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Water for Life, Life of Water

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Abstract

Water is critical for life. Water through photosynthesis 'articulates' itself into the structure and energy system of life. Functioning and the whole dynamics of life revolve round the water. Ours is a water planet and most of the Earth is also composed of water. However, availability and acquisition of water for all organisms on Earth and for all socioeconomic activities is not so easy. The water-related issues do not pertain only to its role in increasing and sustaining productivity worth human consumption, but also to its own productivity. Increasing water productivity means increased productivity of everything valuable for GNP. Increased water productivity leads to improved living conditions and better environmental management. This paper attempts to reflect on water productivity for agriculture and food security. Discussing the third pole of the Earth, i.e., the Himalayas, the paper also links water with ecological integrity of the biosphere.

Keywords: Photosynthesis; Water; Biosphere; Environmental management

Introduction

Planet Earth is a water planet. It is due to being a water planet that the planet Earth is a Living Planet, the lone living planet in the cosmos. No life process can occur in the absence of water. Thus, water is not only a physical resource; it is a phenomenon in itself. Water, along with carbon dioxide, in the presence of chlorophyll and light fixes itself into living matter.

Most of the Earth is water, and so are all the organisms [1]. Proportion of water on planet Earth and in the living organisms is almost equal. Water stays in dynamism, so do the living organisms. Since all the living activities take place in the presence of water, the very dynamics of the living organisms, in essence, is the dynamics of water itself. The productivity of life, therefore, has to be governed by water itself. In other words, productivity of water has direct bearing on the productivity of life.

Let us not regard productivity of life as number of living beings per unit area per unit time. When the productivity of life is referred to human life, it ought to carry different notion. Productivity here carries the notion of socioeconomic performance. Productivity of all the resources of basic human needs used as pertinent indicators to measure living standards is a critical criterion to have bearing on Gross National Product (GNP) of a nation. In the context of Bhutan, this productivity is directly related with Gross National Happiness (GNH). Thus, speaking ecologically, water productivity is, as it should be, the very basis of GNP and GNH. Productivity of life encompasses the whole philosophy of life. Productivity of water, thus, has to have bearing on the overall philosophy of life.

Water is not only critical to life, in the era of Green Revolution, since 1960s, it has emerged as one of the most basic needs to increase and sustain food production [2]. In the pre-Green Revolution era rainwater used to be the source of irrigation to a great extent. Since 1960s, irrigation-water is a paramount need to ensure agricultural production. This has influenced the ways of water management. Now agriculture sector has emerged as the biggest consumer of water with as much as 72% of global and 90% of developing-country water being diverted for irrigation purposes alone, according to a study of Cai and Rosegrant [3]. Irrigation-water, the major chunk of water of human use, is all that matters to sustain food security of the masses. Further, industrial sector is also not lagging behind in water consumption. In the globalization era, competing industrial sectors are at the state of proxy war with each other over limited water resources.

Water needs will increase with an increase in human populations. World's human population is projected to increase to 7.8 billion by 2025 [3]. Continuous increase in human population would increase pressure on limited water resources for agriculture production purposes. Industrial production would also increase with human population. On the whole water management is going to face myriad challenges in the times to come.

Water Productivity in Agriculture

Our sustainable future depends on sustained supplies of food. As food production is an ecosystem function and water is one of the components of an ecosystem vital for ecosystem functioning, food production can be considered as one of the functions of water. Increasing food productivity requires certain amount of water. If the amount of food production is higher per unit of water involved in ecosystem functioning, it would infer that water productivity is also higher. Food productivity, thus, is a function of water productivity. The higher the food productivity per unit water, the higher the water productivity (in terms of food production).

Development of seed varieties with higher water use efficiency, designing irrigation systems (such as sprinklers) to prevent wastage of excessive water, efficient management of water resources including rainwater harvesting, increased recharge of groundwater sources and regulating water cycle through intensive forestation on uncultivated lands especially in the Himalayan mountains, etc. are some of the

measures through which we can utilize limited water resources in India as efficiently as possible towards boosting development processes which inevitably require applications of adequate water.

Water Productivity in Food Security

With more than 17.5% world's population, India's share in world's water sources is only about 4%. On the whole, India is a water-stressed country. Adding fuel to the fire, water pollution prevailing almost throughout takes big toll annually. According to a recent report, as many as 37.7 million Indians fall ill annually due to lack of water sanitation with as many as 1.5 million children dying of diarrhea alone [4]. As many as 66 millions of people in India are compelled to drink water with excessive fluoride, while another 10 million are cursed to be dependent of groundwater with excessive arsenic [4-6].

