Journal of Environmental Science & Engineering (JESE)

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An Overview of Biomass Estimation Methods

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Availability of biomass is critical for further development of biomass-based systems. While technology benefits have been established, understanding and elucidating biomass estimation is equally essential. The available literature demonstrates development and application of various estimation methods. This paper gives an overview of different biomass estimation methods based on their working principles, application at different geological scales and challenges associated with them. Biomass estimation methods can be segregated into field measurement-based, remote sensing-based, and GIS-based methods. Each method has its own limitations, Wood fuel Integrated Supply/Demand Overview Mapping approach integrate the estimation of availability as well as the consumption of biomass. Although, there is a great interest in obtaining reliable biomass estimates, there is no agreement on best practices amongst these methods. The scale can be decided based on the requirements of the study and available resources. Spatial unit is the lowest administrative unit as it would help to avoid any aggregations or generalisations that may negatively affect the purpose of biomass estimation.

Keywords: *biomass; estimation methods; uncertainties*

Introduction :

Biomass was a significant source of energy until the advent of fossil fuels. Technological advancements, industrial drive, and government policies ensured the generation and consumption of fossil fuels in exponential proportions. The extensive use of these fuels resulted in climate change [Wuebbles and Jain, 2001; Suranovic, 2013; Salunkhe et. al., 2018]. Thus, the need to eliminate them by substituting renewable energy lead to the inclusion of renewable energy as one of 16 Sustainable Development Goals [Gabrielle et al., 2014; Acheampong et al., 2017; Rosenthal et al., 2018]. Additionally, growing concerns over energy security have renewed interest in the biomass sector in several countries [Nelson et al., 1999; Lucia et al., 2006; Guta, 2012; Mirzabaev et al., 2015; Acheampong et al., 2017]. Therefore, it has become imperative for the biomass sector to innovate and develop processing technologies, accurate estimation methods, encourage the use of such technologies and take steps to commercialise them while streamlining the biomass supply chain policy and market instruments for efficient and effective use of biomass [Wee et al., 2012; Bilgili et al. 2017].

Estimation of biomass is essential for a wide range of applications, such as characterising forest conditions and processes [Landsberg and Waring 1997; Fournier et al. 2003; Feldpausch et al. 2006; Szwagrzyk and Gazda 2007]; estimating forest productivity [Zhao and Zhou 2005; Duursma et al. 2007; Feng et al. 2007; Keeling and Phillips 2007]; assessing bioenergy potential, economic and environmental consequences of energy production from biomass [Silversides 1982; Top et al. 2006; Mikšys et al. 2007; Stupak et al. 2007]. The lack of appropriate assessment on the quantity of biomass and its availability throughout the year pose critical challenges such as framing carbon and bioenergy policies [Fassnacht et al. 2014)] identifying optimal locations for bioenergy plants [Temesgen et al. 2015], quantifying carbon stocks [Lu 2006; Temesgen et al. 2015; Gebrewahid et al. 2018; Salunkhe et al. 2018], assessing climate change impacts [Temesgen et al. 2015], forest management [Fassnacht et al. 2014; Sinha et al. 2015], ecosystem functioning [Lu 2006], devising appropriate supply chain mechanisms [Batidzirai et al. 2006; Wangchuk et al. 2014; Siebert and Belsky 2015; Zhang 2019], food security [Kumarappan et al. 2009; Liao et al. 2019] and other allied activities. Biomass estimation is a complex process, and there exist several methods to assess biomass (above- and below-ground).

The estimation of biomass may vary from local to global scales, and significant discrepancies in estimation have

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Seasonal Variations in Groundwater Quality Using Water Quality Index (WQI) of Mewat Region, Haryana, India

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The study is carried out to assess the groundwater quality during both the monsoon seasons of Mewat region in Haryana, India where the groundwater is used for irrigation and drinking. For this study, 60 groundwater samples were gathered in both the season i.e. (pre- and post-monsoon) and were subjected to physicochemical analysis of eleven parameters, t-test, correlation analysis and water quality index (WQI). The paired sample t-test proved that the groundwater quality based on physicochemical analysis varies significantly in the two seasons under consideration ($t_{calculated} > t_{critical}$) which indicates that rainy season very much impacts the concentration of the physicochemical indexes and hence WQI. The drinking water quality index values ranges from 159.56- 1249.8 in pre-monsoon and from 84.03-510.33 in the post- monsoon season, indicating four categories i.e., good, poor, very poor and unfit. Overall, none of the samples is appropriate for drinking in pre monsoon. Only 13% of the samples (4 sampling locations) were found to be of good quality in post monsoon season. Correlation analysis results showed relationship of physicochemical parameters with each other. The findings of the paper showed that the quality of the groundwater of the study area is influenced by ion exchange processes, the rock weathering, industrial effluent and anthropogenic activities.

