WEEKLY FOCUS
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VISIONIAS
INSPIRING INNOVATION

Agricultural Inputs
Part 1

Introduction

The strategies for development of the agriculture sector in India have focused primarily on raising agricultural output and improving food security. Among the strong measures needed to harness all possible sources for agricultural growth, resource use efficiency and minimization of cost of cultivation/production is critical. This is particularly important from the perspective of enhancing net returns from farming activity.

The cost of cultivation has been on the rise, eroding the profits. Lowering the costs without compromising on the output can increase the net income. It is possible to do so as there is a general tendency on the part of farmers to overuse inputs in expectation of higher yields. Therefore, innovating input managerial solutions to maximize farmers' welfare rather than relying solely on modern farming to raise productivity and production should be a preferred option.

This backdrop calls for a thorough understanding of what are agricultural inputs and what is their significance? What are the respective challenges associated with judicious and effective application of each input and what are the future possibilities in utilising these resources to the most optimal level possible for the betterment of the sector as well as the stakeholders.

What are agricultural inputs and how have we approached them?

Agricultural inputs means all substances or materials used in the production, maximization and maintenance of crops. They can be anything from the basic soil to high-quality seeds to high-tech tractors.

We have divided agricultural inputs into elemental, essentially consumable and capital inputs. In accordance with this division, this document will be released in three parts.

Part I	Part II	Part III
Soil and Water: Elemental Agricultural Inputs	**Seeds and Pesticides: Essential Consumable Inputs**	**Agricultural Mechanisation and Credit: Growth driving capital inputs**
		

Soil and Water: Elemental Agricultural Inputs

In this part, we will attempt to analyse various facets of soil and water with regard to their agricultural cycles, economies, and associated environmental implications.

SOIL

Overview: Soil health deterioration has been witnessed in the post-green revolution period which poses a serious threat to agricultural production and farm profit. However, soil ailments are often reversible, and the soils suffering from soil fertility depletion and/or other kinds of degradation can be restored with the adoption of scientifically- proven diagnosis and management protocols, adequate investment and policy support.

Significance of soil

Soils supply the essential nutrients, water, oxygen and root support that food-producing plants need to grow and flourish. Healthy soil is therefore the key for sustainable agriculture and food security.

Challenges/Issues

- **Decline in soil organic matter (SOM)** under intensive cropping which negatively affects the soil function, biological activity and reduces soil's hydraulic properties.
- **Poor soil fertility** due to nutrient deficiency.
- **Decline in Soil Physical Conditions** such as soil structure, stability, water holding capacity, aeration, etc. causes a decline in availability of nutrients and soil microbial activities, and decreases crop productivity.
- **Acidification, Salinization, Alkalization and Waterlogging**
  - **Soil acidity causes deficiencies of Calcium and Magnesium and promotes high solubility of aluminium, Iron and Manganese** causing toxicity and impairing the normal growth and development of plants.
  - **Salinity affects crop production by interfering with nitrogen uptake**, reducing growth and stopping plant reproduction.
  - **Alkali soils contain low amounts of available Zinc** due to high pH, calcium carbonate and low SOM content and reduces the nutrients available to plants.
  - **Waterlogging causes the air within the soil to move out into the atmosphere,** replacing it with more water. The inadequate supply of oxygen **retards or ceases the growth of a plant** as the accumulating carbon dioxide hampers the growth of the plant's roots.

- **Induction of Poor Lands into Agriculture** as expansion of cities and towns and other developmental/ infrastructural activities often take place in prime agricultural lands around cities/townships.
- **Weaknesses of Soil Testing Service:** Voluntary demand for soil testing is low due to lack of trust in the services offered by Soil Testing Labs (STLs), and also on account of not realizing the importance of soil test based nutrient-management.
- **Ad hoc fertilizer prescriptions** over broad areas (e.g. districts, state or agro-ecological zones) do not address differences in indigenous soil fertility, crop management practices, yield responses to added nutrients, or differences in attainable yield potential across sites or years.
  - Several states still prescribe fertilizer schedules comprising NP or NPK only, whereas widespread deficiencies of secondary and micronutrients, especially those of sulphur, zinc and boron exist in the soils.