In a water stressed region or a country water productivity must be measured against access of populations to pure (uncontaminated and disease-germ free) water necessary to maintain human health and productivity in terms of output per individual per unit time to contribute to social/ national development. With tall figures of morbidity and mortality associated with polluted water, the water productivity would naturally be seen as dismally low. This can be enhanced by preventing and controlling water pollution implementing social, engineering, ecological, environmental and legal measures and ensuring supplies of pure and 'productive' water to our people.

Water is not a nutrient. But water is inevitable for nutrition. Digestion, absorption and assimilation of foods/ nutrients take place in the presence of water. All metabolic enzymes function only in aquatic medium. Thus, food security of a society or nation inevitably requires the primacy of potable water security- availability and access of populations to pure water for drinking and sanitary purposes. Productivity of water in this respect also links with food security. In this case water productivity would be defined as the amount of available and accessible water ensuring food security of the masses. Underlying precondition is that for the food security to be ascertained there should be no dearth of availability of and accessibility to healthy foods [7].

The criteria of water productivity for food production and for food security are to be adjudged differently. In case of agriculture minimum possible water pronounced in potential production will be indicative of high productivity. However, digestion, absorption and assimilation of foods/nutrients cannot be compromised or ensured by 'minimum possible' water. Water productivity pronounced in food security fulfills the water use efficiency or the 'minimum water maximum food production' in agriculture, that is, in creating availability of food. The second and more pertinent part of food security, i.e., digestion, absorption and assimilation of food, embraces no criterion like 'minimum water, maximum digestion, absorption and assimilation of food' or 'water use efficiency in nutrition'.

Water productivity necessary for ensuring food and nutrition security of a society or nation would emanate from the water management systems, water policy, infrastructure, and natural factors. Our water related security aspects are challenged by increased chances of environmental pollution. Preventing water sources from getting polluted and unhealthy rather than depolluting it by means of a variety of chemicals and physical measures must be the primacy of our water related management systems and national water policy [8].

Third Pole of the Earth

Most of the water sources on Earth have been polluted to a certain degree. Only the Himalayan waters (and some sources in the other mountains and highlands of the Earth) are regarded to be pure sources of potable water. The Hindu Kush-Himalayas (HKH) extending into the boundaries of the eight Asian nations - Afghanistan, Pakistan, India, China, Nepal, Bhutan, Bangladesh and Myanmar - are the largest storehouse of fresh water in the lower latitudes and as such serve as important 'water towers' for more than 500 million people.

The highest, the youngest and the most fragile mountains of the HKH provide origin to major river systems, viz., the Indus, the Ganga, the Yarlung-Tsangpo, the Brahmaputra, the Nu Salween, the Yangtze, and the Mekong. The HKH Mountains are also called as the 'Third Pole', for they contain the largest mass of ice and snow outside the Earth's Polar Regions. There is a permanent snowline above 5000 m. Some of the glaciers in the Region are longest outside the poles of the Earth [9].

Himalayan mountains' water productivity must be gauged in terms of the amount of snowfall to maintain cryosphere (glaciers-laden environment) and water flow per unit time (say annually) in perennial (snow-fed) streams to be used for all purposes in their basins before they eventually drain into Indian Ocean.

To keep the 'Third Pole' of the Earth preserved through assured conservation of the water resource is one the greatest changes for our contemporary world. The HKH Mountains are the common fragile natural resource. For the conservation of the waters of this Region, the entire world needs to extend help and support. As the mountain ecosystems have enormous bearing on the Earth's systems, their special care, regeneration and conservation of their pristine resources would fetch happiness, peace and prosperity to the larger parts of the world. The Agenda 21, Chapter 13 of the United Nations underlines the importance of the mountains for the world as a whole: "mountain environments are essential to the survival of global ecosystem".

However, due to maldevelopment, mismanagement, and continuous neglect, the Himalayas' aquatic resources are in hot waters. Dry spell all over can be witnessed especially in summer season. In the land of plentiful water, most of the villages are suffering from the lack of drinking water. Majority of the people do not have easy access to potable water. Only some 10 percent of the arable land is irrigated, and the rest 90 percent depends on rain. So gloomy is the situation in the area that drains almost the entire plains of North India.