Keywords: *Correlation analysis, groundwater quality, spider map, t-test, water quality index (WQI)*

Introduction :

Water plays a vital role in all types of living things. Groundwater is extensively used as a resource of drinking for millions of rural and urban families. As emphasized by Patil et. al., [2010] the groundwater is considered to be relatively clean and unpolluted than surface water. Pollution of this precious resource is the major consequence of industrialization and urbanization [Mishra et al. 2008a]. Agriculture is considered the most important, source of pollution caused from fertilizers, insecticides, and animal wastes that impacts the quality of groundwater [Mishra et. al., 2008a]. It was observed that due to human activities, groundwater is getting contaminated. In the 21st century, India is encountering groundwater crisis due to its overuse as examined [CGWB, 2017] and also due to growing pollution from point and non-point causes of pollution as inspected [SoE, 2009]. Discharge of various kinds of pollutants into surface water bodies (lakes, ponds, reservoirs, rivers, and streams) makes it unfit for drinking, agriculture practices and industrial uses. Several states in India have been detected with diseases rising from water [Nag et.al. 1992, Kumar et. al. 1992, Krishan et.al. 2004, Bakore et.al 2004, Soodh et. al. 2005, Omezuruike et. al. 2008] such as hepatitis, typhoid, cholera, diarrhea, fluorosis etc. Hence, there is always a demand to protect and manage groundwater quality. Water Quality Index (WQI) is considered as an efficient index to represent the overall quality of the water. It is beneficial for managing the water resources. It indicates the impact of various water quality parameters on a given water resource. WQI is determined to examine groundwater suitability for human utilization. Horton [1965] and Landwehr [1974] started classification of quality of water. Brown et al. [1970] created a general water quality index. Bhargava [1983a, b, c], expressed water quality index as a number (starting from 0 for extremely polluted to 100 for unpolluted water) indicating the effect of the parameters magnifying the pollution load. In this proposed research, WQI is calculated using the Weighted Arithmetic Index method. Eleven parameters were considered for calculating WQI for assessment of quality of groundwater of Mewat.

Materials and Methods

Study Area :

Mewat is a district of Haryana state in northern India. The district was formed from former Gurgaon and Hathin Block of Faridabad districts in 2005. It is bordered from north by Gurgaon district, west by Rewari district and from east by Faridabad and Palwal districts. Nuh town is the headquarters of this district as given [CGWB 2017]. Mewat occupies an area of 1859.61 km². The population of Mewat is 10, 89,263 as examined [2011 census]. Mewat is inhabited by the Meos, and their primary living is agriculture. The district is socio-economically backward. There are five blocks in the district

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Domestic Wastewater Treatment using Constructed Wetland and Impact of Treated Wastewater Irrigation on Soil Physicochemical Properties and Crop Yield

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A comparative study was carried out to evaluate the effects of untreated and constructed wetland treated wastewater on physicochemical parameters of soil in different depths and crop yield. The designed constructed wetland has reduced the nutrient levels up to 47 -70 %, salts up to 10 -20 %, and organic load (BOD_5, COD, and TSS) up to 80-90% in the treated wastewater. After irrigating different experimental plots, results show that treated wastewater significantly reduced the concentration of organic carbon by 20.38%, total nitrogen by 18.65%, and available phosphorus by 17.56% in the soil as compared to that untreated wastewater irrigated plots. Moreover, a slight reduction in soil electrical conductivity, available potassium, cation exchangeable capacity, and exchangeable sodium percent was also observed. Most of the physical properties of soil remain unaffected with any of the treatments. The study concludes that irrigation with treated wastewater has the potential to prevent soil degradation in the longer-term without affecting normal crop yield.

