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USE OF RAIN WATER IN AGRICULTURAL

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ABSTRACT

Within a context of scarce water resources for agriculture, rainwater harvesting constitutes a promising alternative that has been studied by different disciplines in recent years. This article analyses the dynamics of global research on rainwater harvesting for agricultural irrigation over the last two decades. To do this, qualitative systematic analysis and quantitative bibliometric analysis have been carried out. The results reveal that this line of research is becoming increasingly important within research on irrigation. Environmental sciences and agricultural and biological sciences are the most relevant subject areas. Agricultural Water Management, Physics and Chemistry of the Earth, and Irrigation and Drainage are the journals that have published the most articles on the subject. India, China, the United States (USA), South Africa, and the Netherlands are the countries that lead this line of research. Although significant progress has been made in this subject area, it is necessary to increase the number of studies on the capacity of rainwater harvesting systems to cover irrigation needs in different farming contexts, the factors that determine their adoption by farmers, the economic and financial feasibility of their implementation, and their contribution to mitigating global climate change.

Keywords: rainwater; harvesting; irrigation; sustainability; unconventional water resources

INTRODUCTION

The supply of food is one of the greatest challenges faced by humankind in the 21st century [1]. Agricultural ecosystems are the principal suppliers of food, but they are also the main consumers of water resources on a global level [2,3]. These ecosystems use between 60–90% of available water, depending on the climate and economic development of the region [4,5]. The global area dedicated to irrigated crops is estimated at 275 million hectares with an upward growth trend of 1.3% per year [6]. This accounts for just 23% of farmed land; however, 45% of total food production is obtained through these types of crops [7,8]. It has been estimated that in order to satisfy food demand in 2050, world production must increase by 70% [9]; this implies an increase in the consumption of water resources on a global level of 53% [10,11]. More and more regions throughout the world are facing severe water shortages. Water resources are subject to severe degradation due to many factors, such as the consequences of global climate change, rapid population growth, changes in land use, agricultural and urban expansion, the increase in the demand for water from different productive sectors, the inadequate distribution of water resources, regional hydropolitical conditions, the deterioration of the quality of water due to overexploitation, rainwater scarcity, and the high rate of evaporation and aridity resulting from the increase in temperatures.

The key to rainwater harvesting lies in assuring the availability of adequate quantities of water for crops during the planned growing season. A recent study1 conducted by The Food and Agriculture Organization of the United Nations (FAO), in collaboration with Caribbean partners, confirmed that rainfall intensities and patterns of distribution across the Caribbean were suited to rainwater harvesting systems for agriculture. Furthermore, on-farm, cumulative annual storage of rainwater runoff can be sufficient to maintain small-scale production systems of many of the food crops grown throughout most of the annual dry periods.

Water is an important resource that is used in our daily lives. It used in vitally important sectors of the economy, such as the agriculture sector. Farmers use water to grow crops. Not only is water used to grow crops, it is also used to process agricultural products before they can be sent to the marketplace. Even when they reach markets and are bought by consumers, water is still needed to transform raw food items into edible forms. Water is indisputable an essential resource used by everyone linked to the agriculture sector.

Water conservation is increasingly being encouraged in crucial sectors of the economy, such as the agriculture sector. This is fuelled by an increasing demand for water and growing concerns of water scarcity in the society. The United Nations even considers water availability to be a major issue for the 21st century.

A commonly asked question regarding water conservation is how do we conserve water? It is noteworthy that water can be conserved in many ways. One way to conserve water is through rainwater harvesting. Rainwater harvesting is simply the act of collecting rainwater during and/or after rainfalls. Once rainwater has been collected, it is treated and stored for re-use.

Rainwater harvesting has agricultural uses. It can be used for watering gardens in our homes and crop plants in agricultural fields. These reduce the reliance of garden owners and farmers on other sources of water supply, thus saving them money.

Also, we are in a climate change era where intense rainfall is expected. And it can damage agricultural land areas. Rainwater harvesting can be used to divert heavy rainfall from reaching agricultural lands, thereby protecting crop plants from getting damaged.

One good property of rainwater is that it is a soft form of water and does not impact plants negatively. Unlike hard water, that adds calcium carbonate to crop plants, forming a coating on the roots/leaves. When such coatings are formed, it prevents plants from receiving the maximum amount of the water, minerals, fertilizers and pesticides that are supplied to them. It also prevents plants from receiving maximum sunlight, thereby slowing down photosynthesis.

