NorCal Open Access Publications
Journal of Aquatic Research and Marine Sciences
Volume 2019; Issue 3
Sharma RK

Opinion Article

Forest Development and Water Resource Improvement: The Latest Researches

Ramesh Kumar Sharma*

Scientific Writer, Food and Environment Issues, Bikaner, Rajasthan, India

***Corresponding author:** Ramesh Kumar Sharma, Scientific Writer, Food and Environment Issues, Bikaner, Rajasthan, India. Ph: +91-7627011619, Email: rksharma.writer@rediffmail.com

Received Date: 26 May, 2019; **Accepted Date:** 01 July, 2019; **Published Date:** 11 July, 2019

Abstract

Despite acceptance of the fact that forest trees attract humidity and tend to create rain clouds and maintain groundwater level, the attempts of forestation or tree plantation are often considered as acts resulting in lesser water availability especially in dry regions. The 'intermediate or optimum tree cover theory' stating that groundwater recharge is maximized at an intermediate tree density, came in light. The limitation of this theory appears to be the unaccountability of strong groundcover-groundwater correlation, particularly in wet regions. Nowadays 'minimum forest cover theory' seems again in limelight with the emphasis on soil conservation. In this paper, an attempt is made to conceptualize the forest development and water resource improvement phenomena in the light of the latest researches by means of unification of their correlations observed in dry and wet regions. A hypothesis: people's habit of living in forests as integral part of biosphere might lead to upliftment of groundwater, evolved in this attempt, appears as a specific area of study.

Keywords: Groundcover-Groundwater Correlation; Improvement Via Forest Development; Integral Humanism; Intermediate or Optimum Tree Cover Theory; Minimum Groundcover Theory

Introduction

The often-averred statement, 'man is a social animal,' perhaps exhibits two aspects of human-biosphere interaction; first that the man is part and parcel of biosphere and second that the man is the supreme over all fauna and flora. The availability of good quality of air, water and food for biosphere on the planet earth to an extent, depends upon the human interactions of both the exploitation and the conservation of natural resources. According to McGuire, despite the experience in Europe, national recognition in the USA concerning the role of forests in protecting watersheds did not occur until the nineteenth century, and during the mid to late nineteenth century there was much speculation on the role that forests played in climate [1]. The Indian story contrarily appears to be historically initiating with dense forestation, but undergoing deforestation in the British colonial period and accelerated deforestation in the post-independence time after 15th August 1947 [2]. In 1960s Pandit Deen Dayal Upadhyay, an economic and political thinker, presented his theory of integral humanism, based on not only economic or political grounds but also regenerative natural cycles - water cycle, nitrogen cycle, oxygen cycle etc. [3]. The quintessence of integral humanism theory is that human integrity to biosphere to maintain biodiversity and forests is required by nature to maintain regenerative natural cycles including water cycle. However, there are observations that forest trees attract humidity and tend to create rain clouds and maintain groundwater levels. But it has also been observed that the attempts of forestation often tend to reduce water availability. In this paper, an attempt is made to visualize water resource improvement as an impact of human integrity with nature like dense forestation and also mention anomaly in this context, particularly observed in dry regions. In the way to theorize this phenomenon, the intermediate or optimum tree cover theory explains the anomaly of dry regions. But the latest researches, concerning with impact of forest development on water resource improvement anyhow attempt to bring minimum forest cover theory again in limelight. This matter is discussed in the paper and it is concluded that fundamental researches are required in the field of ecology for systematic studies to theoretically judge the correlation of forest development and improvement of natural resources including water. In this attempt, a hypothesis, concerning with human integrity to biosphere and groundwater upliftment, is evolved.

