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Water Crisis and Agriculture Approaches To Overcome It In India : A Review

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Abstract

India is currently experiencing a serious water crisis as a result of a number of issues, including the overuse of groundwater, ineffective irrigation methods in agriculture, climate change, and rising water demand from diverse industries. To solve the water issue, the agriculture sector which consumes the majority of the nation's water must embrace sustainable practices. Promoting water-saving irrigation techniques like drip irrigation, which is 90% effective and may save up to 60% more water than conventional flood irrigation, is one strategy.[8] To preserve soil moisture and lower their need for water, farmers can also use conservation agriculture techniques including mulching, crop rotation, and minimal tillage. The cultivation of less water-intensive plants like millets, pulses, and oilseeds, which can thrive in arid climates and use less water, is another strategy that may be used. In addition to giving farmers a nice and supplementary source of income, this helps to lessen the strain on water supplies. To increase the amount of water that is available for agricultural use, integrated water management practices including rainwater harvesting, watershed development, and aquifer recharge can also be encouraged. Further reducing water use is possible by utilizing water-saving technology like micro irrigation systems and laser land leveling. To solve the water situation in India's agriculture sector, a multifaceted strategy is needed. Adopting environmentally friendly techniques and technology may increase farmers' output and revenue while also ensuring water security.

Keywords: Drip irrigation, Rainwater harvesting, Mulching, Crop rotation, Use of drought-resistant crops, Minimal tillage, Conventional flood irrigation.

Introduction

The overuse of groundwater, ineffective irrigation methods, climate change, and rising demand from diverse industries are all contributing to India's present water problem. This situation will have an especially negative

impact on agriculture, which uses the majority of the nation's water. To address this difficulty, the agricultural industry must adopt sustainable practices that not only conserve water but also guarantee the livelihoods and food security of millions of farmers. To reduce the effects of water shortage and ensure sustainable agricultural expansion in this setting, a number of agricultural practices might be advocated. These strategies include the use of water-efficient technology, crop diversification, conservation agricultural methods, integrated water management, and the use of effective irrigation techniques. The possibility of these strategies to resolve the water issue in India's agriculture sector will be thoroughly examined in this review paper.

India's Agriculture sector :

India's agriculture industry is the foundation of the nation's economy since it directly or indirectly employs a sizeable section of the population, particularly in rural regions. Over 50% of the workforce receives a living from this industry, which makes for around 17% of the nation's GDP.[9] Crops, forests, fisheries, and livestock are all a part of India's complex agriculture industry. Rice, wheat, sugarcane, cotton, and oilseeds are some of the main crops grown in India. India is a significant player in the world grain trade being one of the biggest producers of these products, notably in the production of rice and sugarcane.[10] The dependence of India's agriculture on monsoon rains, land fragmentation, insufficient irrigation, a lack of modern technology, and inadequate infrastructure for storage and transportation are just a few of the problems the country's agriculture industry faces. It is challenging for farmers to make a good living since these problems jeopardize their production and profit. To solve these issues and enhance the efficiency of the agriculture industry, the Indian government has taken a number of actions. The government's goals are to modernize agriculture, boost productivity, and enhance the standard of living for farmers through programs and initiatives including Pradhan Mantri Fasal Bima Yojana, Pradhan Mantri Krishi Sinchai Yojana, National Agriculture Market, and eNAM.[11] The Indian economy's agriculture sector is still a crucial component, and the advancement of the nation as a whole depends on its continued expansion and development.

Drought and their Impact

Droughts have negative consequences on crops, irrigation, cattle, animals, the environment, the soil, public health concerns, and ultimately, the loss of a considerable number of lives. They also have negative effects on the economy, society, and ecology. During the 18th and 19th centuries, drought in India was responsible for millions of fatalities.[12] The 20th century was also mentioned. According to the most current studies, India has experienced a significant rise in the frequency of drought years over the past three decades, even if dry and rainy seasons have alternated. In the 16 years after 1950, there have only been five drought years, compared to ten between 1950 and 1989. (Since 2000).[13] In the years 2020 to 2049, meteorologists predict a rise in the frequency. Indian agriculture is greatly impacted by the local environment; for example, procuring water for crop irrigation requires a favorable southwest summer monsoon. Water shortages and below-average agricultural production are brought on by the absence of monsoons in various parts of India. This is particularly true in significant drought-prone regions like Southern and Eastern Maharashtra in Western India, Northern Karnataka in South-Western India, Andhra Pradesh on the Southeastern Indian Coast, Odisha on the Eastern

Indian Coast, Telangana on the Southeastern Indian Coast, and Rajasthan in Western India. Droughts generally result in diminished water availability for agriculture. Groundwater consumption has risen as a result of the drought, which might help people get by in such difficult circumstances. Despite the fact that there is currently less groundwater accessible for agriculture than there was previously because of misuse and the resulting quality degradation, this has a negative effect on agricultural productivity. The most crucial point to bear in mind is that all of the aforementioned effects must be carefully considered while making plans for and responding to drought-related situations.

