Contribution of FPO for Environmental Stability

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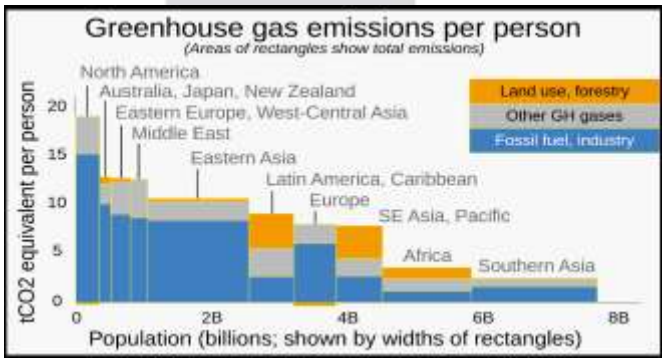
***Abstract*—**Farmer Producer Organizations (FPOs) can play an important role in promoting environmental stability and sustainability in agriculture. Since FPO contains a large number of Farmers for the purpose of production and business activities. There is a vast scope and possibility for the contribution of FPO in the Environmental Stability.

They achieve this through various means such as advocating for organic and integrated farming techniques, efficient resource management, and the conservation of biodiversity. FPOs also promote the responsible use of water resources, reduce chemical inputs, and facilitate waste management practices within farming communities. Their efforts extend to afforestation and agroforestry initiatives, contributing to carbon sequestration and mitigating soil erosion. Furthermore, FPOs engage in policy advocacy to foster environmentally friendly regulations and collaborate with partners to attain environmental certifications. By bridging the gap between agriculture and environmental conservation, FPOs are at the forefront of efforts to ensure that agriculture remains sustainable, resilient, and ecologically responsible. This article brings the capability of FPO about their role extends beyond economic benefits to include the preservation and enhancement of the environment, contributing to a more sustainable and resilient agricultural sector through various process and management strategy.

***Index Terms*—Ecological Impact; Greenhouse Gas Emissions;Biodiversity ,Conservation; Agroecological Approaches**

I. INTRODUCTION

Farmer Producer Organizations (FPOs) can also play a significant role in promoting environmental stability and sustainability in agriculture.Farmers Producer Organisations (FPOs) play a pivotal role in bolstering environmental stability by uniting farmers towards sustainable agricultural practices. These organizations serve as catalysts in fostering eco-friendly methods, encouraging responsible land management, and promoting biodiversity conservation. FPOs advocate for the adoption of innovative techniques like organic farming, efficient water usage, and reduced chemical inputs. Through collective action, they implement strategies that minimize ecological impact, such as crop diversification and afforestation. By educating members on climate-smart approaches and advocating for eco-conscious policies, FPOs empower farmers to be stewards of the environment, ensuring a balance between agricultural productivity and preserving natural resources.Land use pattern for agriculture and forestry are also the reason of emisson including the Fossil fuel and Industrial emission. The following data shows the Greenhouse gas emission per person in the global phenomenon..



