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More Crop Per Drop – A new Venture for Production Management in Agriculture

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ABSTRACT

Globally only 1.5% of the World's water resources is usable. Indian Agriculture withdraws nearly 80 % of its water resources being an agrarian economy. As the Indian economy and its population grows there will be more need for water for industrial and domestic use which will put a great strain on resources needed in agriculture. The Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)' launched in 2015, introduced various schemes regarding irrigation, micro-irrigation, command area development and watershed development under the ambit of a single umbrella with a universal motto — 'More Crop per Drop' that can be described as immensely important for sustainable and drought-proof agriculture. Under these schemes priority will be given on improved performance of irrigated and rainfed production, smarter water saving agricultural practices, better and productive water management techniques and towards hydroponic agriculture. In 2018-19, under micro-irrigation scheme, an area of 5.75 lakh ha and 5.83 lakh ha has already been covered in drip and sprinkler irrigation systems, respectively. It is high time for farmers shifted to less water-intensive agriculture including millets, pulses, oil seeds, high value vegetables, fruits, ornamentals and medicinal plants to increase gross returns and thus help in improving farmer's income. A number of medicinal plants such as Mullein, Borage, Echinacea, Sage, Rosemary, Lavender, Calendula, Thyme, Dandelion, Perwinkle, Senna, Glory lily, Rauvolfia etc. can be chosen for drought prone areas. The implementation of PMKSY will also provide various other social, economic and environmental co-benefits namely reducing poverty, increasing agricultural productivity, judicious use of water, economic growth and sustainable production.

Keywords: *Micro-irrigation, hydroponic, PMKSY*

INTRODUCTION

Globally only 1.5% of the World's water resources is usable. Indian Agriculture withdraws nearly 80 % of its water resources being an agrarian economy. As the Indian economy and its population grows there will be more need for water for industrial and domestic use which will put a great strain on resources needed in agriculture. To feed an additional 2 billion people by 2030, water needs to be used more efficiently.

Rainfed agriculture accounts for 60 percent of food production in developing countries on 80 percent of arable land. Only 20 percent of the arable land in developing countries is irrigated, but it produces

around 40 percent of all crops and close to 60 percent of cereal production.

The contribution of irrigation to world crop production is expected to increase in coming decades: the irrigated area in developing countries is expected to increase by 40 million hectares (20 percent) by 2030. Irrigation expansion will be largest in land-scarce areas where irrigation is already very important: mainly in South and East Asia, and in the Near East and North Africa.

'More Crop Per Drop' promotes efficient water conveyance and precision water application devices like drips, sprinklers, pivots, rain-guns in the farm. It also focuses on construction of micro-irrigation and storage systems.

WATER SOURCES

Earth's water resources, including rivers, lakes, oceans, and underground aquifers, are under stress in many regions (Table 1). Humans need water for drinking, sanitation, agriculture, and industry; and contaminated water can spread illnesses and disease vectors and therefore clean water is both an environmental and a public health issue. Rivers, lakes, and underground aquifers supply fresh water for irrigation, drinking, and sanitation, while the oceans provide habitat for a large share of the planet's food supply.

Table 1. Water sources

Sl. No.	Water type	Volume ($1000km^3$)	Percentage of total global volume
1.	Ocean	1370323	94200
2.	Groundwater (Fresh and saline)	60000	4100
3.	Glaciers	24000	1650
4.	Lakes & reservoirs	280	0.019
5.	Soil moisture	85	0.006
6.	Atmospheric water	14	0.001
7.	River water	1.2	0.001
	Total	1454703.20	100.000

ADOPTION OF METHODS OF IRRIGATION

In 2018-19, under micro-irrigation scheme, an area of 5.75 lakh ha and 5.83 lakh ha has already been covered in drip and sprinkler irrigation systems, respectively. An Impact analysis of micro-irrigation scheme by Department of Agriculture Cooperation & Farmers Welfare indicates the following major findings:

- Irrigation cost is reduced by 20% to 50% with average of 32.3%.
- Electricity consumption is reduced by about 31%.
- Saving of fertilizers in the range of 7% to 42%.
- Average productivity of fruits and vegetables increased by about 42.3% and 52.8%.
- Overall income enhancement of farmers in the range of 20% to 68% with an average of 48.5%.

