# Increasing agricultural production through efficient utilization of water resources.

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## Introduction:

Water is an essential resource for economic development. Also, it is one of the vital necessities of mankind. So far, water was considered as a *free natural resource*, and its use has remained haphazard – both in the industrial sector as well as in the domestic sector. But, increasing water demands, declining rainfall, lack of water storage facilities to save excess water during floods, have all proved that water can no longer be considered as a free natural resource.

More than 200 million (20 crore) of India's poor live in rural areas without irrigation. About two-thirds of the country's cropland currently depends exclusively on rain for needed moisture[1]. At the same time it should be noted that India is having biggest rivers in the world – Ganga and Brahmaputra – delivering immense quantity of water to the Bay of Bengal. This demonstrates that we lack in necessary policies to utilize available water resource.

Knowing the importance of water, the Indian Government has adopted the *National Water Policy (NWP)* in September 1987[2]. The National Water Resources Council (NWRC), Chaired by the Prime Minister, is responsible for developing plans, determining water allocation priorities,

making policy decisions on drinking water, irrigation, water quality, water zoning, water conservation and flood management.

**Need for water reuse and increasing utilization efficiency:**

In India the average annual precipitation is around $4 \times 10^{15}$ litres, (4000 $km^3$), and the average flow in the river systems is estimated to be $1.869 \times 10^{15}$ litres (1869 $km^3$). Thus, there is around $2.131 \times 10^{15}$ litres (2131 $km^3$) of water should be available for our use. Instead, only $6.9 \times 10^{14}$ litres 690 $km^3$ is only utilizable due to the congregation of rain in the three monsoon systems, and $1.441 \times 10^{15}$ litres (1441 $km^3$) of water should be available for exploitation – which is enough to meet our demands. Since annual withdrawal of ground water is around $4.32 \times 10^{14}$ litres (432 $km^3$), considering the water requirement to maintain the water table, only $1.009 \times 10^{15}$ (1009 $km^3$) water is available in a sustainable manner. However, it should be noted that, this amount of water is not available uniformly – both in time and space. And, evaporation loss should also be taken into account. Thus, careful planning is vital for the proper utilization of water so that domestic, industrial, and agricultural needs.

In order to meet our water demands, the following steps may be adopted:

1) Encouraging *reuse* of water in domestic and industrial sectors;
2) Promoting *irrigation efficiency* in the agricultural arena;
3) Augmenting *water storage facilities* (viz., construction of check dams, lakes, ponds, recharging canals, and dams);
4) Preventing *water loss* by evaporation and other means through adoption of necessary techniques;

5) Maintaining *soil moisture and fertility* through proper maintenance of the ecosystem and the environment;

6) Undertaking all other necessary measures, which may be necessary in a local perspective.

**Promoting agricultural production:**

The major thrust of our government on agricultural production is on improving the efficiency in the use of scarce natural resources *viz.*, land, water, and energy. The methods necessary for improving efficiency of water resource utilization could be categorized as given below:

1) ***Irrigation methods:*** Adoption of suitable and efficient irrigation methods viz., drip irrigation for coconut, tapioca, sugar cane, cotton, banana, tomato, etc., and sprinkler irrigation for ground nut, and others;

2) ***Crop suitability:*** This is vital to suit the local micro climate, soil type, soil fertility with respect to major and micro-nutrients, local water quality as reflected by Sodium Absorption Ratio (SAR), toxic element concentration in the soil, crop water requirement, and all other *local environmental factors* such as water retention capacity of the soil, soil aeration, soil microbial composition, sunshine, day and night time duration, presence of symbiotic plants and symbiotic microbial biota, humidity, wind velocity, slope of the land, altitude, rain intensity, season, which all have a significant impact on the crop;

3) ***Water potential:*** Raising crops, that are suitable and compatible with the available water quantity and quality is another thing that

should always be taken into account. The availability of water during the lifetime of the crop is very essential. If water becomes scarce at the onset of germination, or during maturation, whatever effort has been put forward towards raising the crop would become waste along with the water that has been *spent* so far for raising the crop. It would be unwise to grow paddy in a drought prone zone; similarly it would be imprudent to raise cotton, onion and tapioca in a waterlogged land.