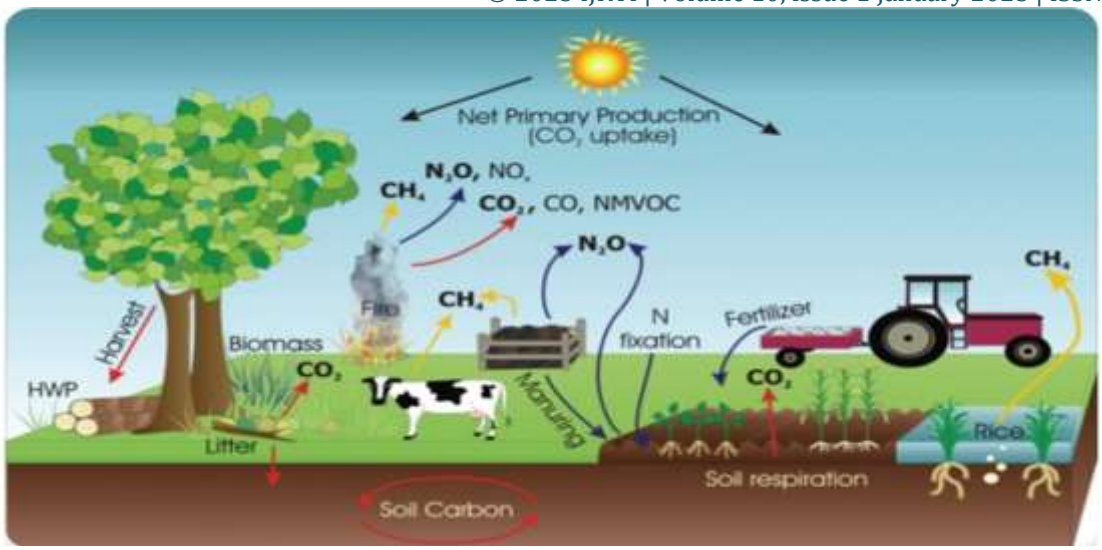
SOURCE:IPCC AR6 WG3 - FIG SPM.2C.SVG

Image 1 Greenhouse gas emission per person in various countries.

Agriculture is the largest single source of global methane emissions from human activities. Agriculture contributes around 40-46% of global methane emissions. These emissions are expected to increase roughly 40% by 2050 due to rising food production.

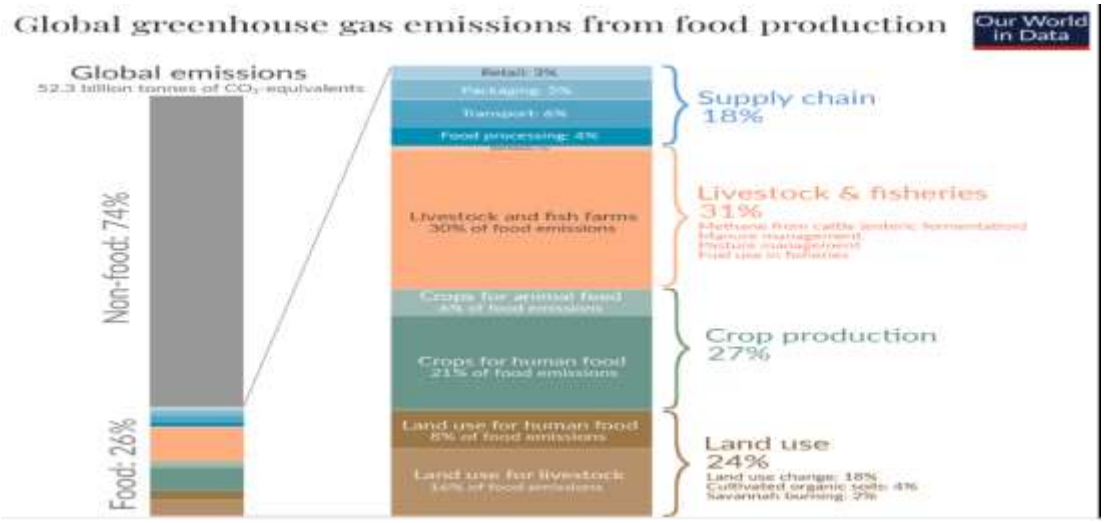
Methane is formed from "enteric fermentation" in the digestive systems of certain types of livestock called ruminants (cattle, sheep, goats). About 80% of agricultural methane arises from livestock systems of these emissions:

- ✓ Two-thirds are from enteric methane from ruminant livestock
- ✓ Roughly 20% are from rice
- ✓ 7% are from managed manure



