Carbon farming and credit for mitigating greenhouse gases

Carbon farming describes a collection of eco-friendly techniques that have the ability to increase carbon sink into soil, i.e. carbon sequestration. Increasing C sink in the soil will help reduce the amount of CO_2, CH_4 and N_2O emissions in the environment. Carbon farming that leads to reduction in greenhouse gas (GHG) emissions is referred to as abatement activities. It holds carbon in vegetation and soils, and reduces GHG emissions. A carbon offset credit is a payment made by an emitter of carbon (a power plant, mine, oil refinery, etc.) to the developer or owner of a carbon sequestration process (owner of a forest reserve, biochar project developer, etc.). Carbon farming includes a single change in land management, such as zero tillage, agroforestry, methane-reducing feed supplements or stubble retention which maximizes capture of carbon and reduction of emissions[1]. In carbon farming, the amounts of CO_2, CH_4 and N_2O will be reduced with increasing C sinks in the soil because of increased soil aeration from organic carbon addition, which reduces denitrification and increases sink capacity for CH_4. Soil organic carbon adds electron acceptors and increases the redox-potential of the soil to decrease its N_2O source capacity. Carbon farming induces microbial immobilization of available N_2 in the soil, which decreases N_2O source capacity of the soil[2]. In carbon farming, there are some promising options that reduce GHG emissions; storage of carbon in soils and degraded rangelands through forests, tree plantings and regrowth, carbon storage through incorporation of biochar which is carbon-negative, and substitution of biofuels for fossil fuels[3]. Carbon farming gives land managers an opportunity to earn carbon credits through carbon storing or reducing GHG emissions on their own land. These carbon credits can then be sold to the Government-nominated authority who wishes to offset their emissions. Actually carbon farming is a voluntary carbon offsets scheme that provides economic rewards to landholders who take steps to reduce GHG emissions. Carbon farming reduces emissions by sequestration, where carbon is stored on land, and emissions avoidance, which prevents the GHG emissions from entering the atmosphere[4]. It involves implementing practices which improve the rate at which CO_2 is removed from the atmosphere and converted to plant material and/or soil organic matter. Carbon farming is successful when the gain of carbon resulting from enhanced land management and/or conservation practices exceeds the carbon losses. Its benefit includes GHG reduction, carbon sequestration, increased biodiversity, buffering against drought and greater water efficiency. Development of different programmes will facilitate the buying and selling of carbon credits between landholders and Government agencies. Landholders receive carbon credits for storing carbon in the soil and then the credits are assembled and sold desiring to reduce emissions. These credits are often bought independently of an exchange, and can boost the financial status of the client, and help prove how the practices are useful in mitigating the effects of the industrial society.

Initiatives by the Government of India may allow the land managers to earn carbon credits by reducing GHG emissions and storing carbon in vegetation and soil through carbon farming. Besides this, it may also allow landholders to generate offset credits from activities that reduce emissions or sequester carbon. The huge emitters will be able to utilize credits generated through carbon farming to meet their emission reduction targets. The production of biochar from farm waste and their application in soils may offer financial and environmental benefits. Once environmental cost of carbon-based GHG emission has been suitably internalized, we can expect market forces and the price mechanism. Considering the urgent need to take action on climate change, it is recommended to include carbon farming in the portfolio of mitigation strategies. Thus, carbon farming may serve as a promising mitigation strategy deserving much attention as many other geoengineering options.

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Nanomaterials from food packaging and commercial products into ecological and soil environment

Is a well-packed food item from the supermarket safe for human health and the environment? Also, how safe are a tennis racket, a pair of socks, a new television set, or cosmetics being used these days? Nowadays, engineered nanomaterials (ENMs) are being used in numerous consumer products worldwide, including sunscreens, pharmaceuticals, cleaning products, clothing, and even food packaging with an estimated global market value in 2015 of over US$ 1 trillion. Due to large demand for these ENMs along with increased production and use, there is also an increased risk to human health as well as adverse ecological consequences following their disposal to the environment. ENMs are defined as having at least one dimension in the order of 1–100 nm (more than 1000 times smaller than a human hair).

