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Circular agriculture in India: Policy perspective

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Resource depletion and agricultural pollution status in India and world

Economic growth, population explosion and improvement in quality of life are accompanied with the environment and ecological tradeoffs. As an example, human pressure is compromising biodiversity loss despite continued international efforts, especially the Convention on Biological Diversity (CBD). According to an estimate, the cost of biodiversity loss and ecosystem degradation is in a range of 2 - 4.5 trillion USD which is nearly 3.3-3.75% of global GDP (TEEB, 2008) [6]. Further estimates revealed that approximately 52 billion USD is being spent on biodiversity annually globally against an estimated annual financing requirement in the range of 150-440 billion USD (HLP, 2012) [8]. In the Indian context, a study estimated that country is spending nearly 2 billion USD annually on conservation of biodiversity, though requirement should be 15-45 billion USD/ year for continued efforts (BIOFIN 2015) [9]

Human well-being depends on ecosystem services provided by biodiversity, such as agricultural pollination, water purification, flood protection, and carbon sequestration. These services are expected to be worth between USD 125 and USD 140 trillion (US) annually. According to estimates, between 1997 and 2011, the world lost USD 4–20 trillion annually in ecosystem services as a result of land-cover change, and USD 6–11 trillion annually as a result of land degradation. Estimates show that natural wetlands dropped by 35% between 1970 and 2015, natural forests declined by 6.5 million hectares year between 2010 and 2015, over 30% of corals are presently at risk of bleaching, and 60% of vertebrate populations have vanished since 1970 (OECD, 2019) [1].

Agricultural pollution presents another major challenge toward sustainable growth. Studies estimating economic costs due to agriculture pollution are quite limited. According to a research effort made in China, it has been estimated that between 2001 and 2010, excessive nitrogen emissions associated with the manufacturing of basic foods cost the nation 1.4 percent of annual GDP, or almost US$49 billion. The estimated cost of forest fires in Indonesia in 2015, which were largely attributed to the conversion of land for oil palm production, was US$16.1 billion, exceeding the US$12 billion additional value from palm oil output in 2014 (World Bank 2016) [2]. India also, witnesses an enhanced use of agricultural chemicals including fertilizers and pesticides in past decades, which effectively contributes for an enhanced pollution.

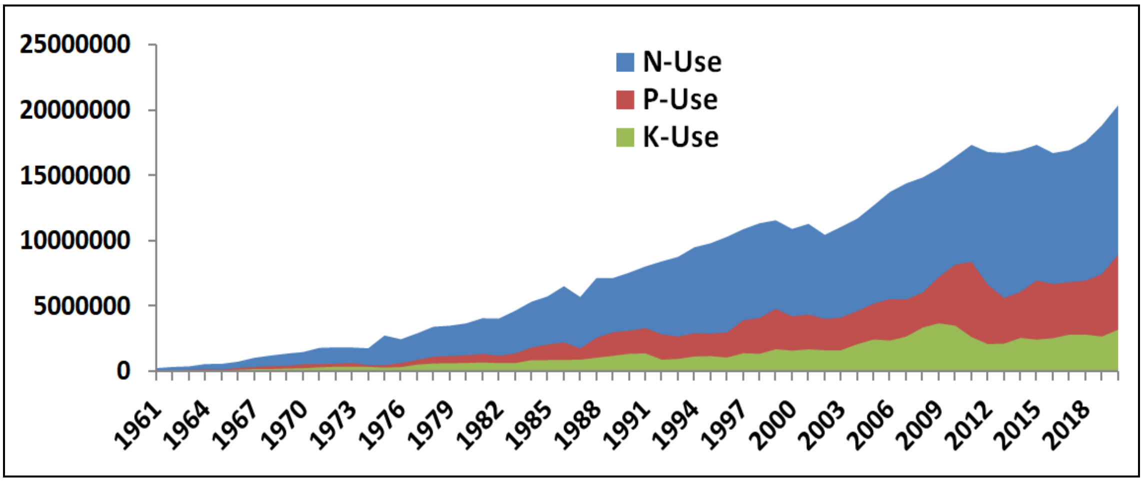

Fig 1: Figure presets the fertilizer use in India from 1960 – 2020. On 'Y' and 'X' axis amount and year are represented respectively. Source: FAOSTAT (https://www.fao.org/faostat/en/#home)