Measures taken so far

Soil Health Card Scheme

- Launched by government of India in 2015 **for effective soil health monitoring and management** through steps such as distribution of micronutrients and soil ameliorants and setting up micro soil testing labs (STLs).
  - Soil health card contains information on soil type, nutrients, water and its properties.

Rashtriya Krishi Vikas Yojana (RKVY)

- **To protect the loss of topsoil, improving soil fertility,** enhancing crop production, land and water productivity of watershed areas comprising of wastelands, river valleys and the ecosystem as a whole.

NABARD Loan- Soil & Water Conservation Scheme under Rural Infrastructure Development Fund (RIDF)

- It envisages **to promote sustainable development** through conservation and management of soil and water.

Other initiatives

- Supply of Plant protection chemicals, Bio-fertilizers and Micronutrients at subsidised rates under **National Food Security Mission.**
- Promotion of Integrated Nutrient Management, Adoption of organic farming under **National Horticulture Mission.**
- Setting up of state-of-the-art liquid/carrier based Biofertilizer /Biopesticide units under **National Mission for Sustainable Agriculture.**
- Reclamation of Problem Soil under **Rashtriya Krishi Vikas Yojana.**

Soil Health Card Scheme

Performance

- Deeper Knowledge of soil leads to better crop yield
- **648** Krishi Vigyan Kendars &1000 other mini-labs help in testing
- **5.6 crore** Soil Health Cards already distributed

Challenges

- Lack of farmer awareness
- Loopholes in soil sampling
- Delay and non-uniformity in report generation
- Lack of specified guidelines leading to improper data compilation
- Lack of an organized regulatory and monitoring body

Possibilities moving forward

- **Revamping soil testing services** by establishment of modern high output STLs, creation of a dedicated service cadre for soil health monitoring, deployment of trained human resource and using ICTs for effective monitoring.
- **Strengthening Soil Health Card (SHC)** by revisiting its soil-test parameters and expanding them to include water testing and integration of best management practices and Impact assessment mechanism with SHC.
- **Promoting balanced and integrated use of fertilizers** by revising general fertilizer recommendations under NBS (nutrient based subsidy), exploring newer fertilizer recommendation approaches such as Site-specific nutrient management, revisiting customized fertilizer policy and incentivizing crop residue recycling.
- **Enhancing nutrient use efficiency through precision nutrient management (PNM):** It involves assessment of soil fertility variation and suggesting nutrient prescriptions following the principle of 4R (right rate, right source, right time and right method).
- **Enhance awareness of farmers** regarding the threats of extractive farming practices, and simultaneously the long-term benefits of investing in soil health improvement.
- **Promotion of community level mechanised composting** as a small-scale farm industry would enhance availability of quality compost to partially curtail fertilizer input and restore soil health.
- **Promoting conservation agriculture:** It is a production system involving minimum soil disturbance, soil cover through crop residues or other cover crops and crop rotations for achieving high productivity with most efficient resource use.

Talking Point

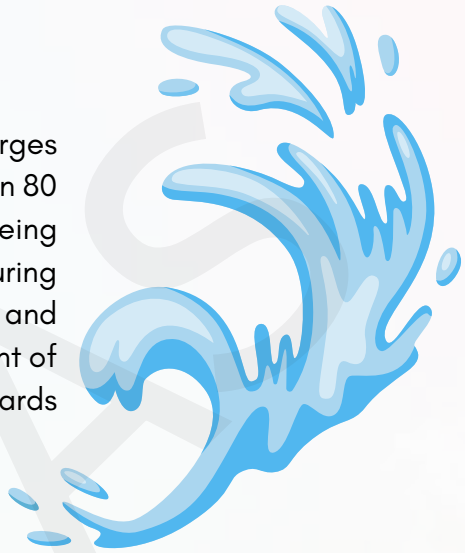
Why farmers resort to imbalanced use of fertilizers and what are its implications?