4) ***Cropping pattern:*** Even if all the above conditions are satisfied, raising the same crop again and again will severely reduce the capability of the land to support further the healthy growth of a repeated crop. At first, this is due to the depletion of vital nutrients essential for the growth of that particular crop. Secondly, the composition of the microbial community in the soil is affected by monotonous cropping pattern, which also limits the soil fertility with respect to a particular crop. Thus, suitable *rotational cropping* and *inter-cropping* techniques should be adopted in order to maintain the *crop yield.*

5) ***Technological adoption:*** In order to meet the increasing demands, we should also focus our attention on implementation of suitable technological advancements into the agricultural system. Some of these are:

    a. Use of *hydroponics* for growing selected plants.

    b. Utilization of *greenhouse* for maintenance of suitable temperature and humidity.

c. Adoption of *genetically modified plants* to suit local environmental conditions and to have good disease control and yield.

d. Conserving *genetic resource* to maintain the specialty of particular species that may of importance with respect to getting more crop yield or obtaining good quality seeds.

e. Developing suitable *ecosystem* to suit the ecological and environmental needs of the crop. Since every species on Earth depends on other species for some purpose or the other, it is essential that the required ecosystem is either retained or, restored; otherwise, it may not be feasible to obtain optimized crop yield.

**Relevance to PAP canal irrigation, and recommendations for effective water resource utilization:**

The Parambikulam – Azhiyar Project (PAP) canal irrigation was designed to promote irrigation in around 2000 acres of land from the runoff of watershed areas in Parambikulam and from the streams in the Navamalai, Upper Azhiyar, and Valparai hill areas. However, at present, the irrigation area is greatly reduced due to a reduction in rainfall in the basin areas. Under this reduced water potential, it is essential that necessary remedial measures are taken, and proper water management plan is drawn for promotion of agriculture in this area. The following guidelines may be adopted for promotion of agriculture in the PAP canal irrigated areas to suit the local environmental conditions:

1) The *PAP canal could be widened*, and the concrete lining should be eliminated, so that water could be stored in the canal below the sluice level, in order to promote recharge of ground water aquifers;

2) Water conserving irrigation methods, viz., *drip and sprinkler irrigation*, could be implemented to reduce water requirement and increase irrigation efficiency;

3) Conserving *soil fertility* and preventing *soil erosion* to retain the fertility;

4) *Augmentation of recharging potential of PAP canal* is necessary for increasing percolation of surface water into the ground. For this purpose, the PAP canal could be lined up with grass, instead of concrete, for retention of water, promotion of percolation into the ground. Growth of grass along the bunds also helps in attaining higher stability of the bunds, during flooding and in other times.

5) Establishment of *water harvesting structures in farmer's land* is vital and essential for storing excess water. In addition, these water structures could be used for storing water from the canal, and utilizing it during summer time for irrigation purposes.

6) Changing *crop patterns* to suit local soil and microclimatic conditions;

7) *Lavish use of water should be avoided* along with the *implementation of efficient irrigation systems* (drip and sprinkler irrigation), so that more land could be irrigated with the currently available water;

8) Implementing vegetative techniques, such as growth of *vetiver* and other locally available *grass* varieties in the canal, along the streams, and areas inside check dams, *for preventing soil erosion and improve ground water recharge*.

9) *Water logging should be avoided* to maintain soil characteristics in the long run. thus, proper drainage facilities should be provided in the agricultural fields, and the overflow from the agricultural land could be stored in farmer's recharge ponds, and can be wisely utilized for raising crops with low water requirement;

10) Using *nets for reducing heat and retaining soil moisture* for longer time. While controlling exposure of plants from excess heat enhances their productivity, retention of soil moisture improves its fertility through the growth of soil microbes.

11) *Information centers* could be established in order to promote awareness among the farmers about the *best practices of agricultural production*. Also, this center may cater to the needs of local people by providing vital information about crop selection, crop water requirement, soil condition, disease control, required rotational and inter-cropping pattern, optimized pesticide and fertilizer load, prices of various agricultural products in the market, etc.

12) Moisture retention capacity of the soil could be enhanced by the *application of fibrous materials*, such as coir pith;

13) *Application of organic manure* could be promoted by providing subsidies, so that the demand for fertilizer is greatly reduced, soil fertility is maintained, and agricultural production is sustained;

14)Local bodies should be given necessary powers and facilities to *prevent theft and irrational use of water*;

15)Promoting *Self-Help Groups (SHGs)* with the supervision of non-governmental organizations (NGOs) to implement *greenhouse agriculture*, so that quality agricultural products could be obtained. The initial capital investment required for the establishment of the greenhouse could be made available through bank loans with a provision for around 50% subsidy. This initiative will promote rural livelihood, rural economy, and also help uplift of women.