Source:WIKIFARMERS

Image 2 Agriculture Land pattern emission



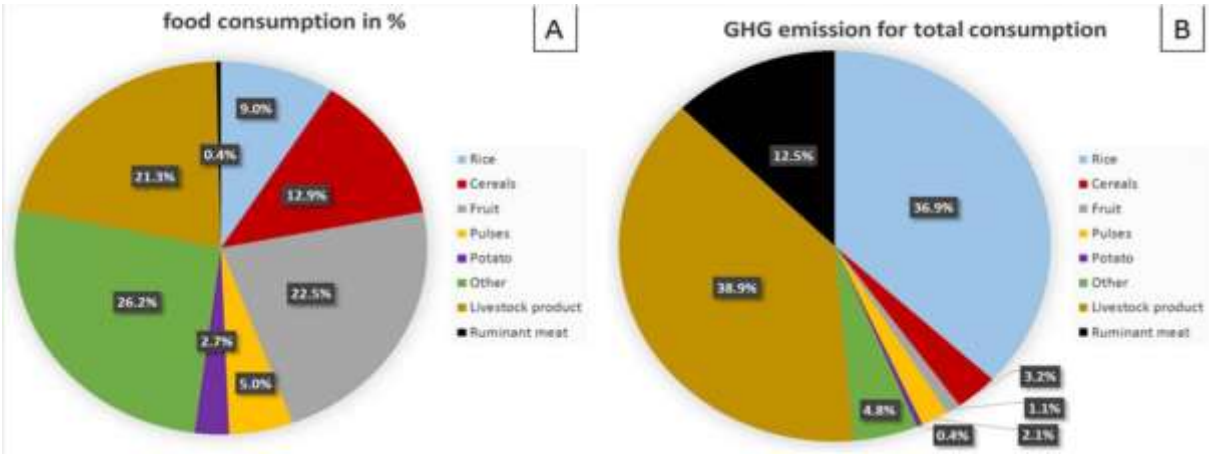
Source: Our World in Data

Image 3 Global Greenhouse emission for food production

In the United States, agriculture emitted an estimated 669.5 million metric tons of carbon-dioxide equivalent in 2020:

- ✓ 50.5 percent as nitrous oxide
- ✓ 37.5 percent as methane
- ✓ 12.0 percent as carbon dioxide

Carbon dioxide remains in the atmosphere for hundreds to thousands of years. Methane takes only about a decade to break down.



Source :Agriculture, Ecosystems & Environment,Science Direct

Image 4 Food consumption Vs. GHG emission in total consumption

GHG emission calculations for agricultural production of the commonly consumed food items in India are based on a substantial data set with representative plots across the country. This analysis gives an overview of GHG emissions produced through on-farm management at different locations, representing diverse soil types and climatic conditions, and encompasses major drivers of variation within the country. Using the same model to calculate GHG emissions for all of the major food groups allows emissions from different crops and products to be compared.

II.Major sources of agricultural greenhouse gas emissions:

Agricultural activities cause emissions of three greenhouse gases: carbon dioxide (CO2), nitrous oxide (N2O), and methane (CH4). The gases have different impacts on climate change. To evaluate the total impacts, emissions of the latter two gases can be converted to "carbon dioxide equivalent" (CO2e) based on their relative impacts on climate change (Box 1).

