Significance of Carbon Footprints Estimation in Changing Global Environment

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Abstract- *Anthropogenic carbon emissions plays a crucial role in global climate change by causing imbalance in carbon cycle, rainfall changes and a shift in earth's energy balance towards warming. The carbon footprint or the impact of an individual on environment responsible for creating greenhouse gases has emerged as a widely used metric to analyze CO2 emissions. Large carbon footprints indicates high level of natural resources depletion, therefore individual approaches to control the activities that causes impact on the environment, are initial measures to combat the problem. Further, the carbon management technique focusing on energy efficient processes like recycling, use of public transport, water consumption, managing pollutant inputs, analyzing product supply chain carbon emission and their mitigation, and assessing and applying carbon offset technology for various entities has potential to minimize the emission. The aim of this study is to discuss the increasing public interest in environment protection and the desire for eco□friendly consumption like demand for carbon labels on products and goods. The various approaches for calculating the individual's primary carbon footprint over which it has direct control or secondary carbon footprint those are associated with consumption of product and services are important factors to mitigate this problem.*

Keywords- CO2 emission, carbon footprint, environment protection, carbon reduction

I. INTRODUCTION

Carbon footprint' also referred as 'carbon emission accounting' mainly obtained from consumption rather than production from any anthropogenic activities or entity, has become more crucial in this changing global environment. The term introduced in 1990s by a Canadian environmentalist William Rees is more realistic the calculation of carbon emission and often includes other greenhouse gases, and is expressed in terms of measure of weight as in 'tons of CO2' annually by an individual. In other words, carbon footprints are the amount of carbon emissions [1] and can be referred as a component of the ecological footprint in form of resource consumption and waste absorption [2].

Although there is no clear definition of this term but in terms of ecology it stands for a certain amount of gaseous emissions that are closely related to climate change pertaining to human production or consumption activities [3]. Instead of using 'carbon footprints' the most appropriate term should be actually a 'carbon weight' of kilograms or tonnes per person or activity [4]. Carbon footprint is thus a measure of human demand on the Earth's ecosystems. It is a measure of demand for natural capital that may be differentiated with the earth's ecological capacity to regenerate. It also meant for the amount of biologically productive land and sea area necessary to supply the resources consumed by human population, along with assimilation of the associated waste [5]. Carbon footprints are an important arena for climate change governance extending beyond the realms of the international climate regime [6].

According to an estimate the per capita carbon footprint is expected to rise substantially in many countries specially the developing world over the next 50 years, mainly due to broad increase in the standard of living, so every citizens have to cut short carbon dioxide emissions in due time [7]. Carbon offset or carbon reduction technology becomes more meaningful with the modification in the living styles, use of energy-efficient products and switching towards food products with less carbon emission.

II. FACTORS RESPONSIBLE FOR CO2 EMISSIONS

Processes and factors responsible for greenhouse gas (GHG) emissions are unevenly distributed across and within countries. In developing countries Food and services and in rich countries mobility and manufactured goods are dominant entity in rich countries. The analysis of goods and services of 73 nations and 14 aggregate around the world reveals that 72% of greenhouse gas emissions are related to household consumption, 10% to government consumption, 18% to investments, 20% Food, 19% operation and maintenance of residences and 17% to mobility. The cross-national expenditure elasticity is 0.81 thus suggesting a global relationship between expenditure and emissions [8].

The food system process like raw material acquisition, processing, packaging, preservation, transportation, consumption, and disposal constitute a large part of greenhouse gases (GHGs) emissions [9]. The chemical shows a great impact on ecosystems and human health and a

big scientific challenge for ecotoxicology [10]. Aviation sector is the fastest growing source of GHG emissions, and it is projected that the world's commercial fleets will triple their CO2 emissions by 2050 [11]. Among the industrial sectors, the built environment creates the most pressure on the natural environment and according to an estimate buildings-related emissions are going to double by 2050 [12]. The Construction activities are considered to be the largest consumer and utilities the largest producer in the cities [13].

III. IMPACT OF CO2 EMISSIONS

The technology roadmap of global transport biofuels reveals that first generation biofuels dominate the market up to 2020, whereas the advanced generation biofuels that is divided into components like bioproductive land, built land, embodied energy, materials and waste, transport, and water consumption and carbon emissions, may constitute nearly 75% of biofuel production by 2050. Among these components bioproductive land shows maximum sharing, followed by carbon footprint, embodied energy, and water footprint [2]. The human-induced regional and global environmental changes have resulted in ecological nonsustainability and health risks requiring assessment of environmental footprint of global population health. The data suggests that the larger footprints may impair health giving rise to obesity and the impact is more in some lower-income countries. Thus there is a need of social and ecological sustainability with an equitable sharing of global environmental footprint [14].

CO2 emissions cause climate change, chemical pollution or depletion of natural resources, and thus it becomes necessary to generate the product or process more "green" [15]. Anthropogenic CO2 emissions have modified hydrological cycles, marine ecosystems and species lifecycles due to emissions from the consumption of coal followed by petroleum, natural gas, and biomass causing global habitat loss [16]. According to a study, in countries like India and the UK small-scale institutional sewage treatment plants (STPs) consume more energy than large-scale municipal plants. Among the total energy intensity of the municipal and institutional STPs, embodied energy from construction material followed by chemicals, shows maximum contribution. The fugitive emissions from large-scale were higher than small-scale STPs. Further, in India average electrical energy intensity is much lower compare to UK, for small-scale STPs therefore the country do not have resource recovery processes and hence use solar heat for sludge drying. Thus there is a need of designing low carbon strategies for urban waste infrastructure [17].