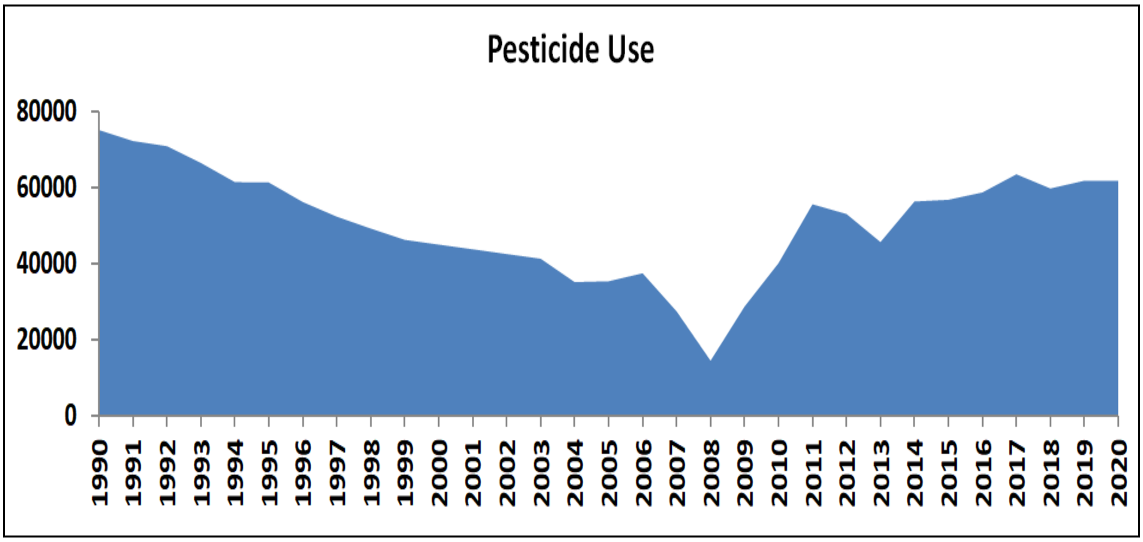

Fig 2: Figure presets the pesticide use in India from 1960 – 2020. On 'Y' and 'X' axis amount and year are represented respectively. Source: FAOSTAT (https://www.fao.org/faostat/en/#home)

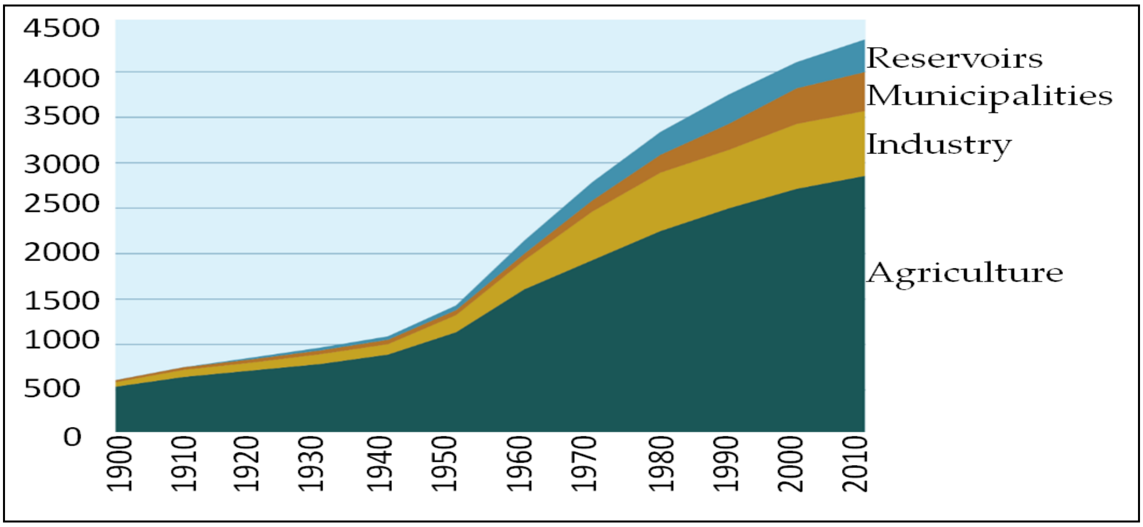

Fig 3: Figure showing global water withdrawals during 1910 – 2010. On 'Y' and 'X' axis, water withdrawals cubic kilometers and year are represented respectively. Source: UNESCO World Water Assessment Program 2020 (https://en.unesco.org/themes/water-security/wwap/wwdr/2020).