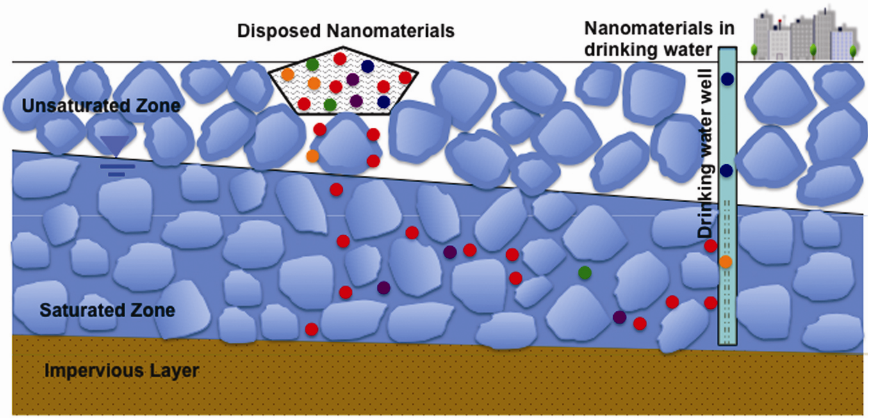

Figure 1. Scenarios for transport of nanomaterials from landfill sites to a drinking water well.

Nanomaterials have been receiving extensive interest in a variety of fields due to their unique and beneficial chemical, physical, mechanical and biological properties. However, these properties also give ENMs the innate ability to interact with biological systems, which can lead to detrimental environmental impacts (or even in remediation of contaminated soil and groundwater). The properties of materials, such as gold, silver or iron in the nano form can substantially differ from their parent materials. This generates a range of new applications of such materials in items, including food and food packaging products[1]. For example, quantum dots, fullerene, carbon nanotubes, silica and silver nanoparticles can be found in electronics, cosmetics and food packages. Some of them are safe and some may be hazardous to the environment and human health.

A recent study estimated that 63–91% of over 300 kilo tonnes of ENMs produced globally ended up in landfills by 2010; 8–28% entered the soils, 0.4–7% reached the surface water bodies, and 0.1–1.5% entered into the atmosphere[2]. However, the study[2] was a broad global estimate. In developing countries like India, the magnitude of potential ENM mass releases to the environment requires detailed investigation[3]. Unlike developed countries (USA, Europe or Japan), the Indian industries have started looking at nanotechnology only more recently, and many big companies have now initiated programmes on nanomaterials on their own or in collaboration with academic/research institutions. Many of these companies work on application of nanomaterials for value-addition despite the increased usage, there is limited or non-existent information available about the disposal of nanomaterial wastes in the Indian subcontinent[4].

In the event of transport of nanomaterials present in landfills or soils, it may disperse into drinking water sources or major surface water bodies (Figure 1). Given the large proportion of nanomaterials ending up in soils, an understanding of the impact of these nanomaterials on soil organisms or ecosystems is required for informed risk assessments and policy discussions. Interestingly, most of the potential hazards of these nanomaterials are undocumented and there is lack of awareness among common people[5].

There are significant studies available worldwide about the presence of nanoparticles in several food products being sold in supermarkets, but the health impacts of the nanomaterials being used in food items are not well understood even by manufacturers or big companies[1]. However, recent studies indicate that nanomaterials (such as carbon nanotubes, nano-clay and metal oxide nanoparticles) are present in several food-packaging materials and enter into several steps of the food chain[1]. They are supposed to improve the packaging characteristics and ultimately the food durability in the consumer markets. In addition, they are being used for invisible nano-leveling or nano-barcodes. However, the impact of nanomaterials from food packaging on human health is lacking in the Indian market and globally as well[4].

It is also not well known which types and categories of nanomaterials could be hazardous and to what extent to the human body and the environment. So an informed guideline may be needed for consumers of such nano-based food and commercial products manufactured by national and international companies.

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