The Uttarakhand Mountains are especially rich in their water resources. This area is home to dozens of perennial streams and numerous other rainfed rivers along with innumerable rivulets, waterfalls, and ponds, etc. India's largest river system - the Ganga River System - also takes its origin in the Uttarakhand Mountains. In Garhwal Himalayas, the largest glacier Gangotri, the origin of the river Ganga, has an estimated volume of well over 20 km^3 of ice, which is much more than even the maximum capacity of storage created by the Bhakra Dam on Sutlej, which is less than eight km. This glacier, unfortunately, now continues to recede. Apart from these streams and rivers, there are several lakes in the area as also the perpetual ice fields and glaciers [10].

Uttarakhand's glacier-fed rivers are being seen only as a potential source of hydropower. Mega projects carrying potential risk to ecology as well as to humanity, like the Tehri Dam Project, have been constructed. Ruthless mismanagement of Himalayan waters might

trigger potentially negative consequences not only in Uttarakhand, but also in the entire Indo-Gangetic Valley. Aquatic ecology in the mountains, on the whole, is in a bad state, affecting the integrity of the entire food production system.

As Himalayan mountains supply water through perennial and rainfed streams, rivers and rivulets to a vast area of South Asia, water productivity of the Himalayan region must be measured in terms of the amount of water that is utilized in the whole basin for drinking, irrigation, groundwater recharge, industry and domestic purposes, etc. before it is drained into the Indian Ocean. To enhance Himalayan water productivity to its maximum level, we would have to rely on ecological development of the region. Himalayan mountains constitute extremely fragile ecosystems. At the same time, they harbor extreme biodiversity. Further, high degree of inaccessibility limits efforts for development intervention. Therefore, ecological development of the region is a bit complex phenomenon. Eco-development intervention in tune with mountains' specificities is an imperative for better management of the Himalayas' waters.

Water Productivity and Ecological Integrity

Water, in fact, is the most important factor to strike ecological integrity of the biosphere. Hydrosphere of the planet is more dynamic than the lithosphere and less dynamic than the atmosphere. It is hydrological cycle that governs the very ecological integrity of the biosphere. Simultaneously occurring in all the three states of the matter - solid, liquid and gas - water carries distinctive and most extraordinary properties. It is thanks to hydrological cycle that the whole biosphere blossoms with life. Water productivity at ecosystem, regional and global scale itself is a function of water cycle. Water cycle is a natural phenomenon. However, it is largely influenced by anthropogenic factors. Water productivity in agriculture and food and nutrition security is 'governed' by the ways we manage our agriculture and settlements. Vegetation of the ecosystems plays crucial role in global water cycle. Since most of the ecosystems now cease to be natural due to humans' large scale 'development intervention, the global cycle is to be, as it is being, influenced by anthropogenic factors.

Photosynthesis, through which solar energy is fixed into living (biochemical) energy, feeds the biosphere. It is photosynthesis through which water becomes an integral part of the living organisms. It is photosynthesis which creates a living dimension of global pathway of water dynamism. It is photosynthesis which determines the patterns of global climate making it benevolent for the biosphere. Photosynthesis, in essence, is a phenomenon to strike ecological integrity. Photosynthesis itself, however, is largely governed by anthropogenic factors, for most of the terrestrial ecosystems to inhabit photosynthesizing organisms (chlorophyll-containing green vegetation) are managed by human beings. Since structure and functioning of Earth's ecosystems is significantly influenced by anthropogenic factors, the on-going changes in global climate system are also owing to human intervention.

Water productivity of ecosystems, thus, eventually is a function governed by energy flows of the biosphere largely governed by photosynthesis; hence by human factors. An ecologically sound management of Earth's ecosystems that leads to enhancement in photosynthesis to its maximum efficiency would be phenomenal in increasing water productivity to be pronounced in ecological integrity of the ecosystems.

Sustainable development, in essence, emanates from ecological integrity. Ecological integrity optimizes ecosystem functions, maintains ecological equilibrium, combats entropy, and ensures flows of the ecosystem products of socioeconomic significance, including water, foods and raw material of materialistic values. We can restore ecological integrity of our ecosystems through their ecological regeneration to their ecological climax state. Terrestrial ecosystems stocked with climax vegetation and vibrant with photosynthesis at maximum efficiency will serve as a cornucopia of socioeconomic development of our societies.

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