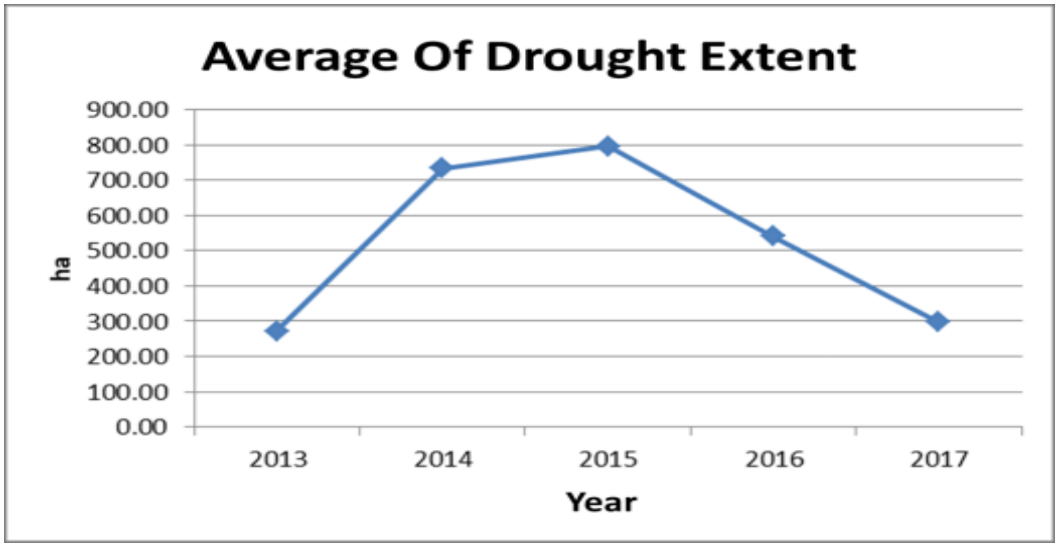

Fig. 1. Yulistya, Viola & Wibowo, Adi & Kusratmoko, E. (2019). Assessment of agricultural drought in paddy field area using Vegetation Condition Index (VCI) in Sukaresmi District, Cianjur Regency. IOP Conference Series: Earth and Environmental Science. 311. 012020. 10.1088/1755-1315/311/1/012020. [1]

Water available for Agriculture production

Available water

India has a shortage of water resources, the negative consequences of climate change, significant waste caused in part by poor management, and unjust water pricing restrictions. The Northern Ganga River Basin has an abundance of water resources, whereas the Southern There aren't many in the River Basin, but those that do exist have severely contaminated water on the surface and underneath. Due to population expansion and shifting lifestyles, both urban and rural areas now have higher water demands, mostly for irrigation. India has 4% of the world's freshwater resources, 80% of which are utilized for agriculture, and has 18% of the world's population. The average yearly precipitation in India is 4,000 billion cubic meters.[14] The groundwater and surface water systems in India barely use 48% of them. The choice of crops, the timing of their production, irrigation methods, and other factors will all be negatively impacted by climate change on agricultural output. The three crops that use the most water rice, wheat, and sugarcane makeup almost 90% of the country's total agricultural output. using plants to make food. It can take up to 3,500 gallons of water to produce one kilogram of rice, a key export product. Only 18–20% of the water is actually used due to a lack of storage methods, inadequate punishment deters crime more effectively infrastructure, and poor water management. The average annual rainfall in India is 1183 millimeters, and the monsoon season accounts for 75% of that total. August to

September. Because of this, irrigation costs need to be covered all year round due to runoffs during the monsoon. With an estimated 1.6 billion people living in India by 2050, there will be a greater need for food, water, and energy. Building more infrastructure and using more resources are required as a result.[15]

The water crisis in India causes

Growing population and urbanization: Water resources in India are under tremendous pressure due to the country's constantly expanding population and urbanization.