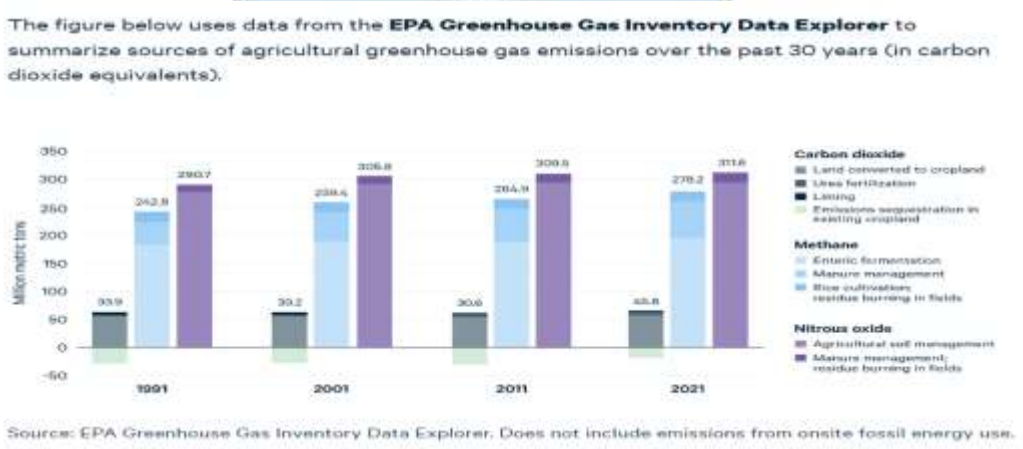


Image 5 MmT emission of CO_2, CH_4 and N_2O in CO_2e

Livestock and rice production were found to be the main sources of GHG emissions in Indian agriculture with a country average of 5.65 kg CO2eq kg−1 rice, 45.54 kg CO2eq kg−1 mutton meat and 2.4 kg CO2eq kg−1 milk. Production of cereals (except rice), fruits and vegetables in India emits comparatively less GHGs with <1 kg CO2eq kg−1 product.

Agriculture contributes approximately 10 percent of total U.S. greenhouse gas emissions (not including emissions from onsite fossil energy use).

· Agricultural emissions of greenhouse gases include carbon dioxide, nitrous oxide, and methane. To evaluate the total impacts, emissions of the latter two gases can be converted to "carbon dioxide equivalent" (CO2e) based on their relative impacts on climate change.

· Agricultural emissions of greenhouse gases result from complex natural processes that are difficult to measure – in contrast with emissions from burning fossil fuels.

- Methane comes primarily from livestock digestion (known as enteric fermentation) and the way livestock manure is managed. It contributes the most to agricultural emissions of greenhouse gases.
- The second largest contributor is nitrous oxide, which results mostly from agricultural fertilizer application to soils and from manure management.
- Carbon dioxide emissions come from increased decomposition of plant matter in soils and from converting lands to agricultural uses. Those emissions are partially offset by the increased plant matter stored in cropland soils.

III.Contribution of FPOs to environmental stability:

- ✓ · *Carbon dioxide* emissions can be reduced by planting additional crops outside of the primary growing season (known as cover cropping). Using cultivation methods that cause less disturbance to soil also can reduce carbon dioxide emissions.Rice straw residues burning in the fields can be used for mushroom cultivation.Solar pumping units can be utilized for irrigation in the place of Diesel pumps to reduce CO2 emission.
- ✓ · *Nitrous oxide* formation can be limited by reducing the amount of fertilizer applied and avoiding applications when conditions are more favorable to nitrous oxide formation.
- ✓ · *Methane emissions* from manure can be reduced through the adoption of manure management that allows capture and use of the emissions (an anerobic digester).

a. **Promoting Sustainable Farming Practices:** FPOs can educate their members about sustainable farming practices, such as organic farming, crop rotation, and integrated pest management. These practices reduce the use of chemical inputs, conserve soil fertility, and minimize environmental degradation.

Reduce agricultural greenhouse gas emissions :

i. **Carbon dioxide**

Reducing emissions from soil management and increasing storage of carbon dioxide in agricultural soils require actions to reduce soil disturbances and build up soil organic matter. One widely used practice for increasing soil organic matter is growing a "cover crop" that protects the soil between plantings, and then plowing the plant matter into the soil. Reducing soil disturbance by modifying or eliminating traditional tilling also has been promoted. However, there is scientific debate over the effectiveness of this approach for avoiding carbon dioxide emissions from the soil.

