation. This helped in producing over 500 tonnes of watermelon through group farming. Many tribal farmers from Mokhada, Jawhar and Vikramgad talukas of Palghar district are growing crops for two consecutive seasons and fetching higher profits. The farmers are of the view that construction of *Bandhara* should be included under MGNREGA to increase its reach.

Konkan *Jalkund*: A micro rainwater harvesting structure

(Dapoli Centre)

R.T. Thokal, T.N. Thorat, B.L. Ayare, D.J. Dabke, K.P. Vaidya, M.S. Jadhav, P.M. Ingle, P.G. Ahire

Background

Hilly region of Konkan is a high rainfall zone (2500-3500 mm) but faces water scarcity during summer season. Soils in the region are coarse, shallow, derived mostly from lateritic rock, and poor water retention capacity. Mango and cashew grafts are usually planted on hill slopes and watering to those grafts for initial three years period is essential for their survival. There is a need to harvest rainwater, check evaporation losses and irrigate as much area as possible in the isolated hilly areas. Keeping above points in mind, a micro level lined pond named Konkan *Jalkund* was developed by the AICRP on IWM Dapoli centre.

Technology Development and Testing

Konkan *Jalkund* comprises of two major components *viz.*, rainwater harvesting in lined storage pits and efficient utilization of the water to irrigate newly planted mango/cashew grafts by sub surface irrigation system. For hill slopes and tops with shallow soil depth and rocky terrain, a rainwater storage pit of 4 m (L) × 1 m (W) × 1 m (D) was excavated for a block of newly planted 10 mango or 20 cashew grafts. If soil depth is more, pits of 2 m × 1 m × 2 m were excavated. Components of *Jalkund* were rice straw bundle (5 to 10 cm thick pre-lining cushioning bed) and HDPE lining film (500 micron). One Jalkund can hold 4000 litres of clean rainwater. Stored water in one *Jalkund* is sufficient to irrigate 10 mango or 20 cashew grafts during post-monsoon season of 30 weeks period (15th November to 15th June) @ 10 litres per

mango graft or 5 litres per cashew graft per week. For efficient utilization of rainwater stored in *Jalkund*, sub surface irrigation system was used. For this, four hollow bamboo/PVC applicators of 15 cm diameter and 35 cm length were buried in upright position around each planted mango graft. The applicators were placed over manure (FYM) beds beneath the soil. After installing, the applicators were filled with soil. During the post-monsoon period (15th November to 15th June), every week 10 litres of water from *Jalkund* should be poured manually in equal proportion into all the four bamboo/PVC applicators around every mango graft. Thus water reached directly to the active root zone of plant and evaporation loss is checked. Also, manure beneath the applicators retained water in the root zone for longer period and nutrients were available to the plant (graft) in soluble form. Cost of construction of 10 *Jalkund* for mango plantation was ₹ 55,000 for one hectare land.

Benefits of Technology

Physical indicators showed that average area under horticulture and irrigation in tribal area increased from 0.11 to 0.42 and 0.07 to 0.42 ha per respondent, respectively. After the intervention, average survival rate of mango and cashew grafts ranged from 72.5-88.1% and 88.1-91.4%, respectively. Retention period of stored water in *Jalkund* was 116-141 days, indicating that the irrigation facility would last till April end. Land utilization increased two folds and water storage capacity utilization ranged from 77.1-89.1%. Partial budget analysis of economic evaluation during year 2019-20 indicated that additional return of ₹ 49,000 can be fetched from mango and cashew plantations with *Jalkund* technology. Additionally, a return of ₹ 1,78,000 can be fetched through irrigation to an intercrop of jasmine in the mango and cashew plantations.

Impact of Technology

Many farmers in the remote areas mostly from Ratnagiri and Sindhudurg districts are benefitting from the technology. Government of Maharashtra has passed a resolution for allocation of grant of ₹40 crores for construction of *Jalkund.* State government decided to allocate ₹2 crore 60 lakh during the year 2010 and ₹ 2 crore 82 lakh as subsidy for two districts. Since 2013-14, major dissemination of *Jalkund* technology is being taken up under joint venture of Tribal Sub Plan program of AICRP on IWM scheme and MITTRA-BAIF, Jawhar. In the past nine years, total 1305 *Jalkund* has been constructed benefitting 704 tribal farmers from 85 villages of Mahad taluka of Raigad district, and Jawhar, Vikramgad and Mokhada talukas of Palghar district. Total 130.5 ha area has come under irrigated mango and cashew plantations in isolated hilly areas of Konkan. Once the mango and cashew grafts survive after three years of irrigation, farmers irrigate jasmine as an intercrop. More than 30 co-operative jasmine selling societies have been formed by tribal farmers in Vikramgad and Jawhar talukas. They are selling their flowers and other produces to markets of Mumbai and Nashik.