Climate change: The supply of water has been greatly influenced by rising temperatures and erratic rainfall patterns brought on by climate change.

Poor water management and infrastructure: Water shortage has been made worse by insufficient expenditures in water infrastructure, poor management of the water supply, and unrestrained groundwater exploitation.

Agricultural practices: India uses 80% of its water for agriculture, and the country is experiencing a water crisis as a result of faulty irrigation systems, excessive fertilizer and pesticide usage, and inefficient water use in farming practices.[16]

Industrialization: The water supply for human use has been contaminated as a result of growing water resource contamination brought on by rapid development.

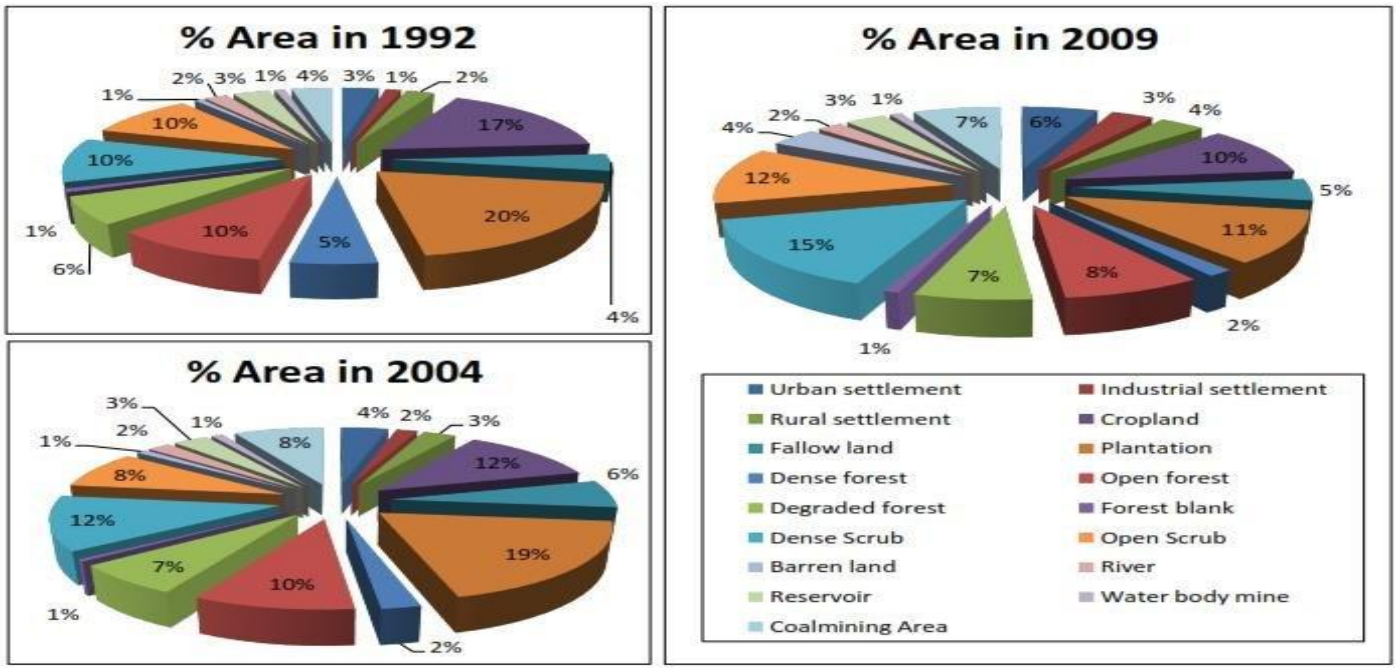

Fig. 2. Kumar, Akshay & Pandey, Arvind. (2013). Evaluating Impact of Coal Mining Activity on Landuse/Landcover Using Temporal Satellite Images in South Karanpura Coalfields and Environs, Jharkhand State, India. International Journal of Advanced Remote Sensing and GIS. 2. 183-197.[2]

Quality of water sources: The supply of water is also threatened by poor water quality since it needs further treatment before usage, which is frequently neglected owing to a lack of resources and money.

Inequitable distribution: The water crisis in India is not only caused by a lack of water but also by an uneven distribution of resources, with some parts having abundant water resources while others are severely short of it.

Overconsumption of water: A further factor in the water problem is the excessive use of water for home purposes, leisure, and personal hygiene.