Water Resource Improvement visualized as Impact of Human Integrity with Nature

In the ancient Indian texts, the water resource improvement is often visualized as impact of human integrity with nature, say forest or biosphere. The dense forest Vrundavan is an example for which Ved Vyas writes in Srimadbhagawata, "It is the Vrundavan (a dense bio-diversified forest) where the season appears as the spring (even in the summer), where the sound of springs so prevails that the cry (sound) of crickets is not audible, where water droplets scatter from the springs, where air flows touching the waves of river (Yamuna river), ponds and springs are fragrant by flowers like Kalhar, utpal etc types of lotuses, where foresters (people living in forests) do not experience much heat from intense sunrays, where the river carries abundant water and big waves formed use to kiss and clean its banks, where the intense sunshine is incapable to dry the wet land and green grass, where tree branches are laden with beautiful flowers, where the birds twitter, deer run, peacocks and bees sing, cuckoos coo and black bees bum. In such a charming forest Krusna and Balrama take walk, play and recreate with the cattle keeper friends and the cows." [4].

In this depiction of the natural scenery of a dense bio-diversified forest, the human being - foresters, cattle keepers and princes (Krusna and Balrama) - too appears as an integral part of entire biosphere. The question arises whether the forest is recognized by natural resources, particularly tree cover and water resources, or by integrated biodiversity, fauna and flora including humans. It appears that biodiversity, along with human integrity to biosphere, is the foundation of the forest environment. And within the limitations of biodiversity and human integrity to entire fauna and flora, the availability of water resource is perhaps correlated with tree cover. According to Science American Heritage Science Dictionary, trees prevent the process of desertification (that means, maintain soil conservation and water cycle) [5]. Therefore, it can be safely said that both the ancient texts like Srimadbhagawata and modern write-ups like Science American Heritage Science Dictionary emphasize the concepts of forestation, as integral human attempts, for water resource improvement.

Forestation Reduces Water Resource Availability: Anomaly of Dry Regions

The popular hypothesis of Makarieva, explaining how forests attract moist air and increase rainfall in area covered by trees [6] has been several times challenged by the results of human forestation attempts, particularly made in dry regions. For example, Canadell and Raupach, in their article 'Managing Forests for Climate Change', opine that there exists a risk of spread of stored carbon (in the form of vegetation in reforested areas) back in the atmosphere via forest fire or insect outbreak; reforestation can consume water from other such activities and extract moisture from the soil on a large scale [7]. Of course, they admit that reduced harvesting rates and fire suppression have caused an increase in the forest biomass in the western United States, but still state that longer and hotter dry seasons affect the frequency of fires with an increase of about a factor of four [7]. The question arises whether Makarieva-Gorshkov hypothesis is correct or Canadell-Raupach's observation is worth considering. The author of this paper attempts to consider both the facts as not contradictory submissions. That means attraction of moist air and increase of rainfall is the general outcome of forestation; however, an anomaly of dry regions exists where forestation attempts might reduce water resource availability. The management of forests is a very big issue. The USA and Canada are neighbours but differ in forest management aspects. The national forest cover was decreased by 0.34% from 1990 to 2015 in Canada with the lowest deforestation rate in world [8] and contribute 7% share to national economy [9].

Intermediate or Optimum Tree Cover Theory

On account of the prevailing view that trees reduce water availability, despite several benefits, tree plantation in dry regions is often discouraged. The intermediate (or optimum) tree cover theory, developed by Ilstedt on experimental basis, stating that groundwater recharge is maximized at an intermediate tree density, suggested to change the prevailing view about tree planting in dry regions and succeeded a lot particularly in Africa continent [10]. According to this theory, below the optimal tree density the benefits from any additional trees on water percolation exceed their extra water, leading to increased groundwater recharge, while above the optimum the opposite occurs [10]. The theory appears conceptualizing the anomaly of dry regions, where attempts of forestation appear to reduce the availability of water resource. But the limitation of intermediate or optimum tree cover theory appears to be the unaccountability of strong groundcover (mostly forest-pasture cover)-groundwater correlation, particularly in wet regions. Furthermore, the theory connotes that 0% and 100% groundcover (mostly forests and pastures) will lead to maximum risk of groundwater depletion or the maximum risk of soil loss, due to intense rainfall, because only the conserved soils can hold the groundwater. The connotation of the theory appears to be partly correct. However, 0% groundcover situation will lead to maximum groundwater depletion, it seems quite tenable. But 100% groundwater situation too lead to the same outcome, it is untenable. In the light of the latest researches, it would be appropriate to distinguish the modes of forestation, particularly afforestation (forestation of long-ago deforested tract), reforestation (forestation of a recently deforested tract) and dense forestation (forestation of scattered forests).