Water use efficiency of micro-irrigation including drip irrigation is as high as 80 to 95% in comparison to only 30-50% in conventional flood irrigation resulting in considerable amount of saving irrigation water under drip irrigation as also evident from the research studies conducted by centres of All India Coordinated Research Project on Irrigation Water Management in different agro-ecological regions of India.

WATER USE EFFICIENCIES IN AGRICULTURE SECTOR (LITRES/100 $ OUT PUT)

Rice: 470,000
Cotton: 160,000
Dairy milk: 147,000
Sugar: 123, 900
Vegetables & Fruits: 37,900
Wheat & grain: 24,500
Hydroponic crops: 600

PRADHAN MANTRI KRISHI SINCHAI YOJANA

The Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)' launched in 2015, introduced various schemes regarding irrigation, micro-irrigation, command area development and watershed development under the ambit of a single umbrella with a universal motto — 'More Crop per Drop' that can be described as immensely important for sustainable and drought-proof agriculture. Under these schemes priority will be given on improved performance of irrigated and rainfed production, smarter water saving agricultural practices, better and productive water management techniques and towards hydroponic agriculture.

The priority vision of Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) is to ensure access to some means of protective irrigation to all agricultural farms in the country, to produce 'per drop more crop' and thus bringing much desired rural prosperity.

OBJECTIVES

- To achieve convergence of investments in irrigation at the field level.
- To enhance the physical access of water on the farm and expand cultivable area under assured irrigation (Har Khet Ko Pani).
- Integration of water source, distribution and its efficient use, to make best use of water through appropriate technologies and practices.
- To improve on - farm water use efficiency to reduce wastage and increase availability both in duration and extent.
- To enhance the adoption of precision - irrigation and other water saving technologies (More crop per drop).
- To enhance recharge of aquifers and introduce sustainable water conservation practices.
- To ensure the integrated development of rainfed areas using the watershed approach towards soil and water conservation, regeneration of ground water, arresting runoff, providing livelihood options and other NRM activities.
- To promote extension activities relating to water harvesting, water management and crop alignment for farmers and grass root level field functionaries.
- To explore the feasibility of reusing treated municipal waste water for peri - urban agriculture.
- To attract greater private investments in irrigation.

PROGRAM IMPLEMENTATION

- Krishi Sinchayee Yojana with an outlay of Rs.50,000 crores for a period of 5 years (2015-16 to 2019-20) is to achieve convergence of investments in irrigation at the field level.
- PMKSY has been formulated amalgamating ongoing schemes viz. Accelerated Irrigation Benefit Programme (AIBP) of Ministry of Water Resources, River Development & Ganga Rejuvenation; Integrated Watershed Management Programme (IWMP) of Department of Land Resources; and On Farm Water Management (OFWM) component of National Mission on Sustainable Agriculture (NMSA) of Department of Agriculture and Cooperation.
- PMKSY has to be implemented in an area development approach, adopting decentralized state level planning and projectised execution, allowing the

states to draw their irrigation development plans based on district/blocks plans with a horizon of 5 to 7 years. States can take up projects based on the District/State Irrigation Plan.

- All the States and Union Territories including North Eastern States are covered under this programme.
- The National Steering Committee (NSC) of PMKSY under the Chairmanship of Hon'ble Prime Minister, will provide policy direction to programme framework and a National Executive Committee (NEC) under the chairmanship of Vice Chairman of NITI Aayog will oversee the programme implementation at national level.
- Provision has been made under PMKSY during 2015-16 for carrying out extension activities in the field with special focus on water harvesting, water management and crop alignment for farmers and grass root level field functionaries.

PROGRAM COMPONENTS

PMKSY has the following programme components:

A. Accelerated Irrigation Benefit Programme (AIBP)

To highlight on faster completion of ongoing Major and Medium Irrigation including National Projects.

B. PMKSY (Har Khet Ko Pani)

Creation of new water sources such as surface and ground water through Minor Irrigation.

Maintenance, restoration and renovation of water bodies; strengthening carrying capacity of traditional water sources and construction rain water harvesting structures (Jal Sanchay);

Command area development, strengthening and creation of distribution network from source to the farm.

Development of Ground water in the sinking areas to store runoff/ flood water during peak rainy season.

Improvement in water management and distribution system for water bodies to take advantage of the available source which is not tapped to its fullest capacity. At least 10% of the command area to be covered under micro/precision irrigation.

