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Organic Farming: As a Climate Change Adaptation and Mitigation Strategy

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According to the Codex Alimentarius Commission (FAO/WHO), "Organic farming is a holistic approach to managing food production that maintains and enhances the health of the agro-ecosystem, including biological variety, biological cycles, and soil biological activity.It emphasizes the use of management strategies over the use of off-farm inputs while taking into account the need for regionally tailored systems according to area variables. To achieve this, synthetic materials are avoided whenever possible in favor of agronomic, biological, and mechanical techniques to carry out any necessary systemic functions. Organic farming is not only a particular agricultural production system; it is also a systemic and all-encompassing approach to sustainable livelihoods in general, where relevant factors of influence for sustainable development and vulnerability are taken into account, whether these are on a physical, economic, or socio-cultural level (Eyhorn, 2007). Due to the lengthy history of organic farming as a farming system and its adaptation to various climate zones and local conditions, there is a wealth of situation-specific information on organic farming that is available.

The agriculture sector contributes 10-12%, or 5.1-6.1 Gt, of all anthropogenic yearly CO_2-equivalent emissions, according to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). However, only direct agricultural emissions are taken into account in this accounting; emissions from the manufacturing of agricultural inputs such nitrogen fertilizers, synthetic pesticides, and fossil fuels used for irrigation and agricultural machinery are not taken into account (IPCC 2007).

Agriculture production is generally influenced by the climate, and changes in the climate may result in variations in agricultural output. Changes in the distribution of plant diseases and pests may potentially have detrimental consequences on agriculture when climatic patterns change. At the same time, agriculture emerged as one of the most climate-adaptable human endeavors (Mendelson et al., 2001). It should be made clear that refraining from using synthetic inputs does not automatically constitute an operation as organic, especially if good farm management and design are not also used.

There are many different adaptation strategies available, but more extensive adaptation than is now taking place is needed to lessen vulnerability to future climate change, according to the IPCC's Fourth Assessment Report. "Barriers, limits, and costs exist, but they are not fully understood," according to the IPCC in 2007. Increased work on adaptation is strongly emphasized in the Bali work Plan from the UN Climate Change Conference in Bali in 2007 (UNFCCC 2007). Organic farming has the innate ability to increase soil carbon absorption and decrease greenhouse gas emissions. (Table 1). However, public policies and research should concentrate on the adaptability features of organic agriculture systems.An increase in uncertainty for weather events and global food markets is one of the key implications of climate change. Organic farming has the potential to significantly increase resilience to climate change. Organic farming meets many of the significant general UN Millennium Development Organic farming standards and handles many of the major issues outlined for adaptation to climate change and variability.

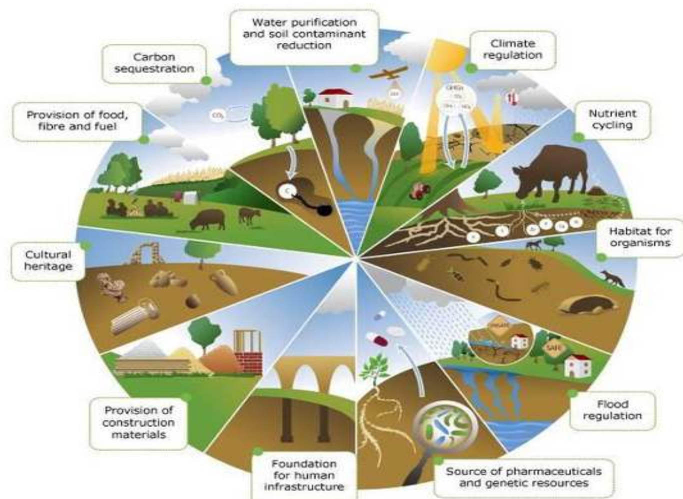

Table 1: Adaptation Potential of Organic Agriculture

Objective	Means	Impact
Alternative to industrial production input (i.e., mineral fertilizers and agrochemicals) to decrease pollution	Improvement of natural resources processes and environmental services (e.g., soil formation, predation)	Reliance on local and independence from volatile prices of agricultural inputs
Landscaping	Creation of micro- habitats (e.g., hedges), permanent vegetative cover and wildlife corridors	Enhanced ecosystem balanced (e.g., pests, prevention), protection of wild biodiversity and better resistance to wind and heat waves
Soil fertility	Nutrient management (e.g., rotations, coralling, cover crops and manuring)	Increased yields, enhanced soil water retention/drainage, decreased irrigation needs and avoided land degradation

Benefits of Organic Farming

- ❖ Recycling wastes of plant and animal origin helps to replenish the soil's nutrients while using less nonrenewable resources.
- ❖ Reduce the rise in temperature by reducing the output of greenhouse gases.
- ❖ Increases soil biological activity and improves the system's overall biological diversity.
- ❖ Encourage the wise use of land, water, and air while reducing any gaseous pollution that might be caused by agricultural operations.
- ❖ Due to the use of traditional skills, farmer knowledge, soil fertility building techniques, and a high level of variety, this population is highly adaptive to climatic change.

Challenges Addressed

The two main organic strategies—diversification and boosting soil organic matter—could both improve resilience to harsh weather events. Because organic farming doesn't exploit nutrients and improves soil organic matter content, the soils it cultivates are better at storing and capturing water than conventionally farmed soils. Because of this, production in organic agricultural systems is less vulnerable to extreme weather events including drought, flooding, and water logging. Accordingly, problems with soil quality, increasing water stress and drought, and increased occurrence of extreme weather events are all addressed by organic farming (IPCC 2007).