Non-judicious fertilizer use is the prime cause for widespread soil fertility depletion in India. Farmers resort to imbalanced fertilizer use mainly due to following reasons:

- **Overuse of Nitrogen:** During the onset of Green Revolution, Indian soils were generally deficient in Nitrogen(N), and the crops often produced optimum yields with supplemental N fertilizer alone. In several high productivity areas of irrigated ecosystems in Indo-Gangetic Plains (IGP), farmers use excessive fertilizer (N) to maintain the yield levels attained previously with relatively less fertilizer.
- **Loopholes in schemes:** With the fractured implementation of nutrient- based subsidy (NBS) scheme during 2010 (keeping urea out of ambit of NBS), the Phosphorus (P) and Potash (K) fertilizers became costlier rendering their decreased consumption. As a result, fertilizer consumption ratio (N:P:K) widened from 4:3.2:1 (2009-10) to 7.2:2.9:1 (2015-16).
- **Excessive mining of soil's native nutrients:** As a result of mining of nutrients from soil's native reserves, not only the number of deficient nutrients kept increasing but also the extent of nutrient deficiencies in soils became larger and larger. The problem is more acute in agriculturally advanced regions, wherein annual nutrient removal under intensive cropping often far exceeds replenishments.
- **Less focus on micronutrients:** Except Zinc (Zn), application of other secondary and micronutrients is also ignored by the farmers either due to unawareness about their deficiencies or due to their unavailability in the market.

Implications: Such indiscriminate use of Nitrogenous fertilizers and ignorance towards other micronutrients aggravates soil fertility depletion, and proves detrimental in terms of low nutrient use efficiency, poor quality of produce, enhanced susceptibility of crops to biotic and abiotic stresses, and a potential threat of groundwater pollution due to excessive leaching of nitrates beyond effective root zone.

WATER



Overview: Amongst various inputs deployed in raising of crops, water emerges as the most critical one. Of the total water available in the country, more than 80 per cent is being used in agriculture. With 52 per cent of its cultivated land being monsoon-dependent, the rainfed agriculture holds a key position in ensuring food & nutrition security of the country, besides increasing farm incomes and equitability. The nation faces substantive challenges in effective management of available water for which there is need for a paradigm shift in emphasis towards improving agriculture water management.

Significance

Conservative and efficient use of water is important to ensure sustainable agricultural development and food security and will help extend its availability to make ways for adoption of modern inputs, practices and technologies. This will increase farming intensity, productivity and farm income.

Challenges/Issues with water availability

- **General scarcity of water:** India accounts for only about 4 per cent of global water resources, but supports 18 per cent of the world's human population and 15 per cent of its livestock.
- **Substantial area under rainfed:** About 72 million hectares (Mha) of net sown area (52%) is still completely dependent on rainfall. Further, irrigated area except from reservoir as a source, is also dependent on rainfall. These areas are therefore **more vulnerable to weather aberrations** and are characterized by **low levels of productivity and low input usage.**
- **Regional imbalance:** Most of the water is available during monsoon period and that too, through few spells of intense rainfall, resulting in floods in major rivers. The Ganga-Brahmaputra river basin contributes to more than 50 per cent of total annual water availability, whereas, Southern and Western basins account for only about 15 per cent each.
- **Sub-optimal utilization of created facilities** due to inadequate maintenance of canal system, lack of participatory management, changing land use pattern, deviation from the designated cropping pattern, soil degradation and delay in command area development.
- **Poor irrigation efficiency:** Gross irrigated area in the country is about 96 Mha from nearly 650 BCM (billion cubic metre) of water (~38% efficiency) compared to water use in irrigation systems in developed countries, like USA where water use efficiency is ~60-70%
- **Quality of water used in cultivation is not good:** Poor quality of water can dissolve organic carbon in soil and make it unavailable.