Keywords : *Agriculture; Constructed Wetlands; Soil degradation; Wastewater reuse*

Introduction

Rapid urbanization and population surge have led to extreme water scarcity which requires an urgent resolution. In such a scenario, wastewater reclamation is becoming a viable option as freshwater counts as a sparse commodity (Shingare et al. 2019). The recycling and reuse of wastewaters for agricultural purposes can lessen the burden on environmental water sources and aids in its conservation (USEPA, 1992; Gregory, 2000; Almuktar et al. 2018). The use of wastewater for crop irrigation is not a new concept. It has been reported long back in the 19th-century from various developing countries (Yekutiel et al. 1986). Even today, the trend of using municipal and industrial wastewater for agricultural purposes is prevalent in urban and peri-urban areas of most of the countries (Kiziloglu et al. 2008; Raschid-sally and Jayakody, 2009).

Wastewater can be used as a dependable and perennial source of water supply required for irrigation. Another benefit of wastewater includes its supplementary nutrients and organic matter content which enhances soil fertility and productivity (Horswell et al. 2003; Liu et al. 2005). Numerous authors reported an increase in the organic fraction of the soil and improved structure due to wastewater application (Rusan et al. 2007; Galavi et al. 2010; Sánchez-González et al. 2017; Ganjegunte et al. 2018). Boruah and Hazarika, (2010) and Kiziloglu et al. (2008) reported the increased concentration of exchangeable and water-soluble cations like Na^+, K^+, Ca^{2+}, and, Mg^{2+} in wastewater irrigated soil compared to those irrigated with treated water and groundwater. Besides, wastewater applications can also boost the proliferation of soil microorganisms and related metabolic activities (Meli et al. 2002; Ramirez-fuentes et al. 2002).

However, irrigation with untreated wastewater raises the concern related to agronomic nature like the accumulation of salts, nutrients, and heavy metals (Heidarpour et al. 2007; Rusan et al. 2007; Van der Zee et al. 2017). Such kind of soil deterioration can be avoided by treating the wastewater before it is used for agricultural and landscape irrigation (Pereira et al. 2002). It is widely known that Constructed Wetlands (CWs) offer an economic and robust technological solution to treat domestic wastewater for irrigation purposes. Moreover, the small scale units of CWs can be installed in the agricultural fields for the prior treatment of wastewater. CW not only provides safe water for the agricultural crops but also adds to the aesthetic value of the landscape. Horizontal subsurface flow constructed wetland is most commonly used for secondary treatment of domestic wastewater. These are excellent in the removal of solids and organic matter, but less efficient in the removal of nutrients (El Hamouri et al. 2007; Masi and Martinuzzi, 2007; Brix et al. 2007; Vymazal 2009). Irrigation with such nutrient-rich treated wastewater can help to bring down the demand for fertilizer application thereby

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Mercury Accumulation into the Crop Plants (Vegetables/Fruits) in Agricultural Lands Nearby Nagpur, Maharashtra State, India

SHARDA DHADSE, PIYUSH GHOSHE, ROHINI RAUT AND MALLIKARJUNA RAO

The current study was focused on mercury (Hg) accumulation and the assessment of various other heavy metals such as Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, and Zn in six vegetable/fruit plant-like Spinach, sweet lime (Mosambi), Banana, Fenugreek, Pigeon pea, and Coriander. Plant samples were collected from the Pawangaon village agricultural fields, the area farming/irrigation was dependent on Nag river water. In this study, the irrigating water was analyzed and recorded the Hg concentration as 0.65mg/L and other toxic elements in the irrigating river water, plant biomass (leaf) and regarding soils was analyzed for Hg and other heavy metal contamination. Among six plants leaf, sweet lime has detected the highest Hg (33.19 ppb) concentration and the related soil Hg deposition was 63.23 ppb, it clearly shows the toxic heavy metal contamination raise in the local agricultural food web, it shows the alarm towards future heavy metal pollution in Nagpur agricultural field.

Keywords : *Mercury Accumulation, Heavy Metals Pollution, Agricultural Fields, Irrigated Water, Leaf Matter, Food Web.*