Feedback

Mango and cashew are predominanatly cultivated by the Konkan tribal farmers. The farmers have opined that survival rates of mango and cashew grafts have greatly enhanced with the help of *Jalkund* technology. They accepted for creating this decentralized water resource in the isolated and water scarce hilly region of Konkan. Farmers have suggested scientists to increase the capacity of *Jalkund* so that period of irrigation can be extended. Farmers have become fond of this low-cost technology because it reduces drudgery of irrigation in both the hill slopes and tops.

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भारतीय जल प्रबंधन संस्थान

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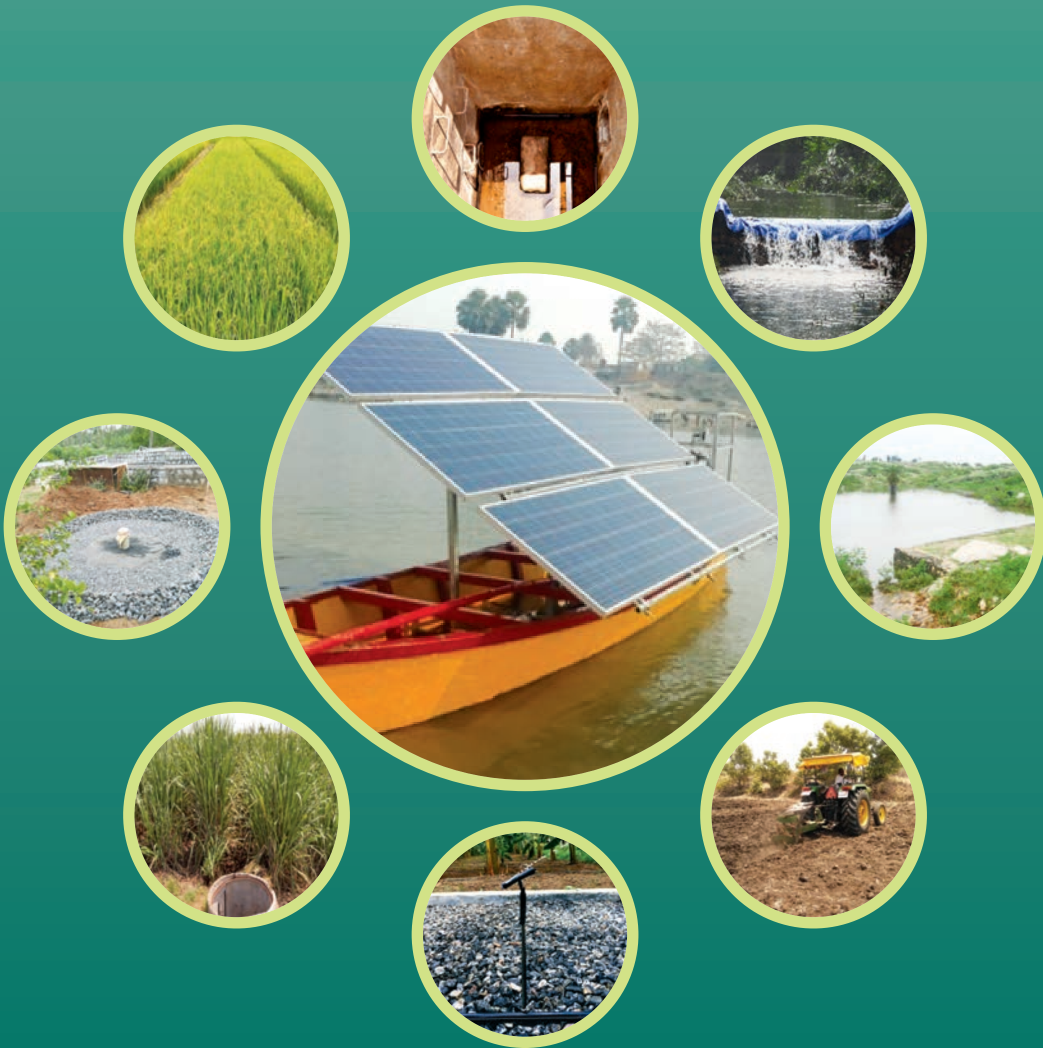

भाकृअनुप - भारतीय जल प्रबंधन संस्थान

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