AGRICULTURAL IMPACT ON GREEN HOUSE GAS EMISSIONS

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Abstract: Agriculture is an important sector when dealing with climatic changes as greenhouse gasses emissions account for a significant amount of concentration. Although modern agriculture is the outcome of experiences gained over decades of traditional farming practices, modern agricultural methods have made agriculture one of the significant contributors to global warming through a share of about 10–12% increase in total anthropogenic greenhouse gas emissions. In today's practice, most of the country's farmers are used for chemical fertilizer because it takes less effort to use them. With time, with the continuous use of chemical fertilizers, the soil has adapted to those chemicals, and the organic fertilizer doesn't give that much harvest due to this reason. As a result, farmers tend to use chemical fertilizers, which would increase their yield. In evaluating options for implementing mitigation measures, reducing chemical fertilizers must be paid massive attention to. Other than that, it is vital to focus on other agricultural practices and modern ways that reduce greenhouse gas emissions, which have a positive impact on the environment.

Keywords: Agriculture, Environment, Greenhouse gases, Mitigation

1 INTRODUCTION

Agriculture is identified as the most important sector of the Sri Lankan economy. Although its contribution to gross domestic product has decreased dramatically over the past three decades, it is the most important labour source for most Sri Lankan workers. In addition to rice, various other food crops are cultivated for local consumption. These include yams, pulses, grains, fruits, and vegetables. The major plantation crops of the country are tea, rubber, and coconuts. Tea, which is the most prominent crop in the plantation sector, grows in many wet zone areas, particularly in the central hill country. The second major commercial crop is rubber and is grown in the ridge and valley country of the wet zone interior. The third commercial crop, coconuts, is grown mainly in the western seaboard hinterland [1]. Although the modernization of farming methods, such as the use of high-yielding seeds, tractors, and chemical fertilizers, has led to increased productivity in the agricultural sector, this has resulted in rising greenhouse gas emissions to the atmosphere contributing to taking the carbon footprint of the country to a higher level.

2 COMPARISON BETWEEN TRADITIONAL (PAST) AND MODERN (CURRENT) AGRICULTURAL METHODS PRACTICED IN SRI LANKA.

Agricultural methods are practices and techniques involved in agriculture to improve yields and productivity [2]. Some of the traditional and modern agricultural methods practiced in Sri Lanka are compared below in Table 1.

Table 1: Comparison between traditional and modern agricultural methods

Agricultural practices	Traditional Methods	Modern Methods
Nursery	GODA THAWANA	MADA THAWANA
Land preparation	Animal power Man power	Machinery
Transplanting method	Manually	None
Fertilizer Application	Organic fertilization (PIDURU POHORA)	Inorganic/ chemical fertilizer
Pest and disease management	• Manually • Use repellent plant species • Apply natural extractions of plants • Flooding and draining • LANU ADEEMA • KURULU PAALUWA	Chemical Control
Threshing "KOLA MADEEMA"	• Manually (Man Power) • Animal power	• Use tractors • Thresher

3 WHY ORGANIC METHODS ARE IMPORTANT?

Although modern agriculture is the outcome of experiences gained over decades of traditional farming practices, the modern agricultural methods have made agriculture one of the major contributors to global warming through a share of about 10–12% increase in total anthropogenic GHG emission [2]. Hence, today's entire world is focused on these traditional agricultural methods in which GHG emissions are so much less than that of the modern methods practiced.

Agro forestry, intercropping, crop rotation, cover cropping, traditional organic composting, and integrated crop-animal farming are prominent traditional agricultural methods practiced in Sri Lanka. These

traditional organic farming methods are identified as the model practices for the climate-smart approach in agriculture today, as shown in Fig. 1 [3]. The importance of these organic methods is discussed below.