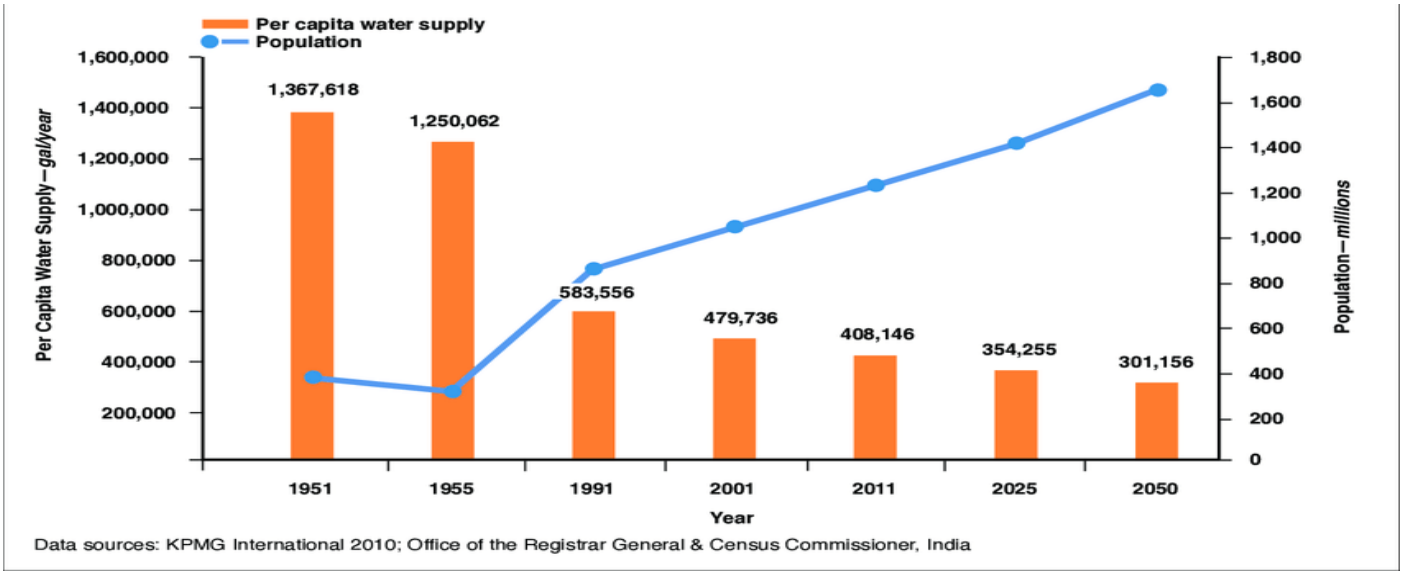

Fig. 3. Thakur, Ankaj & Kumar, Anshuman & Vanita, Brij & Panchbhai, Girish & Kumar, Narender & Kumari, Anjali & Dogra, Pardeep. (2018). Water Footprint - A Tool for Sustainable Development of Indian Dairy Industry.[3]

Solving the water crisis by saving money in Agriculture

One approach to the water problem is to focus on cost-cutting in agriculture. 70% of the freshwater in the world is used for agriculture, and a significant amount of that water is wasted due to incorrect crop selection and irrigation techniques.[17] By encouraging farmers to use less water and implement more environmentally friendly practices, we can reduce overall water consumption and ensure that there is enough water for everyone. One way to do this is to provide farmers with incentives to switch to crops and irrigation techniques that use less water. Governments and non-profit organizations, for instance, might offer financial incentives or subsidies to farmers who utilize drip irrigation systems, which use a lot less water than traditional flood irrigation. Encouragement of more ecologically friendly farming practices, such as cover crops, crop rotation, and soil preservation, is another tactic. These methods not only use less water but also improve the soil's quality and reduce the need for chemical pesticides and fertilizers. by aiding farmers in water conservation and cost reduction. We can ensure that everyone has access to water by taking action on the water crisis.[18] This plan requires financing support from governments, NGOs, and the business sector, but it might have a significant positive impact on the accessibility of water and the safety of the global food supply.