The intermediate or optimum cover theory, however, can motivate afforestation and reforestation attempts but might discourage dense forestation attempts.

Forest Development and Water Resource Improvement in the light of Latest Researches

The latest researches, particularly in the wet regions, confirm the positive impact of forest development on the water resource availability, cleanliness and purity. It has been found, in attempts to predict potential pollution contributions at watershed scales, that agricultural and residential lands act as nutrient sources, while grass and forest lands are nutrient sinks [11]. The forest dynamics has been a serious subject, but recently there is an opportunity in development and application of forest dynamics models [12]. Now the advantages of forests - highlighted in the literature on forest, water and energy cycle interactions - have been well investigated and it has been almost established that forest can be used, in particular, to mitigate problems related to water scarcity and global warming [13]. Nowadays, it is almost accepted that large-scale environmental perturbations, such as land use change, could drive major shifts in microbial populations that result in substantial biogeochemical changes, and afforestation has many impacts on soil and nutrient cycling that are likely linked to microbial activity and functions [14]. As far as land use aspects are concerned, the question arises in this context, whether deforestation for residential or other uses and reforestation for environmental benefits may simultaneously run or there should always remain a minimum dense forest tract in a country all the time for better availability of natural resources including water. It appears that groundwater could be better held by conserved soils and efficiently uplifted via tree roots. The soil erosion is a natural process that either cannot be avoided or can be completely avoided by means of almost 100 per cent groundcover, it is the quintessence of BS (bare soil subfactor)–ABS (bare soil area) relationship developed by Bagrello [15]. The forestation line derived from Bagarello's bare soil area quadratic equation by Sharma leads to conclusion that one-fourth, one-third, half and complete groundcovers are capable of covering 40%, 50%, 70% and 100% soil loss risk respectively [16]. It connotes that ample availability of clean potable water and other natural resources, say pure inhalable air and safe eatable food, is possible when 100% soil loss risk is covered by means of forestation up to complete groundcover, while maintenance of partial groundcover leads to partial soil loss cover and consequent partial availability of water and all-natural resources.

Discussion

Minimum Forest Cover Theory again in Limelight?

In this way, the attempts of theorization of observed concepts linked with phenomena regarding impact of forestation as well as deforestation on availability of natural resources including water, raise an important issue for discussion. The worth discussing issue is whether the minimum forest cover theory (for example, as per Indian forest policy 33.33% of country's landscape should be under dense forest cover) will be again in limelight or the intermediate tree cover theory will dominate in the name of motivating forestation process in the hot regions. Another point of discussion is whether the minimum forest cover theory is the perfect environmental thematic presentation or just the tact to keep a little forest tract saved from deforestation process taking place in a country to extend probably industrial, agriculture and roadways infrastructure.

According to Bagarello and Ferro's bare soil subfactor and Sharma's forestation line concepts, the minimum forest cover theory, like the intermediate tree cover theory, is the tact not the thematic presentation as the theory of ecological resources (including water resource) conservation. The Indian forest policy to keep one-third land area under forest cover ensures only 50% soil loss risk cover and perhaps 50% water availability (compared to water availability in 100% groundcover situation). Since complete landscape coverage is required for total soil loss risk cover, and forest-pasture cover is far better than infrastructure cover, it would be quite appropriate for human being to learn to live as a part and parcel of entire biosphere in the forests. Perhaps it would be a way for discovery of eco-friendly dimension of technology. It would be relevant to remember Pandit Deen Dayal Upadhyay, who presented theory of integral humanism in 1960s to make people feel that they are integral part of biosphere instead of mechanical or robotic networks [17]. In other words, humans - being integral part of biosphere – should consume the same kind (quality) of food and water and air which all the creatures do [18]. In other words, the ample availability of potable water, inhalable air and eatable foods appears to be possible when people habitually adapt eco-environment of dense bio-diversified forests for sustenance and livelihood.