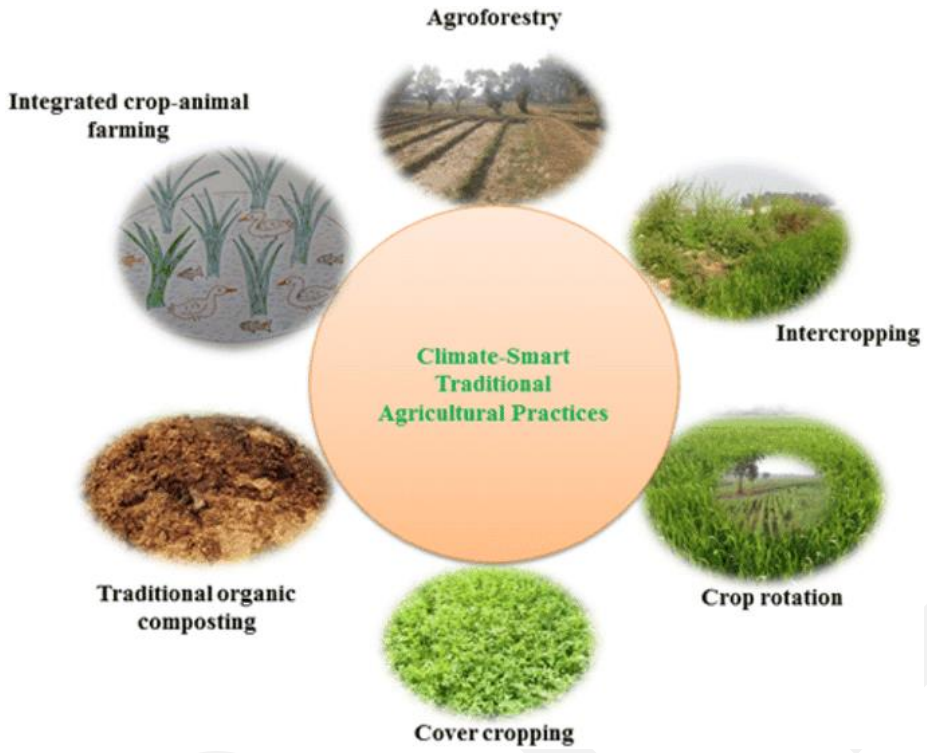

Fig. 1. Traditional organic agricultural methods practiced in Sri Lanka [3]

3.1 Agro forestry

Agro forestry is planting trees with crops to maximize the various components' ecological and economic interactions. Agro forestry improves soil organic matter (SOM), the sustainability of farming, carbon capture, water conservation, agro biodiversity, and profits for farmers.

3.2 Intercropping

Intercropping, the simultaneous planting of more than one crop species in the same field, is a realistic implementation of fundamental environmental concepts such as diversity, competitiveness, and facilitation. Intercropping decreases climate-driven crop failure because several crops have specific climatic adaptability Intercrops use natural resources such as land, sun, water, and nutrients effectively and improves biodiversity, production, sustainability, and agro ecosystem stability. A long-term experimental study showed increased crop rotation rate from single crop to double-crop improved carbon capture by 20 g/cm^2 . year in the humid tropical environment [3].

3.3 Crop rotation

Crop rotation involves the process of raising a series of plant species on the same soil. Crop rotation is an important method for a deficit reduction of carbon relative to the crop type's constant production. It is a potential practice to reduce the emissions of CH4 and other GHGs in irrigated-rice fields [3].

3.4 Cover Cropping

Cover cultivation is a natural solution to enhancing soil quality, soil microbial productivity and agroecosystem facilities, such as nutrient conservation, water preservation, plant and pest management, and carbon sequestration [3].

3.5 Traditional organic composting

The use of organic compost to improve soil productivity is a safe and climate-smart solution. The usage of composted organic waste to improve soil quality and sustainability is attracting tremendous interest worldwide. Composting is a natural solution to the disposal of agricultural wastes. Various organic materials are used in the composting process, such as straw, crop residues, agro industry by-products, livestock waste, sewage sludge, and kitchen waste. A model of traditional organic composting is shown in Fig. 2 [3].