ii. **Nitrous oxide**

As nitrous oxide formation depends strongly on fertilizer application, avoiding the overuse of nitrogen fertilizer or mistiming its application are key. There are several strategies to accomplish this. One strategy is to opt for several smaller applications of fertilizer over the growing season versus one larger application at the start. Another strategy is to take advantage of innovations in drone-based remote sensing of nitrogen levels in soils to target fertilizer applications to where there is greater need. Nitrous oxide formation can be curbed by avoiding application to very wet soils or at times when it is too cold for plants to effectively take up nitrogen. In addition, using legumes as cover crops and plowing them under naturally increases soil nitrogen content because legumes store significant quantities of nitrogen in their roots. That reduces the need for additional nitrogen application.

iii. **Methane**

To reduce methane emissions from the digestive systems of ruminants, experiments have been undertaken with different feed additives. However, there are risks that these additives can inhibit digestive function and pose other health threats to the animals. Increased adoption of them can be expected in the future if some additives prove to be safe for livestock.

Methane emissions from manure decomposition can be reduced through use of devices called anaerobic digesters. These actually facilitate the creation of methane from manure decomposition then capture the resulting biogas (a mixture of methane and other gases) for use onsite or to be sold offsite as a source of energy. Anaerobic digesters have high capital costs, and more affordable digesters are less efficient at conversion of manure to methane. Digesters also can reduce water pollution from manure-containing runoff when manure is not adequately managed. However, anaerobic digestion also yields ammonia, which can inhibit the production of biogas and create a waste disposal issue by dissolving into the water emitted by the digester.

The economic feasibility of biogas production as an energy source remains unclear. It might seem like a free good for a farmer or rancher with a digester; and it is often successfully used as a heat source. However, biogas has a lower energy content per unit and more impurities than conventional (fossil) natural gas. This can limit the use of biogas and raise the cost of its use for a farmer or rancher. The same caveats apply to its sale to offsite energy users. At present, offsite demand is concentrated in California, where state-level regulation of greenhouse gases creates a large premium for biogas as a low-carbon fuel (for example, as "renewable natural gas"). Views are mixed on renewable natural gas.

b. **Organic Farming:** Encouraging members to adopt organic farming reduces chemical usage, minimizing environmental impact and qualifying for certifications promoting eco-friendly practices.

c. **Efficient Resource Use:** FPOs can facilitate the adoption of efficient resource management techniques, including the judicious use of water and energy. This helps in conserving these resources and reduces the environmental footprint of agriculture.

d. **Biodiversity Conservation:** FPOs can encourage diversification of crops and promote the cultivation of indigenous and traditional varieties. This helps in preserving biodiversity and reduces the risk associated with monoculture farming.

e. **Energy-Efficient Techniques:** Implementing renewable energy sources, efficient irrigation methods, and sustainable energy practices can lead to certifications recognizing reduced carbon footprints.

f. **Reducing Chemical Inputs:** FPOs can work towards reducing the reliance on synthetic fertilizers and pesticides, which can have harmful environmental impacts. By promoting organic and natural farming methods, FPOs contribute to reduced chemical contamination and pollution.

g. **Waste Management:** FPOs can implement better waste management practices, including recycling and composting, to reduce the environmental impact of agricultural waste and byproducts.

h. **Afforestation and Agroforestry:** FPOs can encourage their members to engage in afforestation and agroforestry activities. Planting trees and incorporating them into farming systems can help sequester carbon, prevent soil erosion, and enhance overall environmental stability.

i. **Water Management:** FPOs can promote responsible water management practices, including rainwater harvesting, efficient irrigation techniques, and water conservation measures. This helps in addressing water scarcity issues and reducing water pollution.

j. **Conservation of Natural Habitats**: FPOs can work to preserve and protect natural habitats on agricultural lands, contributing to the conservation of local ecosystems and biodiversity.

k. **Advocacy and Policy Engagement:** FPOs can advocate for environmentally friendly policies and regulations at the local, regional, and national levels. They can represent the interests of their members in discussions related to environmental sustainability in agriculture.

l. **Education and Advocacy:** Engaging in awareness programs, FPOs encourage sustainable agricultural practices among members, aligning with criteria for environmental certifications.

m. **Carbon Credits and Environmental Certifications:** FPOs can explore opportunities for earning carbon credits or obtaining environmental certifications by adopting sustainable practices. These can provide additional sources of income for their members.