India's Water Supply Dilemma

The Centre for Green Innovation India aims to make it easier for India's smallholder farmers to access innovations along the agri-value chain for vital commodities including tomatoes, potatoes, and apples. During the course of research that looked at water consumption, it was found that farmers' use of water is improper

because of subsidies for energy. In order to grow new crops, farmers frequently use too much water, which increases groundwater extraction. Many farmers operate their irrigation systems and pump continually to maximize the usage of the electricity that is available since the power runs continuously but in unexpected waves.[19] The water taken from the soil is then greater than what is needed while the machines keep pumping. As the pumps become unable to access it, the groundwater level drops. Therefore, preserving water might also indicate that it's important to plan for and protect the resources that are already available so that agricultural practices are both viable and profitable. The three main irrigation-related problems that illustrate the link between ecological and economic success are as follows.[20] As farmers must manually open and close their valves, irrigation initially typically entails significant labor costs. Second, excessive water use depletes the groundwater table. Last but not least, using too much or too little water may lead to lower yields, higher expenses, unhealthier plants, and a higher chance of root illnesses. To solve these problems, the Green Innovation Centre India is putting a number of cutting-edge innovations to the test.

Underground irrigation

A way of watering plants or crops where the water is sent directly to the roots of the plants underground is known as subterranean irrigation. With this type of irrigation, a network of pipes and water outlets is buried beneath the soil's surface, allowing water to be delivered directly to the area where it is required, without evaporating or being spent on unneeded places. Improved water efficiency, a decrease in the growth of weeds, and the capacity to keep the soil at a constant moisture level are all benefits of subterranean irrigation. Along with that, it enhances soil quality and lessens the chance of water harming plants. Overall, subsurface irrigation is a creative and effective method for providing plants and crops with water while reducing waste and maximizing benefits.

Fig. 4. URL - https://www.netafim.com.tr/akademi/toprak-alti-damla-sulama-kurulumu/. [4]

Precision irrigation

Precision irrigation is a type of irrigation that makes use of technology to improve the way water is distributed to crops or fields. According to the individual demands of the plants, it entails applying the proper quantity of water at the appropriate time and place. Sensors, automation, and remote management systems that track the weather, plant water needs, and soil moisture levels are used to do this.[21] Farmers may enhance crop yields

and quality, use less fertilizer and pesticides, preserve water, and save money on labor and energy by utilizing precision irrigation. Drip irrigation, sprinkler systems, and micro-irrigation are all examples of precision irrigation techniques.