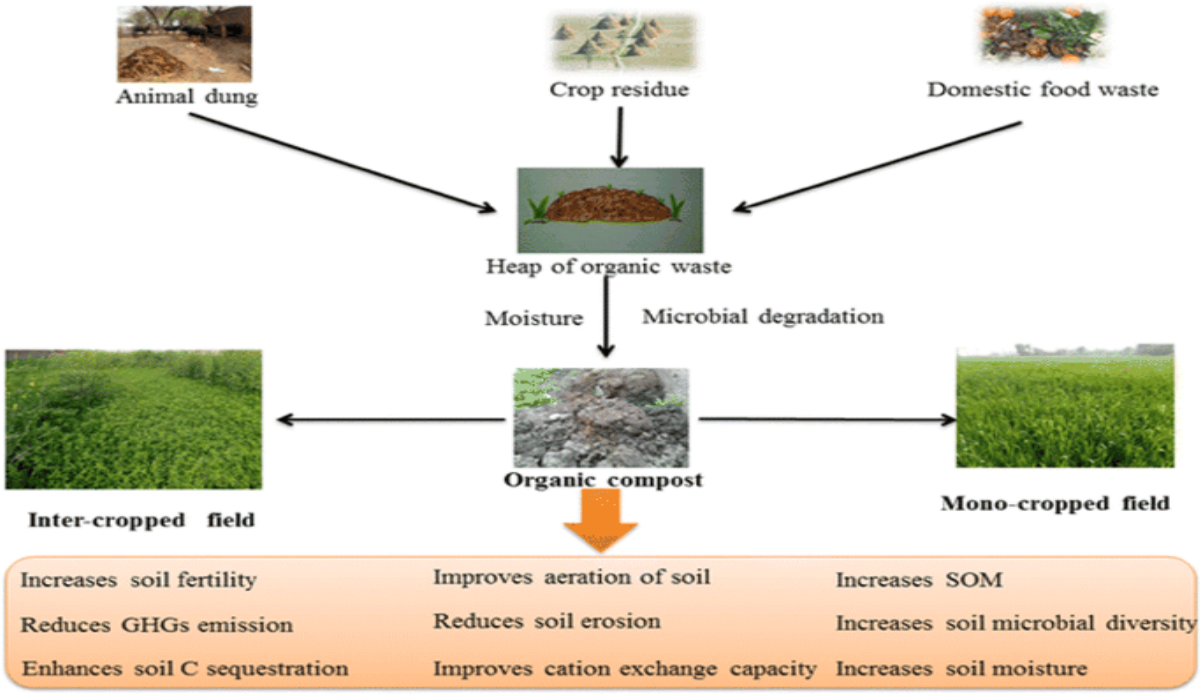

Fig. 2. A model of traditional organic composting [3]

4 Limiting Emissions from Organic Fertilizer

The organic composting cycle starts after a few days or months of placing the agricultural waste in a landfill. A load of organic waste is subjected to microbial degradation, which transforms organic waste into compost. The organic material goes through the thermophilic process (45–65°C) during composting, destroying various pathogenic microorganisms due to CO_2, water, and heat release [3].

Although the levels of greenhouse gas (GHG) emissions from organic waste applications in tropical countries are unknown, a significant amount of GHG is happening through this method, which would be a huge impact when practiced on a large scale. Therefore, considering this fact, the need to take necessary measures to control emissions through organic fertilizer was identified [4].

For instance, integrated crop-animal farming could be a good option wherein cattle farming cow-dung can be used as fertilizer without any pre-processing, which causes GHG emissions. Also, in the composting process, where the waste or residuals are treated under microbial(aerobic) treatments, the gas produced can be used as biogas for cooking purposes, thereby limiting GHG emissions to the atmosphere.

5 Why Chemical Fertilizer Usage Has Increased In The Country And Why Organic Farming Cannot Be Practiced Island Wide?

It is a known fact that Fertiliser-driven GHG emission is the largest source of total GHG emission from the agriculture sector. Inorganic nitrogen (N) fertilizers contribute to approximately 75% of direct emissions from agricultural soil [4].

Also, it is clear from the above discussions that no chemicals or toxins were used to enrich agricultural fields' soil. Ancient and traditional farmers have used manure, fallen leaves, and decayed hay to fertilize their land. These organic fertilizers improved microbial activity in the soil. The yield from this method of fertilization was high and absent from harmful toxins.

But in today's practice, most of the country's farmers are used for chemical fertilizer because it takes less effort to use them. With time with the continuous use of chemical fertilizers, the soil has adapted to those chemicals, and the organic fertilizer doesn't give that much harvest due to this reason. As a result, farmers tend to use chemical fertilizers, which would increase their harvest. Even pesticide usage has increased at a huge rate which again results in high emission rates. Due to many reasons like above, apart from smallholder farmers, almost all the large-scale agricultural activities carried out in the country today use modern methods and chemical fertilizers on a large scale.

Therefore, it is crucial to take the necessary steps to make awareness among the farmers and introduce more eco-friendly and user-friendly modern practices promoting to bring back the traditional organic agricultural methods into life.

6 New methods that could be practiced to reduce the emission of greenhouse gas emissions from agriculture.

6.1 Crop Residue Cover

The materials left on cultivated land after the crop has been harvested are called crop residues. This can improve soil structure, increase organic matter content in the soil, reduce evaporation, and help fix CO_2 in the soil [4]. Good residue management practices can improve soil quality on agricultural lands. Crop residues contain large quantities of nutrients such as 5-35kg of N, 1-4Kg of P, 5-30Kg of K, 4-24Kg of Ca, 1-8Kg of Mg 30-100Kg of total nutrients per Mg of crop residue [4]. Besides, crop residues can be used for biofuel production. By this method, crop residue can be used as a fertilizer, ultimately a fuel source. Here the waste is reused, and since it is organic can reduce the negative impact on the environment.