Introduction

Nagpur is the third major city in Maharashtra after Pune and Mumbai, it is the winter capital of Maharashtra and also one of the main commercial and political capital located in the Vidarbha region. Situated in 21º06' N and 79º 03' E and also well-known as "orange city" due to the highest cultivation of oranges and one of the fastest rising city which covers about 220 sq.km area (Puri et al, 2011). Contamination of mercury can also decrease photosynthesis, transpiration rate and also reduce the chlorophyll synthesis. The level of potassium, magnesium, and manganese can be decreased due to the mercury accumulation in plants, and by decreasing the level of these elements; there may be a change in the permeability of the cell membrane. Hg^{2+} in the form of mercury that can be infected to the plasma membrane and shows the toxicity effects in the aerial parts of the plants such as shoots (Boening, 2000). The Nag River receives freshwater only during the monsoon, onto the riverside, disposal of solid waste into sewage such as plastics, waste food and other material which can be dumped into the river, most of this action leads the Nag river water pollution (Varade et al, 2018). The untreated sewage and waste matter from industries of about 345 MLD were discharged directly into the river. In the non-monsoon period only, the effluents run through the river. Therefore, Nag river water is a dark gray and polluted smell. The eco-system of the Nag river is under maximum stress due to the water pollution by anthropogenic and natural sources (Kumar et al, 2017). Mercury can introduce harmful errors in the genetic material of plant species, Hg ions enter into the cells then it forms covalent bonds due to their easily deformable outer electron shells. DNA has many reactive sites for the Hg bonding, it results in many toxic effects including chromosomal damage. It has been confirmed that low doses of Hg in plants affect c-mitosis, sister chromatid exchanges, chromosomal aberrations, and spindle alterations (Azevedo and Rodriguez, 2012). The interaction of mercury with the sulfur atom of nucleosides and amino acids shows the mutagenic effects on the plants, similarly, the ligation of Hg to nucleobases such as purine and pyrimidines can lead to the impairing of nucleobases and changes the amino acid sequences of proteins in plants (Zalups, 2000).

Materials and Methods

Study area

The study was focused on the accumulation of toxic heavy metals including Mercury in the river banks of Nag river, Pawangaon village. Six crops were selected and collected the leafs material, with reference site soil and water and analysis was carried out in CSIR - National Environmental Engineering Research Institute, Nagpur, Maharashtra, India.

Sample collection

Selected six plats species S*pinacia oleracea* L. (Spinach), *Citrus limetta* Risso (Sweet lemon), *Musa acuminata* Colla (Banana), *Trigonella foenum-graecum* L. (Fenugreek), *Cajanus cajan* (L.) Millsp. (Pigeon pea) and *Coriandrum sativum* L. (Coriander) were sampled from the river basin of the Nag river region. On the other side soil and water samples were collected and analyzed for heavy metal

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An Eco-Friendly Strategy for the Production of Cellulose Acetate and Development of thin Films from Jackfruit Peel using Polyethylene Glycol

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An efficient route is developed for the utilisation of agricultural waste materials for extraction of cellulose and its acetylation. Cellulose acetylation is usually performed using acetic anhydride, a hazardous and prohibited chemical. In the present study, pure cellulose is extracted from jack fruit peel and the acetylation was carried out via a multicomponent one pot reaction which bypassed the use of acetic anhydride. These cellulose acetates (CA) were used as plasticizers for the development of thin films using a solvent casting process using polyethylene glycol (PEG). The CA-PEG film was characterized by Fourier Transform-Infrared (FT-IR) and X-ray diffraction techniques (XRD). The action of acids, alkalis and salt are investigated. The CA-PEG film was found to be resistant to both acids and salts but is affected to some extent by alkalis. Such thin films can be classified into biodegradable, biobased and compostable by nature on the basis of investigations.

Key words: *Cellulose acetate; Thin films; Biowaste; Jack fruit peel; PEG*

Introduction

Non-degradable plastics are inexpensive and durable which led to the accumulation of plastics in the environment that terribly affects human beings, wild life and all environmental processes (Forde et al. 2016; Harrison, 2001; Hester and Harrison, 2011). It is high-time to replace non degradable plastics by biodegradable ones that disintegrate into organic matter and compost in a particular time (Biswas et al. 2006; Thompson et al. 2009). Biodegradable polymers can be developed from biomass or bio-derived monomers. These materials are to be chosen because of their abundant availability, low cost, high specific strength, improvable mechanical and barrier properties (Ach, 1993; Bilo et al. 2018; Emadian et al. 2017). In this context, the use of jack fruit peel for the extraction of cellulose acetate using an environmentally friendly route to the manufacturing of new products with low production costs for high-quality finished products is promising. Cellulose acetate can be easily dissolved in organic solvents compared to cellulose and can be modified with chemicals to satisfy the green requirements such as biodegradable, reusable and recyclable (Bayer et al. 2014; Fei et al. 2015; Imre and Pukánszky, 2013; Puls and Hölter, 2011; Rivero et al. 2017).