Measures taken so far

Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)

- Launched in 2015, it focuses on creating sources for assured irrigation and creating protective irrigation by harnessing rain water at micro level through 'Jal Sanchay' and 'Jal Sinchan'. The components of the scheme are:-
- **Accelerated Irrigation Benefit Programme (AIBP)** to focus on faster completion of ongoing major and medium irrigation projects.
- **Har Khet ko Pani** for providing end-to end solutions in irrigation supply chain.
- **Per Drop More Crop** promoting Micro-irrigation comprising sprinkler and drip irrigation.

Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS)

- About 70 per cent of the resources of MGNREGS are used for soil and water conservation activities in rural areas and creating infrastructure like small irrigation structures.

Rashtriya Krishi Vikas Yojana (RKVY)

- Under this, many states have been accessing funds for water conservation and management activities.

Atal Bhujal Yojana

- It envisages people's participation through the formation of 'Water User Associations', water budgeting, preparation & implementation of Gram-panchayat-wise water security plans, etc.

Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)

Performance

- Around 300 irrigation/ multi-purpose projects were included for funding under AIBP and an irrigation potential of around 25 lakh hectare has been created through the completed projects.
- Benefited about 22 lakh farmers, including more than 2 lakh SC and ST farmers.
- So far an area of 138 lakh ha has been covered under Micro Irrigation (10% of total agricultural area).

Challenges

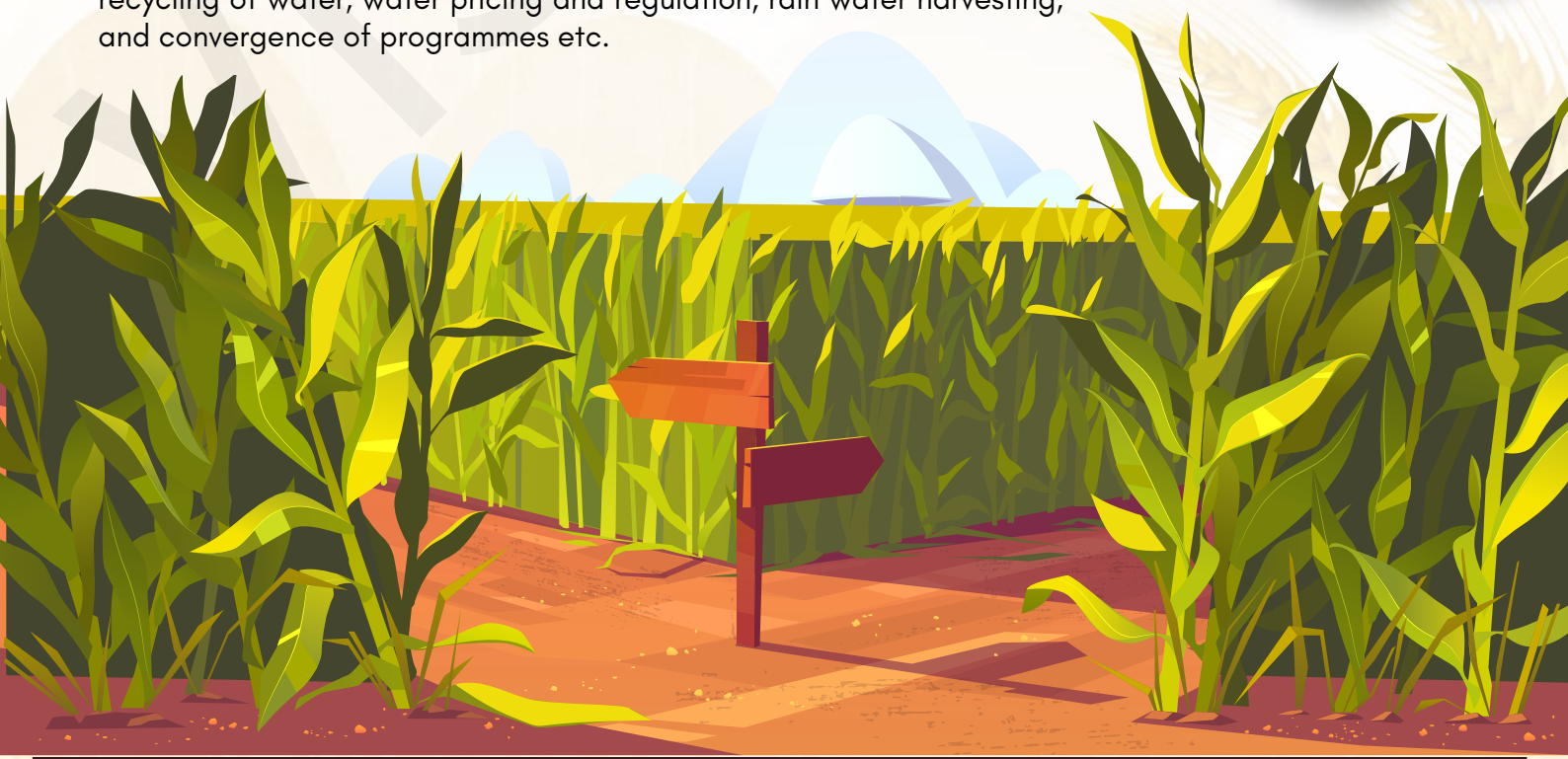
- Delay in project implementation
- Bureaucratic bottlenecks
- Higher investment to introduce costly sprinklers and drip irrigation
- Lack of specialists
- Deficiencies in financial management and monitoring