Conclusion

In the light of above discussion, it is concluded that tree cover, biodiversity, soil conservation and human integrity to biosphere appear to be truly the dimensions of forestry. And more fundamental researches are required in the field of ecology to systematically study how to correlate forest development and water resource improvement. When human being will become habitual of living in forests as integral part of biosphere, ecological technologies will evolve, soil will be enriched with microbial diversity and groundwater will be uplifted; it is a hypothesis.

Acknowledgement

The author thanks Dr Ivan P. Vizcaino, reviewer of this paper, for valuable suggestions.

References

1. McGuire KJ, Lickens GE (2011) Chapter 1 Forest hydrology and biogeochemistry: synthesis of past researches and future directions, Historical roots of forest hydrology and biogeochemistry. Springer Pp. 4.
2. Sharma RK, Parisi S (2017) 4.4 India towards intensive industrial and integrated farming practices. Toxins and contaminants in Indian food products. Springer Pp. 41.

3. Sharma RK (2018) Integral Humanism in context of regenerative natural cycles. Scholars' Press. Pp. 29-38.

4. Ved Vyas, Chapter 18, Shlokas 3-8, Srimadbhagawata Mahapurana, Second part, 10th skandha, 34th Edition. Gita Press. Pp. 214-215.

5. Future of Working. 10 Advantages and disadvantages of deforestation.

6. Makarieva AM, Gorshkov VG (2007) Biotic pump of atmospheric moisture as driver of the hydrological cycle on land. Hydrol Earth System Sci. 11: 1013-1033.

7. Canadell JG, Raupach MR (2008) Managing forests for climate change. Sci 320: 1456-1457.

8. Indicator: Forest area (2014) Natural Resources Canada. Government of Canada.

9. How does the forest industry contribute to the economy (2014) Natural Resources Canada

10. Ilstedt U, Bargues Tobella A, Bazie HR, Bayala J, et al. (2016) Intermediate tree cover can maximize groundwater recharge in the seasonally dry tropics. Sci Rep 6: 21930.

11. Sun R, Cheng X, Chen L (2018) A precipitation–weighted landscape structure model to predict potential pollution contributions at watershed scales. Landscape Ecol 33: 1603-1616.

12. Shifley RS, He HS, Heike L, Wang WJ, Wenchi J, et al. (2017) The past and future of modeling forest dynamics: from growth and yield curves to forest landscape models. Landscape Ecol 32:1307-1325.

13. Ellison D, Morris CE, Locatelli B, Sheil D, Cohen J, et al. (2017) Trees, forests and water: Cool insights for a hot world. Global Environ Change 43: 51-61.

14. Berthrong ST, Schadt CW, Pineiro G, Jackson RB (2009) Afforestation alters the composition of functional genes in soil and biogeochemical processes in South American grasslands. Appl Environ Microbiol 75: 6240-6248.

15. Bagarello V, Ferro V (2006) Erosione e conservazion del suolo. Mc Graw-Hill.

16. Sharma RK (2018) Environmental land use aspects in Indian context. Res & Rev: J Ecol Environ Sci 6: 46-49.

17. Walker R (2011) Hindutva: Indian nationalism and politics of religious violence. In: Denton PH, editor. Believers in the battlespace: religion, ideology and war. Kingston: Canadian Defence Academy Press.

18. Sharma RK, Parisi S (2017) 5.3 Ethics regarding protection of biosphere from Detrimental Chemicals: Anti-pesticide movement and integral humanism. Toxins and Contaminants in Indian Food Products. Springer Pp.59.