- ❖ The highly diverse farming systems used in organic farming boost the variety of revenue sources and the ability to adapt to the negative consequences of climate change and variability, such as altered rainfall patterns. Through improved ecological balance and risk distribution, this results in increased economic and ecological stability.
- ❖ With lower input costs, organic farming is a low-risk farming technique that lowers the likelihood of partial or complete crop failure owing to extreme weather events or altered weather patterns as a result of climate change and unpredictability (Eyhorn 2007). As a result, it serves as an option for struggling farmers. Additionally, by having the products certified as organic, higher pricing may be gained. Therefore, because input costs are lower and sales prices are greater, higher farm profits are conceivable. The farmers' ability to handle stress is improved, and the likelihood of being indebted is decreased. As stated in the Bali Action Plan (UNFCCC 2007), risk management, risk-reduction methods, and economic diversification to increase resilience are also important parts of adaptation.
- ❖ By definition, organic farming is an adaptation strategy that can be used to improve the livelihoods of rural populations and those areas of societies that are particularly susceptible to the negative effects of climate change and variability, such as the rural population in sub-Saharan Africa. Improvements can be made through decreased financial risk, decreased debt, and increased diversity (Eyhorn 2007).
- ❖ With the potential to contribute to the UN Millennium Development Goals (to "eradicate extreme poverty" and "ensure environmental sustainability"), organic farming offers a systemic approach to adaptation. It is commonly understood that organic farming is essential to achieving these

goals and that climate change presents difficulties in doing so.

According to the IPCC, reducing the cost of agricultural GHG mitigation alternatives makes them cost-competitive with non-agricultural solutions for meeting long-term climate goals. However, because it is so dependent on regional environmental factors and management techniques, it is challenging to estimate the entire amount of mitigation. Paying farmers for carbon sequestration (increasing soil organic matter) creates a situation where CO2 is removed from the atmosphere (mitigation), higher soil organic matter levels increase the presence of agro-ecosystems (adaptation), and improved soil fertility results in better yields (production and income generation).Organic farming's intrinsic adaptive strategy promotes simultaneously climate mitigation.Developing resilience in the face of climate change is a great potential of organic agriculture (Table 2).

Table 2: Mitigation Potential of Organic Agriculture

Source of GHG	Share of total anthropogenic	Impacts of optimized organic management	Remarks GHG emissions
Manure handling	0.8%	Equal	Reduced methane emissions but no effect on N_2O emissions
Direct emissions from forest clearing for agriculture	12%	Reduction	Clearing by primary ecosystems restricted
Indirect emissions Mineral fertilizers Food chain	1%	Totally avoided	Prohobited use of mineral fertilizers Inherent energy saving but still inefficient distribution systems
Carbon sequestration Arable lands Grasslands		Enhanced Enhanced	Increased soil organic matter Increased soil organic matter

Organic farming as a mitigation strategy may address both emissions avoidance and carbon sequestration. The first is achieved through:

- ❖ lesser N2O emissions (due to lesser nitrogen input)—Irrespective of the form in which nitrogen is inputted, it is typically believed that 1-2 percent of the nitrogen provided to farming systems is released as N2. The IPCC currently uses a defaultvalue of 1.25 percent, although more recent research has found significantly lower values, particularly for semi-arid regions (Barton et al. 2008).
- ❖ Lower CO2 emissions from farming system inputs (pesticides and fertilizers generated using fossil fuels); Less CO2 emissions from erosion (owing to better soil structure and more plant cover); and Less erosion in organic farming systems compared to conventional ones.

Carbon storage in soils and less destruction of primary ecosystems represent organic farming's greatest promise for reducing greenhouse gas emissions. When CO_2 is either removed from the atmosphere or redirected from emission sources and stored in the seas, terrestrial environments (vegetation, soils, and sediments), the process is referred to as soil carbon sequestration. It is greatly improved through agricultural management practices that increase soil organic matter content and improve soil structure, such as increased application of organic manures, conservation tillage, cover crops, nutrient management, irrigation, restoring degraded soils, pasture management, soil use of inter crops and green manures, higher shares of perennial grasslands, trees, and hedges (Niggli et al., 2008). The IPCC (2007b) has also identified increasing soil organic carbon in agricultural systems as a key mitigation strategy. The potential for enhanced pasture management practices to sequester 0.22 t C per hectare per year of carbon has been determined. The entire carbon sequestration capacity of the world's grassland would be 1.4 Gt per year at the current level, which is equivalent to around 25% of the yearly GHG emissions from agriculture (FAOSTAT, 2009) assuming 0.2 t C per ha per year for organic agricultural practices.

However, the Kyoto Protocol's clean development mechanism (CDM) does not include the sequestration of CO_2 in soils. The FAO should take the lead in this process, including the creation of a global soil carbon sequestration initiative. It should be tasked with promoting agricultural technologies that improve soil quality and carbon pools (such as organic farming and conservation agriculture), as well as developing tools to measure, monitor, and verify soil-carbon pools and fluxes of greenhouse gas emissions (such as nitrous oxide) from agricultural soils.

Conclusion

Although impressive, there are still a number of important problems with organic farming. First of all, further research is required.Recent research disproves this stereotype, particularly in the context of intensive farming practices that account for the majority of agricultural output in emerging nations like India. But more study is still required in this area. For organic farming, it is currently especially important to have easy access to and a growing local market for the products, as well as local processing options and export infrastructure. To do this, the topic of trade policies and the function of international organizations must be brought up in relation to organic farming. In particular, on a global scale, the institutional context for organic farming as an adaptation and mitigation strategy must be defined. For organic farming to be successful, organizations that today primarily support pure conventional agriculture must take notice of its potential.

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