Possibilities moving forward

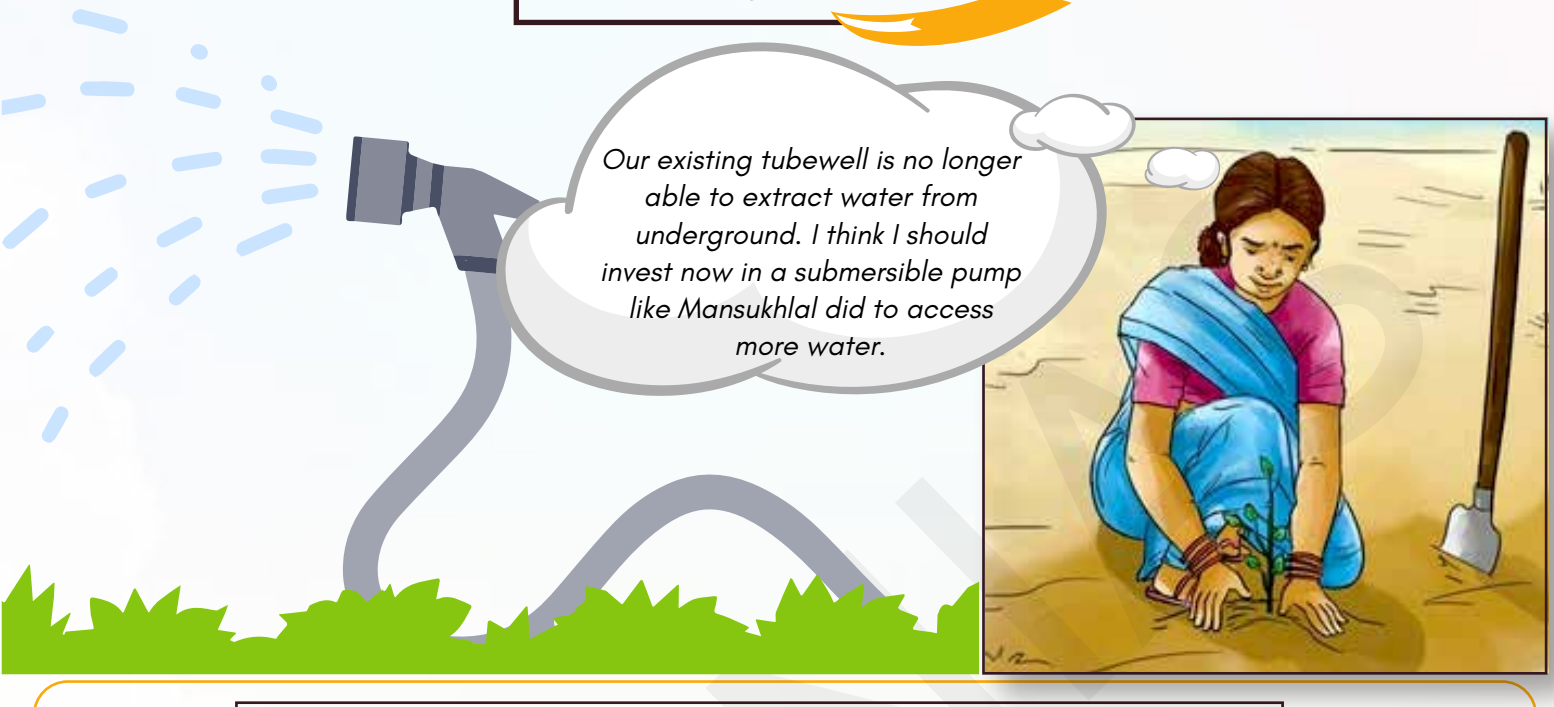
- **Addressing the problems of over-exploitation of ground water** by incorporating artificial recharge of groundwater and rainwater harvesting, conjunctive use of surface water, water conservation, regulation of groundwater development, etc.
- **Irrigation development in eastern and north eastern region:** In East and Northeast India, ground water resources are under-utilized to the tune of 55-99 percent, while also being blessed with high rainfall. Rice is a staple diet in major parts of India and food security at the country level may be ensured by enhancing its productivity and production in these regions.
- **Conservation Agriculture :** The water stored in the soil and root zone that is available for plant growth is called green water (GW). The green water use techniques also known as in-situ moisture conservation measures improve the soil physical properties, increase the infiltration and convert rainwater to available soil moisture for crops.
- **Organic farming:** Extensive promotion of organic farming and compost would help in higher moisture conservation. It has been observed that organic content in the soil improves water retention capacity by up to 80 percent.
- **Crop alignment and diversification with agro-climatic status :** Crop alignment in command areas by promoting low water duty crops such as pulses and oilseeds and in sync with local agro-climatic conditions.
- **Enhancing water use efficiency** by a blend of agronomic practices and deployment of technologies (e.g.,micro- irrigation). Micro- irrigation systems deliver water savings of up to 40 per cent over conventional flood irrigation methods.