One of the main applications of cellulose acetate is in biodegradable packaging because of their advantages like reducing package volume, weight and has control over moisture, gas and solute interchanges (Brodin et al. 2017; Muller et al. 2017). Several studies are reported for the extraction of cellulose acetate from biomass and compared the mechanical and thermal stabilities of films produced from cellulose acetate (Ach, 1993; Biswas et al. 2006; Fei et al. 2015; Puls et al. 2011). In all cases acetic anhydride, a severely hazardous chemical is used as acetylating agent. In the present study, the extraction of cellulose acetate was carried out using an environmental friendly green chemical route which bypasses the use of acetic anhydride. This new route provides a greener and cheaper method for acetylation by avoiding the high risk in the usage of acetic anhydride. Another highlight of this method is bleaching of powdered jack fruit peel was carried out using soap nut solution, thereby avoiding the use

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Social Distancing and Climate Change : A Psycho-Social Critique

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That climate change as an enlivening area of pervasive concerns can in no way dissociate itself from the continuing interventions of COVID-19 forms the canvass of this paper. Also, that Social Distancing, being emphasized often ritualistically, needs to be treated appositely for societal compulsion of the pandemic and finds an arguably tenable framework. The conceptual frailties that may occur in the wider context of thought-processes of celebrities like Karl Popper are reckoned with. Psychologically oriented contextualities pertaining to Social Distancing are looked into. That an overriding consideration lies in conceptualizing distances has been undertaken in depth so that even the neighbourhood is not glossed over. The behavioural pathways *vis-a-vis* Social Distancing are shown to figure conspicuously here so that the climate change assumes futurities, more so, in the impending context of the pandemic COVID-19.

Key Words : *Climate Change, Karl Popperian Sense, Metric Spaces, Modelling, Social Distancing*

Some Prefatory Notes

The use of the two words in Social Distancing (SD) taken together, seems to labour nowadays under a fatigue largely because of blatant usages in the public domain. COVID-19 has possibly allowed public figures to dabble in such exercises and often, competing adroitly in delivery modes [Basak et al., 2020; Brown, 2004]. Notwithstanding this, SD has come to stay essentially because of the intrinsicality it carries in wider domains. Shifts in behaviour, being so visibly palpable, are yet to be paradigms so that one can profitably move around in the thought-realms of a well known celebrity, J. Kuhn. Again, a query does arise about the origin of the behaviour as to whether it emerges from habits. So, a wider realm seems to creep in embracing all of them with, of course, SD not being at stake. While societal implications may take care of the adjective 'social', the term 'distance' continues to be a vague descript, unless the proximity is appropriately envisaged. One may agree to have it deliberated a bit later so that an in-depth treatment of 'distance' is not lost sight off. Even if we jump on to the fray on the usages of SD, the prognosis around it can hardly be stemmed. Climate, chiefly on account of pestering happenings around, may bring about changes. Climate Change (CC) with its entire halo around cannot alienate itself from impatient utterances and verbiages such as 'alarmists', 'deniers', etc. Following up the logic of happenings, one cannot disallow an entry into the pervasive domain of psychology. While one ought to dwell on the extant knowledge, the interest here lies in analyzing in-depth the closely related linkages between CC and SD, reinforced by psycho-social tenets.

CC *versus* SD *vis-à-vis* Psychology

A few words about behaviour closely pertaining to CC ought to be taken up first. Even if they appear to be born out of frustrated or even desperate exuberances, these, in one way or the other, turn out to be mutually propelling. Scepticism about the dynamics of climate has kept of hitting upon quiescent stages so that adjuncts on health, keep on surfacing. It is almost a truism to talk about healthy scepticisms; criticality, of course, not going unattended. Man-made CC does bring about weather endpoints, so that the climate extremism can hardly be precluded. A desired behaviour often imposed by CC, can temporarily remove a habit which may seek for alleys so as to re-assert itself. Habituated behaviour may emanate from exercises on cross-coupling. Isolation and other shifts in behaviour, again primarily because of SD, can help Green House Gases (GHGs) to occur and hence CC to flourish. Almost a cyclical or repetitive behaviour with the mix-up of CC and SD can occur with an argumentative tenor to be developed below.

SD, if practised or insisted upon, turns out to be the human behaviour at different levels, aspiring for some unknown offshoots. An individual having embarked on SD does have a set of values and thought-modes. One can

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