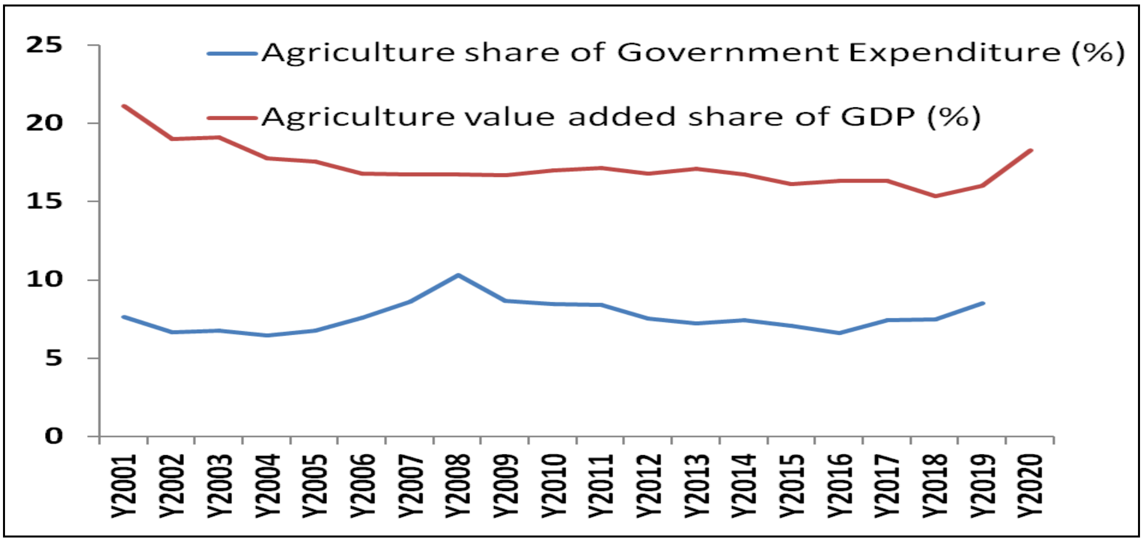

Fig 4: Figure presets the Indian government agricultural expenditure (% of budgetary expenditure) and contribution of agriculture in country's GDP during 2001 – 2020. On 'Y' and 'X' axis percent share and year are represented respectively. Source: FAOSTAT (https://www.fao.org/faostat/en/#home)

Why Circular Agriculture?

The concept of circular agriculture should emphasize on minimizing use of inputs, sustaining an improved soil health condition via ensuring nutrient loops, regenerating soils, and reducing environmental impact. Circular agriculture can lessen the amount of resources. Additionally, it can contribute to a decrease in the usage of land, chemical fertilisers, and garbage, all of which assist lower world CO_2 emissions. According to estimates, a circular approach to food systems in Europe may cut down on the use of chemical fertilisers by 80% (Ellen MacArthur Foundation, 2016) [10].

Reusing and recycling materials is an integral component of the decisions made during the production and use phases in a circular economy. In circular agriculture, sustainable production and sustainable use can be followed through an enhanced application of manures and/or organic fertilizers as well as using wastewater in irrigation.

It is important to note that, circular agriculture is not a good fit for large-scale, specialised agricultural enterprises/ economic models. Transitioning toward circular agriculture, requires emphasis on promoting smallholder farming that is rooted in organic, mixed, and agroforestry methods. Contrary to export-oriented monocrop farming, which frequently results in greater food poverty, circular agriculture with higher diversity of production is linked to better health and nutrition. In nutshell, circular agriculture models can help greatly in addressing the issues of small land holder farmers that are primarily involved in subsistence farming.

Compared to normal farming, circular agriculture requires more labour, which provides a way to boost the economy in rural areas. Thus, the implementation of circular farming techniques can significantly contribute to the reduction of poverty, increase food security, and open up new job opportunities, particularly for rural women. According to the FAO, women work in agriculture at a rate of 48% of that of males in low-income countries, but they are more restricted in their access to financial resources, technology, and market information than men are. While purchasing expensive seeds, fertilisers, and pesticides is a common requirement of conventional farming, the use of circular agricultural practises can minimise this cost and lower entry barriers for women.

In an agrarian and highly populated country like India, where farm holding is dominated by small and marginal farmers, circular agriculture practices should help significantly in improving farmer's income, upgrading the soil health via ensuring nutrient loops, minimizing carbon footprints as well as agricultural pollution and up to some extent enhancing the rural employment.

The circular agricultural practices

Circular agriculture practices can be implemented through integrated models comprising crop-livestock farming, organic systems, agri-horti-pasture systems coupled with wastewater recycling. These practices should reduce CO_2 emissions, use natural resources more efficiently, and cut the use of inputs significantly.

Diverse crop-livestock farming systems offer an efficient way to cut back on inputs, control soil fertility, and boost resilience. For instance, using locally produced feed and manure rather than imported feed and chemical fertilisers can help reduce agriculture's CO_2 emissions. Studies of European agriculture have shown that mixed crop livestock husbandry has potential economic and environmental advantages over such specialised systems (Ryschawy *et al*., 2012) [11]. Farms that raise both crops and cattle have lower expenses, are less susceptible to changes in the market and in prices, and produce less nitrogen pollution. Similar strategies can guarantee more sustainable rural and agricultural growth.