Furthermore, the use of soft water from rainwater harvesting can help to reduce farmers operating costs. This is because calcium carbonate from hard water normally piles up in pumps or sprinklers causing blockages. When such equipment is blocked, money is used to unblock their pathways. In contrast, such problems are not usually associated with the use of soft water in farming operations, thus reducing the cost to maintain crops.

More so, the use of hard water from water mains in farming operations causes scale formations on plants- due to the Calcium Carbonate contents of hard water. These formations promote the growth of bacteria that is capable of damaging crop plants. However, such scale formations are not linked with the use of soft water from rainwater in farming operations, make it safe for plants.

Also, rainwater can be used as a source drinking water for livestock. And it is suitable for livestock compared to chlorinated water. Furthermore, rainwater can be used to carry out domestic tasks in the farm such as cleaning machinery.

What is rainwater harvesting for agriculture?

Rainwater harvesting for agriculture is the collection, conveyance, storage, delivery and utilization of rainwater runoff for productive use, primarily in cropping systems. In practice, the delivery and utilization is at the point of collection on the farm. Rainwater harvesting in the Caribbean is practiced primarily by small farmers. However, successful application of the technology is based both on empirical formulae derived from complex statistical calculations, and on an appreciation of the characteristics which define rainwater harvesting.

Critical characteristics of rainwater harvesting for agriculture 1. The soil/plant/water relationships in rainwater harvesting for agriculture introduce a broader dimension not encountered in runoff water for household purposes. This results from the influence and variability of climate, meteorology, hydrology and geology at the farm site in the determination of crop water demand. 2. Meteorological considerations influence crop behaviour, yields and water demand. Soil water availability (infiltration rate, water-holding capacity, and depth) is influenced by geology. Hydrology is relevant in its applied form, especially the character of water in rainwater runoff rates, estimates of spillway requirements, and storage. 3. Soil/water/plant relationships, especially evapotranspiration rates at the farm, determine the adequacy and efficiency of management of the harvested quantities of rainwater runoff. Calculation of crop water demand requires, at least, a general appreciation of site characteristics such as the interaction between evapotranspiration and climate, particularly relative humidity, temperature and hours of sunshine. 4. Rainwater harvesting has a broader range of catchment surfaces than harvesting from rooftop runoff for household purpose. Natural slopes are of critical importance, as are artificial catchments such as the paved surfaces of roads, airports and highways, and even tree trunks. Natural catchments and storage present as much variability in surface area and rainwater collection efficiency. The management of natural slopes as catchment surfaces is singled out for treatment in the present document.

Agriculture

Rainwater Harvesting is a natural partner for many agriculture practices as water is usually so critical for farmers and growers. Our harvesting systems can be used to collect water suitable for:

- Irrigation
- Herd watering
- Washing
- Application use (such as toilet flushing, etc).
- Machinery Cleaning
- Filter Backwashing
- Sprayer wash out

There’s increasing concern about the growing demand for irrigation and emerging unsustainable practices of groundwater exploitation. This has been my major preoccupation for the past three decades. It was in 1990, when I started exploring problems of farming in Purulia and Bankura districts of West Bengal and adjoining areas of Jharkhand, that I realized unless farmers are encouraged to conserve rainwater in their own field, it would be difficult to meet the demand of irrigation to save their crops from dry spells.

My engagement with farmers on irrigation infrastructure development was guided by the understanding that, so long we are not taking best possible care of rainwater that we receive on our land, we should not think of exploiting other water resources. At that time I proposed that at least 5% of each piece of land or each farmer's holding should be converted in to small water harvesting structures.

That was in context when farmers were primarily worried about saving their Kharif (summer) paddy from dry spells during flowering. The idea emerged through interaction with several village communities in Purulia. If a patch of land, say of 100 hectares, is treated for rainwater harvesting, this area would have 5 hectare of water bodies and each farmer would have free access and full control over water they require.

The question of equity was addressed within the design of land treatment, unlike big dam and canal based irrigation. Demonstrations were made with varied degree of success. In some villages, where soil was not so sandy or clay loam, there was no need for irrigation even during a dry spell of 24 days (in September 1992) as local moisture of treated area with the 5% model got enhanced.