Diversion of water from source of plenty areas to nearby water scarce areas, lift irrigation from water bodies/rivers at lower elevation to supplement requirements beyond IWMP and MGNREGS irrespective of irrigation command.

Creation and rejuvenation of traditional water storage systems like Jal Mandir (Gujarat); Khatri, Kuhl (H.P.); Zabo (Nagaland); Eri, Ooranis (T.N.); Dongs (Assam); Katas, Bandhas (Odisha and M.P.) etc. at suitable locations.

C. PMKSY (Per Drop More Crop)

- Programme management, preparation of State/District Irrigation Plan, approval of annual action plan, Monitoring etc.
- Promotion of efficient water conveyance and precision water application devices like drips, sprinklers, pivots, rain - guns in the farm (Jal Sinchan).
- Topping up of input cost particularly under civil construction beyond permissible limit (40%), under MGNREGS for activities like lining inlet, outlet, silt traps, distribution system etc.
- Construction of microirrigation structures to supplement source creation activities including tube wells and dug wells which are not supported under AIBP, PMKSY (Har Khet Ko Pani),

PMKSY (Watershed) and MGNREGS a s per block/district irrigation plan.

- Secondary storage structures at tail end of canal system to store water in rainy season or from perennial sources like streams for use during dry periods through effective on - farm water management.
- Water lifting devices like diesel/ electric/ solar pumpsets including water carriage pipes, underground piping system.
- Extension activities for promotion of scientific moisture conservation and agronomic measures including cropping alignment to maximise use of available water including rainfall and minimise irrigation requirement.
- Capacity building, training and awareness campaign including low cost publications, use of pico projectors and low cost films for encouraging potential use water source through technological, agronomic and management practices including community irrigation.
- The extension workers will be empowered to disseminate relevant technologies under PMKSY only after requisite training is provided to them especially in the area of promotion of scientific moisture conservation and agronomic measures, improved/ innovative distribution system like pipe and box outlet system, etc.
- Information Communication Technology (ICT) interventions through NeGP - A has to be made useful in the field of water use efficiency, precision irrigation technologies, on farm water management, crop alignment etc. and also to do intensive monitoring of the Scheme.

D. PMKSY (Watershed Development)

- Effective management of runoff water and improved soil & moisture conservation activities such as ridge area treatment, drainage line 5 treatment, rain water harvesting, *in - situ* moisture conservation and other allied activities on watershed basis. Converging with MGNREGS for creation of water source to full potential in identified backward rainfed blocks including renovation of traditional water bodies

HYDROPONICS

Hydroponics is generally defined as growing of plants without using soil by feeding them on solutions of water and mineral salts instead of relying upon traditional method of cultivating the earth. The term hydroponics is derived from the Greek words *hudro*-water and *ponos*-work means water working. Advantages of hydroponics over the traditional method of crop raising include better quality produce, quick growth, no soil or seedbed preparation, clean culture, consistent results and crop production even if the soil is sick or unfit due to salinity, poor structure and drainage problem. Hydroponic systems use 70-90% less water compared with many forms of conventional crop production. There should be no nutrient run off and hence reduced concerns about contamination of ground water, rivers, streams etc. The most widely used type of hydroponic system where a timer controls a nutrient solution to drip on to the base of each plant from a small drip line. Some include a recovery system where the excess nutrient solution that runs off is collected back to a reservoir for reuse. Hydroponics is very popular in the Netherlands, Spain, Canada, Japan, UK, USA, Italy, New Zealand and Australia. Tomato, cucumber, lettuce and bell pepper etc. respond very well to the hydroponic culture. The worldwide area of hydroponics production has increased four to five times in the last ten years or so.

More Crop Per Drop And Agricultural Land Productivity

The PMKSY is an important step towards improving agricultural water productivity. Under this scheme, about 20 lakh hectares of land has been brought under micro irrigation till 2017-18. Under the aegis of NABARD and PMKSY, a Micro Irrigation Fund (MIF) worth Rs 5,000 crore was set up in May 2018.

It is high time for farmers shifted to less water-intensive agriculture including millets, pulses, oil seeds, high value vegetables, fruits, ornamentals and medicinal plants to increase gross returns and thus help in improving farmer's income. A number of medicinal plants such as Mullein, Borage, Echinacea, Sage, Rosemary, Lavender, Calendula, Thyme, Dandelion, Perwinkle, Senna, Glory lily, Rauvolfia etc. can be chosen for drought prone areas.