Another important component of circular agriculture is organic farming, which aims to reduce reliance on synthetic pesticides, fertilisers, and plastics. Organic farming also tends to need more labour, which creates job and development chances in rural areas. Gender issues can arise from reduced pesticide and fertiliser use. Historically, conventional agriculture has produced larger yields than organic farming. Techniques like polyculture, multi-cropping, cover crops, and rotational farming in organic systems further lower the production and land-use disparity (Ponisio and others, 2015) [12].

Circular agriculture is based on agr-silvi-pasture culture paradigms. Planting trees can improve soil fertility by improving the accumulation of organic matter from decomposing nature and restore biodiversity to agricultural areas. Agroforestry and livestock farming in combination present prospects for the implementation of circular agriculture with less detrimental effects on the environment. Smallholder farmers frequently raise livestock, and they frequently use crop leftover biomass as animal feed, reducing the amount of soil cover that is available. Economically speaking, agroforestry can guarantee more varied goods and a more steady income stream for farmers, as seen in African nations. The main technological and policy barrier in the way of agroforestry is the longer time it takes for the trees to develop and begin producing income.

Reusing wastewater for farming can help with water saving, air quality, and providing more resources for replenishing aquifers. Circular agriculture also includes return-flow systems, which reroute drainage and extra irrigation to the irrigation network. Wastewater is a valuable source of water and nutrients when properly treated and used, which helps to enhance livelihoods and the security of food and nutrition. For instance, wastewater produced by livestock, which is nutrient-rich and high in organic matter, is significant in quantity. Water recycling facilities, however, have often been energy-intensive and created sludge that can be challenging to dispose of. By creating new sludge by-products that promote recycling at net zero energy cost by capturing biogas, more recent technology may be able to solve this issue. A by-product of the treatment procedure called biogas can be used to reduce the facility's energy usage. These developments present fresh chances to end the water cycle while also lowering energy use, carbon emissions, and environmental contaminates.

Policy perspectives for promoting circular agriculture in India

Adopting circular practises in rural areas is only feasible in conjunction with other changes that affect the nation's and cities' overall demand for the food system, such as reducing food waste, altering diets, and being willing to pay more for organic goods. To encourage the use of circular agricultural methods in rural regions, a comprehensive collection of policies, technologies, and institutions is required.

(i) Incentives for circular agriculture adoption by small holder farmers: Scaling up of circular agriculture farming requires 'farming with nature with the help of scientific advancements, innovations, and new technologies'. Smallholder farmers can be persuaded to adopt innovative technology in fields including drip irrigation, precision agriculture, rainwater harvesting, and crop production ensuring sustainable use of natural resources. Farmers can be incentivized for adoption of these policies, e.g. prioritization in purchase from FCI.

In order to end the subsidies in agriculture, energy, and transportation that threaten the sustainable exploitation of natural resources, existing rules could also be examined. The savings could be used to fund agricultural research, better water and land use management, compensatory income support for small farmers, and targeted smart subsidies to achieve particular circular agricultural practices. Subsidies that encourage excessive use of water, energy, and fertilizers could also be phased out or eliminated. For instance, farmers may receive subsidies if they use easily verifiable organic soil fertility management techniques that trap sizable amounts of carbon.

(ii) Technological interventions: Agriculture research may also focus on encouraging smallholder farmers to adopt such technology and bridging the production gap between organic and conventional farming. New technologies can be innovated that may ensure completing the water cycle and proceed toward water recycling at net zero energy cost.

(iii) International cooperation for technology and value chains: Through international cooperation for technology transfer and capacity development, smallholder farmers can have better access to new technologies and skills. By establishing uniform guidelines and standards for waste management and reduction, environmentally friendly purchasing methods, agricultural value chains, and reporting on food loss and waste, international collaboration can help promote circular agriculture. An enhanced international cooperation is urgently required for value addition and market chain establishment for organic and safe food products.

Government is spending significant amount of money in including: 1) Fertilizer subsidy, 2) Subsidy on farm machinery and other inputs, 3) Managing pollution, 4) Rural employment (e.g. MANREGA), 5) Health and nutritional, 6) monetary benefits to direct beneficiaries/farmers, 7) other farmer related schemes. All of these sectors require substantial budgetary allocation from the central and/or state governments. However, these sectors are directly or indirectly related with agricultural growth and development. It is important to note that a certain percentage of funds from above mentioned sectors can be mobilized to incentivize circular agriculture scale-up in India. This mobilization can be gradually increased depending upon response or impacts. Long-term policy interventions along-with continued efforts can make difference in this direction.

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