Regulate groundwater exploitation

Thus, there is a need to come up with policies to regulate groundwater exploitation. At the same time, we cannot stop growth of intensive farming. Where would the additional water come from? To my understanding, rainwater harvesting is only sustainable solution. Keeping the future scenario in mind, all state governments should come up with policies to encourage rainwater harvesting based on a scientific assessment of irrigation demand.

At least 70% of demand should be met from rainwater harvesting. The fear of declining land availability from agriculture could be addressed through intensification and diversification in farming. Again, there are deeper technical matters involved in this and this paper in not the appropriate place to get in to that. There have been many such initiatives made by different state governments under the rural jobs guarantee scheme but they need to be strengthened with right policies to stop free riding.

Some development experts say why should the onus of rainwater harvesting be only on farmers when groundwater depletion is a national problem? We must realize that out of the total national water use across sectors, about 80% or more water is used for farming. More that 70% or more rainwater is also received in rural areas since farmland is 60% of India's geographical area and forest is 23%. I would also assume that about 60% of the water must be received directly on farmlands.

It could be assumed that the volume of runoff water is proportionate to sector-wise distribution of area of lands. So, the potential for rainwater harvesting is proportionate to the volume of runoff available from respective areas. That tells us that farmlands are significant in terms of its potential of rainwater harvesting.

Water Harvesting and Storage

Water harvesting (WH) and small-storage technologies are key water-related interventions with the potential to contribute to rapid improvements in the yields of rainfed crops. WH and small-storage technologies can also help provide water for domestic use, livestock, fodder and tree production, and – less commonly – fish and duck ponds.

WH is the collection of rainfall runoff for subsequent beneficial use. Farmers worldwide have been using it for centuries to both reduce erosion and increase crop yields and production reliability. A wide range of WH techniques is available and applicable in various geographical conditions. Many originate locally, and others have been introduced from other regions or countries.

Methodology

Similar to other review studies related to topics in the area of water for irrigation, the database Scopus was selected to obtain the sample of studies to be analysed The search parameters used were all of the frequently used terms related to rainwater, agriculture, and irrigation. Their selection was based on previous studies on the same subject . These parameters were used in the search fields of title, keyword, and abstract. The study period selected was 1999 to 2018. The greatest development in this field of study took place during these years. Only documents until 2018 were included so that complete annual periods can be compared. Given that the results of a study are frequently published as conference papers, book chapters, and articles, in order to avoid duplications, only articles were included in the sample .It is worth pointing out that different search queries can give rise to different results. The search for this study was carried out in January 2019. The final sample analysed was composed of 525 articles. In addition, a search of articles on Irrigation was also carried out with the same restrictions in place in order to analyse the relative importance of RWHI within this general theme.

Conclusions

The study of rainwater harvesting for agricultural irrigation has become a line of research with increasing relevance within irrigation research. This line of research is partly driven by rainwater harvesting for irrigation having strong potential as a source of supplementary water for the sustainability of agriculture, within a context in which the supply of food is a challenge for today's society. Furthermore, the correct use of this resource will contribute to restoring deteriorated aquatic ecosystems, particularly overexploited aquifers, and mitigating global climate change. On the other hand, rainwater redistribution systems can be used to extend the crop area in regions where water resources are the only limiting factor. However, it is necessary to increase research efforts in order to gain a greater knowledge of the ability of these systems to cover irrigation needs in different farming contexts, the factors that determine their adoption by farmers, the economic and financial feasibility of their implementation and their contribution to mitigating global climate change. The results of this study will be of interest to researchers studying irrigation, given that rainwater harvesting for agricultural irrigation is becoming an increasingly relevant topic. Furthermore, these results can also be useful for governments and public policy makers when designing programmes and strategies aimed at contributing to the sustainability of agriculture.

References

1. "Rainwater Harvesting for Livestock".
2. Rural Water Supply Network. "Rural Water Supply Network Self-supply site".
3. Mays, Larry; Antoniou, George & Angelakis, Andreas
4. "Rain water Harvesting". Tamil Nadu State Government, India.
5. ^ "Believes in past, lives in future". The Hindu. India.
6. ^ "Rare Chola inscription found near Big Temple". The Hindu. India.
7. Kamash, Zena Archaeologies of Water in the Roman Near East. Gorgias Press.