- **Awareness campaign, skill development and capacity building** of farmers for most effective use of the precious water resources. Role of village level institutions becomes more significant towards this end.
- **Other measures** include improving on-farm water management, recycling of water, water pricing and regulation, rain water harvesting, and convergence of programmes etc.

Best Practice

Hivere Bazar in Maharashtra is a successful example of drought proofing through efficient demand and supply management involving village level institutions.



Talking Point



What leads to the inefficient use of water in Indian agriculture?

Water scarcity in India is exaggerated by inefficient use of water in agriculture creating a situation of water stress in India. Major reasons for this are:

- **Improper crop and cropping system:** Presently, high proportion of cultivated area under water guzzling crops like rice, sugarcane, cotton etc. is witnessed in areas that receive normal rainfall of less than 650 mm. This crop preference is largely due to easy access to ground water use which has its own negative implications.
- **Imbalanced use of ground water:** Subsidized or free power has encouraged farmers to overdraw water from deep aquifers, causing substantial depletion of water table and water quality deterioration in many cases.
- **Low uptake of Micro irrigation systems in India:** Micro irrigation promotes precision farming by making available water in a targeted manner, thereby achieving higher water use efficiency. But wide inter-state variations exist in utilization of funds under micro-irrigation. Some of the western, southern and central states take the lead but the rest of India, particularly in north and north-east seems to be complacent about the efficiency of micro-irrigation.