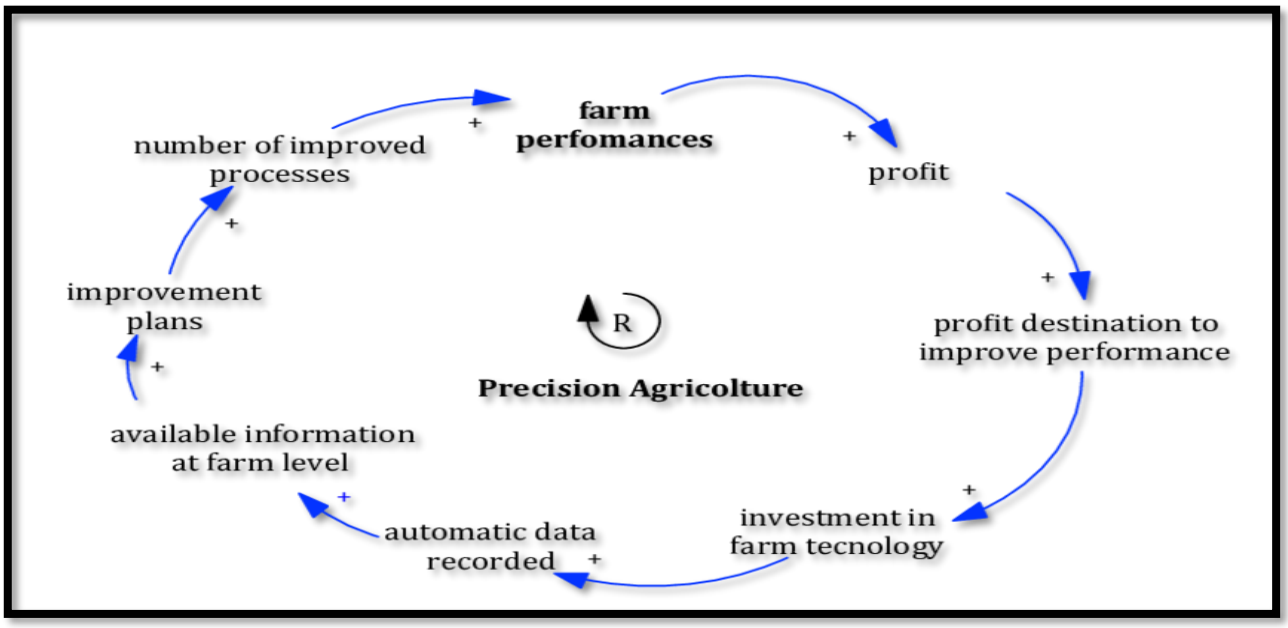

Fig. 5. Atzori, Alberto & Tedeschi, Luis & Armenia, S.. (2013). Farmer Education Enables Precision Farming of Dairy Operations. [5]

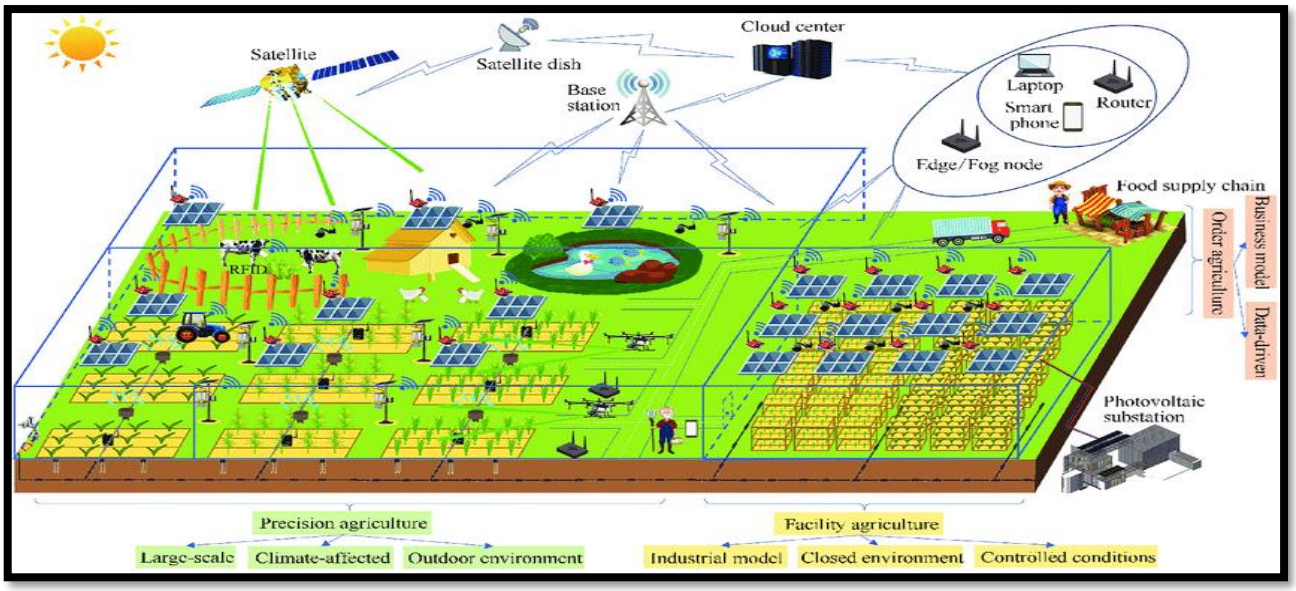

Fig. 6. Yang, Xing & Shu, Lei & Chen, Jianing & Ferrag, Mohamed Amine & Wu, Jun & Nurellari, Edmond & Huang, Kai. (2020). A Survey on Smart Agriculture: Development Modes, Technologies, and Security and Privacy Challenges. IEEE/CAA Journal of Automatica Sinica. 8. 273-302. 10.1109/JAS.2020.1003536. [6]

Rainwater harvesting an ultimate solution for future water crisis:

One of the greatest ways to address India's present water shortage is through the gathering of rainwater. During the monsoon season, India receives a lot of rain, and collecting this water can assist ease the severe water deficit that exists in many areas of the nation.[22]