6.2. Introduction to industries

- Dye Removal Using Agricultural Wastes or Byproducts.

The agricultural wastes or byproducts such as cereal straws are abundant in nature, inexpensive, require little processing, and are effective materials and can be assumed to be low-cost adsorbents. These materials are available in large quantities and because of their physicochemical characteristics and low cost, have the potential as adsorbents. For the removal of dyes, many of these materials have been investigated as adsorbents.

- For the production of briquettes.

Each year, billions of tons of agricultural residue are generated. These volumes can be converted to an enormous amount of energy and raw materials. Here agricultural wastes are converted into charcoal briquettes to provide much needed source of cheap fuel that is cleaner in burning [5]. Agricultural biomass

waste converted to energy can substantially displace fossil fuel, reduce emissions of greenhouse gases and promote renewable energy.

6.3. Water pearls

This is a resilient smart water agro-technology that can reduce pesticides and biocides in all farming environments. This solution uses organic hydrophobic, inert, and re-usable water pearl, which is the technology at ushering the new age of farming with its proven applications in the soil-based, hydroponics, and greenhouse farming industries. This can prevent the formation of bacteria, fungus, and weeds and can be used at any acidity level. This also reduces water consumption by 30% – 50% for current methods. The Payback varies between 3-10 years depending on the crop, market conditions, and climate change. Fig. 3 shows the water pearls used in agricultural methods [6].

Fig. 3. Water Pearls used in agricultural methods [6]

6.4 Living Farming Tree - Indoor garden

This is a soilless mini-indoor farming method that uses the aeroponic technique to grow greens efficiently all year round [7]. This boosts productivity by three times per the same footprint when compared with traditional farming methods. This allows minimum inventory with the maximum diversity to provide the best conditions for plant growth while consuming limited water and energy resources. Living farming trees can be configured in a tree or cubes. With the use of LED lighting technology for horticulture, plants grow efficiently, which adapts automatically to the plants' crop-type and growth stage. Fig. 4 shows a living Farming Tree - Indoor garden [7].

Fig. 4. Living Farming Tree - Indoor garden [7]

6.5 Polymer production using bio-waste

This is a naturally designed polymer using bio-waste for water retention [8]. Super Absorbent Polymers are a type of macromolecular synthetic water-absorbing polymer material. This polymer is a 100% biodegradable product and can be used as a sustainable fertilizer. The designed product is completely pollution-free. It can hold absorbed water for a long period to maintain the soil's moisture level and absorb 150 times its weight in water. Fig. 5 shows a type of polymer produced by using biowaste [8].

Fig. 5. A type of polymer produced by using bio waste [8]

6.6 BeeOmonitoring systems.

This service provides an answer to the necessity of reducing pollution and maintaining and regenerating biodiversity. This solution targets a wide variety of issues such as agricultural (pesticides reduction), water sector (water catchment zone protection from pesticides and nitrates), industrial actors (environmental monitoring of their activities), real estate (impact of construction on the environment), etc. Although the emission of greenhouse gases and pollution constitute operational, reputational, environmental, and financial risks for many sectors, it remains difficult for many actors to take improvement actions, amongst others, due to a lack of metrics. This solution combines nature and technology, where bees act as drones to collect billions of environmental samples on large surfaces [9]. BeeOmonitoring can identify, find the origin and assess the level of pollutants (heavy metals, 523 pesticides, nitrates, PAH, dioxins, GMO, radio-activity, etc.) and assess plant diversity level and quality through the analysis of the samples. This solution enables monitoring industrial and agricultural pollution, which is the most important factor and assesses the quality/diversity of plants.

6.7 Use of Black Soldier Fly to turn agro industrial byproducts into high quality ingredients for animal feed manufacturers.

This method uses an insect (Hermetiaillucens) to valorize the organic agro industrial byproducts into high-quality ingredients for animal feed manufacturers [9]. The Black Soldier Fly (Hermetiaillucens) larvae are used to recycle organic waste into high-quality molecules, mainly protein and oil sold to animal feed manufacturers. The residue of the rearing is also a good organic fertilizer. This method reduces CO_2 emissions owed to transport by 97%. It can be used as a waste treatment method.

7 Conclusion

The agricultural sector has a significant impact on the emissions of greenhouse gases. It is vital to focus on new methods that will mitigate these greenhouse gas emissions because it leads to negative environmental factors such as climatic change and global warming. Several methods are mentioned to overcome this challenge while getting a better yield to lead a sustainable environment.

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