The situation of water stress and its gravity can be understood from the example of Latur in Maharashtra.

The rampant plundering of groundwater reserves for agricultural and industrial purposes, contamination of underground drinking water sources, the cultivation of water-intensive crops such as sugarcane in Marathwada region (the region with chronic shortage of potable water) over a long period of time led to the worst drought situation in the city of Latur. When its 12 lakh residents struggled to get drinking water, Maharashtra government had to run water trains to supply potable drinking water to the people.

The government had also considered banning sugarcane cultivation in certain districts of Marathwada. However, the sugar economy, developed over the course of several decades, continues to be the most remunerative option for farmers in the short-term.

CONCLUSION

Soil and water use efficiency is the first step in bringing long term positive transformation in farmers' income and the agricultural economy. Optimal use of these elemental inputs pave the way for successful application and required effectiveness of other inputs like seeds, pesticides and mechanisation. Therefore, various aspects related to soil health and efficient water use as discussed above are important in order to arrive at sound policies to strengthen these critical components for enhancing productivity and income.

TOPIC AT A GLANCE

AGRICULTURAL INPUTS

All substances or materials used in the production, maximization and maintenance of crops.

ELEMENTAL AGRICULTURAL INPUTS

Significance

Soils supply the essential nutrients, water, oxygen and root support that food-producing plants need to grow and flourish.

Challenges

- Decline in soil organic matter
- Poor soil fertility
- Decline in Soil Physical Conditions such as structure, stability etc.
- Acidification, Salinization, Alkalization and Waterlogging.
- Induction of Poor Lands into Agriculture
- Weaknesses of Soil Testing Service
- Ad hoc fertilizer prescriptions

Measures taken

- **Soil Health Card Scheme** for effective soil health monitoring and management.
- **Rashtriya Krishi Vikas Yojana (RKVY)** to protect the loss of topsoil, improving soil fertility.
- **NABARD Loan**- Soil & Water Conservation Scheme under Rural Infrastructure Development Fund (RIDF).
- **Other related initiatives** under National Food Security Mission, National Horticulture Mission, National Mission for Sustainable Agriculture etc.

Possibilities moving forward

- Revamping soil testing services
- Strengthening Soil Health Card
- Promoting balanced and integrated use of fertilizers
- Enhancing nutrient use efficiency through precision nutrient management (PNM)
- Enhance awareness of farmers
- Promotion of community level mechanised composting
- Promoting conservation agriculture

Significance

Conservative and efficient use of water is important to increase farming intensity, higher productivity and farm income and to ensure sustainable agricultural development and food security.

Challenges

- General scarcity of water and regional imbalance.
- Substantial area under rainfed cultivation
- Sub-optimal utilization of existing irrigation facilities
- Poor irrigation efficiency
- Poor quality of water used in cultivation.

Measures taken

- **Pradhan Mantri Krishi Sinchayee Yojana** to provide assured irrigation to cultivated areas, reduce wastage of water and improve water-use efficiency.
- **Mahatma Gandhi National Rural Employment Guarantee Scheme** for creating small irrigation infrastructure.
- **Rashtriya Krishi Vikas Yojana (RKVY)** under which funds are provided for water conservation and management activities.
- **Atal Bhujal Yojana** for sustainable management of groundwater with community participation.

Possibilities moving forward

- Addressing the problems of over-exploitation of ground water
- Irrigation development in eastern and north eastern region
- Conservation Agriculture
- Extensive promotion of organic farming and compost
- Crop alignment and diversification with agro-climatic status
- Enhancing Water Use Efficiency
- Awareness, Skill and Capacity building of farmers