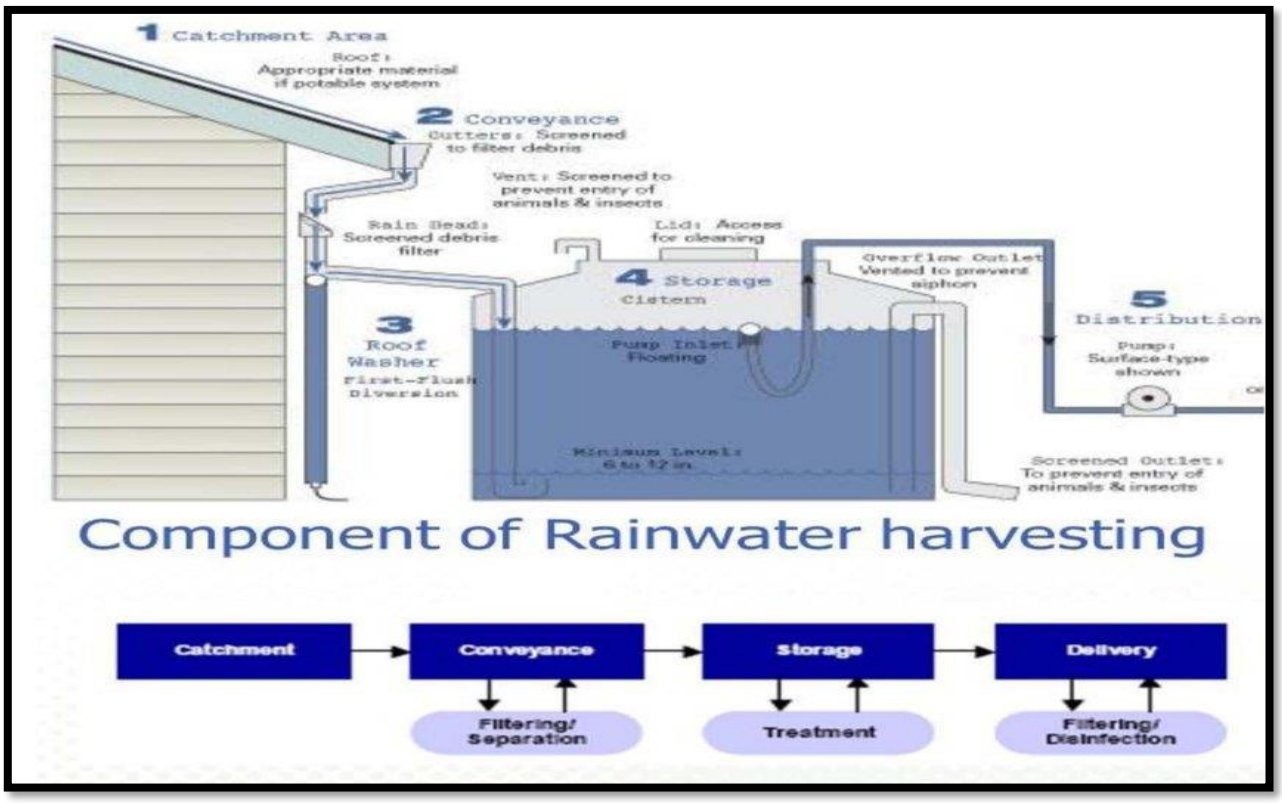

Fig. 7. Mahadeo, Leniel. (2018). Assessing the Potential of Retrofitting Rainwater Harvesting and Greywater Reuse Systems to Domestic Buildings in the Msunduzi Region. [7]

There are several benefits of rainwater harvesting, some of which include:

Reducing the stress on groundwater resources: Water is in much more demand now than it ever has been because of the growing population. As a result, groundwater supplies have been overused in many areas of the nation. By supplementing our groundwater supplies with rainwater, we can lessen the strain on them.

Mitigating floods: By collecting more water, rainwater harvesting can assist places that receive a lot of precipitation lower their risk of flooding.

Providing a source of clean water: Rainwater may be utilized for a variety of things, including drinking, washing, and cooking, and is often devoid of contaminants.

Saving money on water bills: The use of municipal water resources can be reduced and water costs can be decreased by individuals and institutions by collecting rainwater.

Supporting agriculture: In the long run, agriculture may profit from the utilization of rainwater collection to replenish groundwater supplies.[23]

Overall, rainwater collecting is an effective and affordable way to address India's water shortage. By using this strategy, we can save water and make sure that our nation has a sustainable future.

Conclusion

The economy of India is heavily reliant on agriculture, which also uses a lot of water. Water shortage, however, has grown to be a major issue for India's agriculture industry as a result of population growth and climate change. Many strategies have been used to address the water shortage, including agricultural diversification, effective irrigation methods, rainwater gathering, and the adoption of drought-tolerant plants.

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