Implementation of the PMKSY, will not only help in achieving India's climate agenda for 2030 but will also provide various other social, economic and environmental co-benefits namely SDG1 (reducing poverty), SDG2 (increasing agricultural productivity), SDG 6 (judicious use of water), SDG8 (economic growth) and SDG12 (sustainable production).

"But injudicious implementation can lead to various adversities such as more energy use, income disparities among farmers because farmers with electricity access can use significantly more energy per hectare compared to owners of diesel pumps or owners. So, there are possibilities of having negative effects on SDG 7 (energy use) and SDG 10 (income inequalities) as well. Rabi crop is taken only on 38.9% of net sown area due to lack of water and lack of access to water. Changing precipitation patter due to climate change is an immense challenge.

HURDLES IN IMPLEMENTATION

Evidences suggest that the cost per acre with micro-irrigation comes to around Rs 60,000 for vegetables and Rs 35,000 for fruits. Even with the handsome subsidy, this is way above the reach of really small and marginal land holding farmers, who actually need a helping hand to get rid of the poverty. Manufacturers and functionaries from the government set up claim that even though the initial cost of installation of drip irrigation system seems to be high, considering the benefits arising out of installation, such as yield increase, water savings, fertilizer savings, energy savings, increase in water productivity, use of undulating terrain, use of bad quality soils and water, maintenance of soil health etc, the economics of using drip irrigation systems works very well in the long-run. This is a onetime investment that fetches returns faster as against other annual inputs such as seeds and fertilizers.

In order to bring drip irrigation systems within the reach of common man, to take it to large number of farmers, R & D Wings have introduced thin walled tubing which are low cost and can last for 2-3 seasons. This thin walled tubing can be useful crops like cotton, sugarcane and vegetables. This brings down the costs substantially to the tune of about 30-50%. Introduction of low pressure drippers has reduced the recurring power expenses of the farmers. Further, the drip irrigation system has been very successful for perennial horticultural crops but the staple crops such as rice and wheat grown across the country total for highest water usage. Jain drip irrigation is technically feasible for all the crops, including wheat and rice.

The collaborative research between Jain, the International Rice Research Institute (IRRI) and International Maize and Wheat Improvement Center (CIMMYT) has already proved the substantial increase in water productivity under drip irrigationt and experimental set ups across the country have shown that these systems are technically feasible and economically viable for wheat and rice. The drip irrigation system works fantastically well when there is assured source of both water and power. Drip irrigation works well even if you have 30-35 % of the water required for flow irrigation. In hilly areas, the only scientific way of irrigation is through drip irrigation using a pressurized irrigation system and therefore water can easily reach uniformly and equitably to all the highest and lowest points in the field. Micro-irrigation, whether it is drip or sprinkler system, requires uninterrupted power supply to maintain pressure and level. Hence the government first needs to look at the power supply in remote / rural areas. Although power situation has improved much more in over last decades, but rural areas continue to be improved in partial way compared to city centres.

WAY FORWARD

Four years after implementation of PMKSY Andhra Pradesh, Karnataka, Gujarat, Maharashtra and Tamil Nadu have contributed more than 75% of additional coverage in 2017-18 area. The list of under-performing states are Punjab, Jharkhand, Bihar, Chhattisgarh and Goa. Then there are states where micro irrigation is yet to pick up – the entire eastern, north-eastern spectrum of states namely Arunachal Pradesh, Manipur, Meghalaya and Nagaland except Assam. Clearly, both states and the Centre need to gear up and coordinate well for the benefit of the farmers.

As per NITI Ayog report only 15% of the farmers in India are large and medium scale farmers but they account for control over 55% of the total available land. Experts feel that increasing the cap to 10 ha from the current ceiling of 5ha would be extremely beneficial to the sector. “Only 10% of the total potential area (estimated to be 69 million ha in India) has been brought under MI as on date. Hence, area ceiling cap of 5 ha may be increased to 10 ha.

Despite all its current shortcomings, this de-centralised micro-irrigation is the way forward to drought proofing of agriculture. But it needs to spread evenly across all climatic zones of the country.