Crop rotation, crop diversification, and efficient water use significantly contribute to environmental protection by promoting sustainable agricultural practices:

i. **Crop Rotation:** This practice involves systematically alternating different crops in the same field over seasons. It helps maintain soil fertility, reduces soil erosion, and minimizes the build-up of pests and diseases. Crop rotation enhances soil health and structure, promoting biodiversity, and reducing the need for chemical inputs, thus safeguarding the environment.

ii. **Crop Diversification:** Planting a variety of crops in a specific area helps in pest management, reduces reliance on a single crop, and enhances biodiversity. Diverse cropping systems contribute to soil health, reduce the risk of crop failure, and mitigate the environmental impact of monoculture farming.

iii. **Efficient Water Use:** Employing water-efficient techniques like drip irrigation, rainwater harvesting, and precision irrigation minimizes water wastage. This practice not only conserves water but also helps in maintaining healthy soil moisture levels, prevents water runoff, and minimizes the need for excessive irrigation, which can lead to soil degradation.

n. Diversifying agricultural practices, such as combining paddy (rice cultivation) and mutton (sheep farming), can potentially contribute to reducing greenhouse gas (GHG) emissions. This reduction can occur through several mechanisms:

o. **Crop-Livestock Integration:** Integrating livestock and crop production can create a symbiotic relationship where animal waste can serve as a valuable resource for crop fertilization. For instance, sheep manure can be used as organic fertilizer in paddy fields, reducing the need for synthetic fertilizers. This reduces emissions associated with the production and application of synthetic fertilizers.

p. **Methane Reduction**: Rice paddies are known sources of methane emissions due to anaerobic conditions in the flooded fields. By diversifying with sheep farming, the reduction in water use in some areas of the field can mitigate these emissions. Reduced water use can lower methane production because methane is generated in waterlogged soil.

q. **Soil Health and Carbon Sequestration:** Sheep grazing can help maintain healthy grasslands, which play a role in sequestering carbon in the soil. Healthy soil can store more carbon, offsetting some GHG emissions. Additionally, the integration of livestock can improve soil health and reduce erosion, further mitigating GHG emissions.

r. **Agroecological Approaches:** Diversification encourages agroecological approaches that promote sustainable and regenerative farming practices. These practices can lead to lower GHG emissions by reducing the need for chemical inputs and synthetic fertilizers, while increasing overall farm resilience.

s. **Reducing Energy Inputs:** Diversifying with livestock can decrease the reliance on energy-intensive rice production practices, such as excessive mechanization and the use of fossil fuels for irrigation, leading to lower carbon emissions.

However, it's important to note that the impact of diversification on GHG emissions can vary depending on several factors, including the specific farming practices, the local climate, and the scale of production. Moreover, these potential benefits should be balanced with considerations of land use, water resources, and overall sustainability. Sustainable land management and integrated farming systems that consider local conditions are crucial for maximizing the positive environmental impacts of such diversification.

IV.Conclusion

In conclusion, diversifying agricultural practices, such as combining paddy and mutton production, can be a part of a broader strategy to reduce GHG emissions and promote sustainable agriculture. However, it should be implemented with a holistic view of the local ecosystem and farming practices to maximize its environmental benefits. By implementing these practices, farmers can contribute to environmental protection by conserving soil health, promoting biodiversity, and ensuring the efficient use of water resources. These methods play a crucial role in sustainable agriculture, reducing the environmental footprint of farming activities. In summary, FPOs can be key drivers of environmental stability by promoting sustainable agricultural practices, responsible resource management, and biodiversity conservation. Their role extends beyond economic benefits to include the preservation and enhancement of the environment, contributing to a more sustainable and resilient agricultural sector.

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