IV. ESTIMATION AND CALCULATION OF CARBON FOOTPRINTS

Carbon footprints referred as Greenhouse gas accountings are commonly used metrics to analyze environmental impacts due to different products, technologies, and services taken from several sectors [15], either directly or indirectly caused by an activity or accumulated during the life stages of a product [1]. Carbon footprints are an important tool for greenhouse gas management significant in all the areas of life and economy, as different products, bodies, and processes going worldwide, expressed as their carbon footprints, hence requires standards in accounting, emission cuts and verifications with special caution during selection of gases and order of emissions [18]. The selection of Greenhouse Gas, system settings, calculation and carbon footprint, selection of date and treatment of particular emissions are the most significant part of the analyses of the carbon footprint and assessment standards, especially for organizations and products [5].

The footprint methodologies used for environmental assessment should focus on environmental impacts like resource consumption, water consumption and CO2 emission leading to climate change [10]. Ecological Footprint Analysis (EFA) with straightforward calculation technique has potentiality to analyze the human impact on the environmental system by detecting the amount of biologically productive land that withstands a person's level of consumption and waste generation. The population growth analysis shows decline in per capita biocapacity, however the ecological footprint remains constant showing the deviation from sustainability. This simplified methodology needs further investigation especially in large, geographically and culturally varied nations [19]. Calculating carbon accounting and carbon footprints of the firms in general includes carbon labels on products and mapping of products life path, and sometimes encounters problem in case of small companies due to the principal source of CO2 emissions. This can be overcome by determining the emission and passing on the data stage to stage so that a company receives data from its direct trading partners and can distribute with comprehensive life cycle analyses making CO2 calculations easier [20].

There is a need of relevant methods to reduce the carbon footprint within the life cycle of food system process. Rational site selection, environmental choices of packaging stage, reduction in refrigeration dependence, and proper waste treatment, purchase patterns and substitution within food product categories and carbon tax can play significant role in GHG emissions reduction [9]. The assessment of chemical footprint includes two steps firstly use and emissions of a

product, sector, or entire economy, secondly the range of harming the ecosystem and its recovery, and thus requires an appropriate methodologies [10]. In various countries, the company like Waternet is engaged in treating waste water using chemicals and producing drinking water however affected by climate change. The use of Climate footprint methodology for mitigation of this problem should be given preference. Although some process like transport and purification directly generates CO2 emissions but can be reduced at supplier level [21].

An efficient and sustainable designing of cycling modal networks in the transport sector can be a best option to reduce carbon emissions and for this greenways should be developed and carbon costs and savings associated with this process should also be monitored to study and balance carbon footprint [22]. There should be special concern on evaluation of global supplier chain which includes total cost, delay in item delivery, quality rejection, and total value of purchasing (TVP). The model designing in quantification of carbon footprint contains multi-objective fuzzy linear programming for global supplier and quota allocation along with carbon caps and carbon emission management factors [23]. In European countries the assessment of the chemical footprint on the aquatic ecosystems is based on European water volume and the use of pesticides and provides a novel type of information about risk management, focusing mainly on chemicals and environmental compartments [24].

V. ABATEMENT OF CO2 EMISSIONS

The sources of the origin of greenhouse gas (GHG) emissions is becoming difficult in complex world economy with a massive growth in emission in developed compared to developing nations that do not show any spatial expansion of consumption footprints. Thus for abatement measures it becomes significant to link subnational entities like the states, cities and companies with downstream users and regulators who control primary emissions [25]. The abatement measures require addressing the issues of affluence and for this the governments should directly intervene in nonsustainable lifestyles and consumer behavior [16]. Product carbon footprint and characterizing their global warming potentials as point values using life cycle inventory results and quantitative uncertainty estimates helps in testing products environmental quality performance [26].

The methods adopted for Ecological Footprint not addresses all relevant issues at once however linking bioproductivity with ecosystem services and biodiversity and environmentally extended input-output analysis are best fitted tools for EF calculations [27]. The urban carbon management requires rational consumption and industrial symbiosis, and there should be a significant understanding and collaboration along all stages of the global supply chain. The cities with net carbon consumption should transfer carbon emissions by trading in carbon-intensive products, while the cities of net carbon production needed to produce carbon-intensive products for nonlocal consumers [13].

Firms or corporations and individuals can reduce carbon footprints or become carbon neutral by investing in a carbon-reducing activity or technology also referred as ‘carbon offsets’. To reduce the emission of greenhouse gases generating from aviation sector the scientific community have to become a role modal by cutting down on long-distance air travel [7]. The researcher has to focus on to tackle embodied carbon (EC) mitigation and reduction strategy, which requires a pluralistic approach. The use of materials with low EC, quality design, reuse of EC-intensive materials, and better policy drivers are key elements for a low carbon built environment [12]. It is a general tendency of a company or organizations to calculate carbon footprint by estimating direct emissions or emissions from purchased energy, thus have to focus on supply chain emissions. They should approach for integrated environmental life-cycle assessment that includes industry energy inputs plus direct emissions which gives a complete account of the total supply chain carbon emissions [28].

The policymakers, social movements and social scientists have made a great concern about carbon markets in governing carbon flows operating on the global and personal level. These markets regulated by state and civil society authorities connect carbon flows to the family circle and the lifestyles of citizen-consumers in a direct and meaningful manner and improves global climate change politics among citizen-consumers [29]. Although the policy makers are advocating for an alternative energy sources, but afforestation always remains the best option for the balance energy demand.

Therefore, the mitigation of CO2 emissions requires analysis and calculation of carbon footprint generated due to anthropogenic activities, by integrating all social, economical and political causes focusing on assessment of primary sources of carbon emission and reduction strategy.

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