16)Introduction of *ancient agricultural practices*, such as i) use of Kalli, Erukan, Karun Thulasi, Thiruneer Pathini, Thumbai, as fencing to agricultural lands, ii) use of bio-pesticides, etc., in the irrigation area in order to promote sustainable agricultural development, protect soil fertility, prevent pesticide contamination of food, and reduce or nullify use of man-made fertilizers. For this purpose, a *database of ancient agricultural practices* could be created from the knowledge obtained from elder people.

17)*Watershed modeling* should be carried out in the catchment area to predict the runoff during rainy season, so that the quantity of water flow could be estimated in advance and necessary measures could be taken for proper utilization of available water resource;

18)In addition, *flood prediction models* could be used to augment storage facilities to store excess water during the times of flooding;

19)*Climatic models* could be used to predict rainfall, soil moisture, wind speed and direction, and temperature variations during

various seasons, so that proper crop selection could be made to suit local environmental conditions, and ensuing loss due to improper planning could be avoided;

20) Promoting *farmer's participation in project design, management, and modification*. The response of the farmers during various phases of the project should be obtained and their preferences should be adopted from time to time. They are in a better position to assess the outcome of the project on real time basis, and they take utmost care in proposing modifications to the project focus to attain its objectives due to the benefits that they get from the project. Thus, farmer's participation is a very important component required for the success of any agriculture related project.

21) *Implementing projects on micro watershed basis* – so that proper planning for efficient water utilization and crop selection could be made, depending on the local environmental conditions.

22) *Learning from earlier experience* in other watershed areas, both from India as well as from other countries, and suitably implementing the successful ideas for overcoming local limitations in attaining efficient water utilization, proper crop management, retaining soil fertility and arability, using alternatives for pesticides and fertilizers.

23) *Promotion of low-cost and highly efficient agricultural technologies* – for example growth of grass for preventing soil erosion in the basement area, and preventing silt deposition in the check dams, tanks, and dams.

24)Encouraging the establishment of *private and community land forestry plantations* for fuel wood and fodder, thereby promoting conservation of existing forest cover in order to improve the micro-climate of the concerned region.

25)Promoting the use of *biotechnology* to increase *drought and pest resistance* in the plants;

26)Developing plans to efficiently handle harsh *climatic conditions*;

27)Implementing *early warning systems for disease control, draught management, and meeting other natural calamities* that could affect agricultural production. For this purpose, geo-statistical methods can be employed using Geographical Information System (GIS);

28)Providing enough information through *implementation of information technology* for agricultural purpose in rural areas;

29)Promoting *awareness* among the farmers and self-help groups about *conservation of natural resources* and *best practices* in agriculture;

30)Mitigating *environmental pollution* to minimize contamination of water resources, thereby increasing the availability of usable water to sustain the development;

31)Increasing necessary *infrastructural facilities* required for agricultural promotion *viz.*, provision for cold-storage facilities, transport facilities, farmer controlled marketing centers, conservation of genetic resources, safe guarding natural habitats, protection of biodiversity, etc.;

32)Enhancing *application of cost-effective agricultural technology in rural areas*;

33)Promoting *urban agricultural* practices through the use of treated sewage and manure obtained from municipal waste, to meet the needs of urban population, thereby reducing transportation costs associated with food supply.

34)Balanced use of *fertilizers* in order to prevent its excess utilization and ground and surface water contamination.

***The endnote:***

All these above mentioned measures are *cost-effective* in the environmental, ecological, economical, and ethical perspectives. Obtaining higher yield should not be the only criteria to be taken into account while planning for sustainable agricultural development. Externally applied force on the ecosystem to promote agricultural production would invariably disturb the balance in existing natural ecosystem. This will upset the sustainability of agricultural system. Thus, it is important that resource planners and policy makers should take into account the *ecosystem as a whole*, instead of focusing only on the crop, in order to promote sustainable agriculture, thereby accruing long-lasting benefits.

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***About our organization:***

Environment With People's Involvement & Co-ordination in India (EPIC IN INDIA), is a non-governmental organization, registered under Indian Companies Act, 1956, We are committed to address local environmental issues with an aim to promote environmental management for sustainable development and better livelihood of the people. To attain this objective, we closely work together with public, policy makers, and industry.

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