Can Organic Agriculture be Sustainable in the Drylands

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Current Status of Agriculture

- **Agriculture originated in the Caspian basin of West Asia dating back to 7500-6500 BCE. Soils were fertile, with no external inputs**
- **This agriculture was organic farming, which got lost along the way when we entered the nineteenth century industrial era**
- **Population pressure and high frequency of famines needed additional inputs, including chemical fertilizers and pesticides, for increasing crop production.**
- **Cultivable land/capita is getting lesser globally, especially in Asia (0.2 ha per capita in 2020)**
- **Tropical soils are undergoing considerable erosion and are depleted of major plant nutrients**

The Context of Discussion

- **Organic farming alone, in its current form, will not be able to feed the growing population in the coming generations**
- **Current-day agronomists are grappling with the location-specificity of agronomy/ crop management practices**
- **A balanced approach is needed to increase crop productivity, and also maintain and preserve the natural resource base**
- **Essential that we critically assess and understand the reasoning followed in the ancient times, and fine-tune the agronomy with modern science-based technologies to suit the existing conditions**
- **Should harness the synergies of integrating the valuable ancient knowledge and wisdom with modern science-based technologies to meet the challenges of 21st century.**

What is Organic Agriculture/Farming

- **Most agriculture practiced by smallholder farmers with no external inputs is "Organic farming-by-default"**
- **Organic agriculture relies on use of farmyard manure, compost, and green manuring for adding nutrients to soil, and biological control to manage pests and diseases**
- **Based on minimal use of off-farm inputs and on management practices that restore, maintain and enhance ecological harmony**
- **OA avoids chemical fertilizers, herbicides, fungicides, pesticides and other chemicals**
- **OA is suitable for some farmers in some agro-ecologies and niches where it can be practiced profitably and sustainably**

Is Organic Agriculture a Panacea?

- **Proponents claim that Organic Agriculture (OA) is the only way for sustainability of future agriculture**
- **However, we all need to understand that organic agriculture is not a panacea, and a cure for all ills of modern agriculture**
- **There are reasons why organic agriculture alone, *in its present form*, will not be able feed the future global population sustainably**
- **OA is suitable for some farmers in some agro-ecologies and niches where it can be practiced profitably and sustainably**
- **Need to avoid blanket recommendations/advisories on organic agriculture for all farmers and in all ecologies/farming systems**

Synthesis of Organic Farming Practices

- **Most certified organic agriculture (OA) is in the developed countries; and very limited in most of the developing countries**
- **OA is feasible in countries where cultivable land is in plenty, soils are fertile and soil organic carbon content is very high**
- **OA is feasible and practical in perennial horticulture crops such as fruit orchards and plantations that are commercial crops and profits are high**
- **Farmers in arid and semi-arid regions (characterized by degraded soils and low and erratic rainfall) either cannot afford or risk applying external inputs (subsistence farming--organic-by-default)**

Concept of “Soil as a Bank of Plant Nutrients”

- **OA requires good soil fertility (soil organic carbon and essential macro and micronutrients), appropriate soil structure and adequate soil moisture**
- **Most Dryland areas have degraded soils, low soil fertility, high air and soil temperatures, coupled with low and erratic rainfall**
- **Crop yields are low, and farmers also harvest the crop residues to feed their cattle in the Dryland areas**
- **UWA study: not feasible to maintain organic matter in soils with less than 600 mm rainfall and daily average temperatures of >15C**

Content of major nutrients (%) in various manures and fertilizers*

Nutrients	Farm Yard Manure (FYM)	Cattle Manure	Sheep manure	Chicken Manure	Urea	Single Super phosphate	Potassium sulphate
Nitrogen	0.5-1.5	0.6	0.7	1.1	45-46	----------	----------
P205	0.4-0.8	0.15	0.3	0.8	----------	16-22	----------
K2O	0.5-1.9	0.45	0.9	0.5	----------	----------	50-53

*** Amalgamated information from different sources, for comparison only.**

Organic farming to be pragmatic and holistic

- **Large amount of nutrients are removed from the soil (e.g., one ton/ha of maize crop removes ~161kg N, ~66 kg P205 and ~48 kg of K20)**
- **These nutrients need to be replenished after every harvest to maintain a positive balance of nutrients in the soil**
- **Organic manures (cattle manure, sheep manure or farmyard manure) contain 0.5-0.7% N, 0.15-0.80% P2O5, and 0.45-0.90% K2O**
- **Based on average of 0.5% N in manure, farmers' need to add 9.2 ton of organic manure to get the equivalent of 100 kg of Urea containing 46% N.**
- **Hence, farmers need to provide a combination of proper amounts of both organic and other fertilizers to ensure improved soil health and sustainability**

Sustainable Agriculture Practices (SAP)

- **Pragmatic approach of nutrient management to ensure soil nutrient requirements of crops to achieve optimum yield levels**
- **Combines Resource Conserving Technologies (RCT), and principles of conservation agriculture and modern agriculture in a balanced way**
  - **zero or minimum tillage, depending on the soil and climatic conditions;**
  - **use of crop residues for soil cover and as organic manure;**
  - **soil-test based application of nutrients as needed by the soil and crops ,**
  - **manage weeds using safe herbicides as necessary; and**
  - **manage pests and diseases (using a combination of biological methods)**
- **Ensure that crop is healthy and farmers do not incur crop loss**

Way Forward for the Future-1

- **Neither wise nor advisable to follow the past agronomic practices for the current day farming where soils have been impoverished**
- **Take a holistic view of the "soil as a bank of nutrients" and farmers need to replenish the nutrients taken-up by a crop every season**
- **Using GIS and geo-referenced soil fertility mapping helps scientists to make appropriate recommendations of manures, bio-fertilizers, bio-enriched composts, fertilizers, and fertigation.**
- **Disruptive technologies have brought in revolutions in information technologies (IT), and IT is impacting several other fields, including agriculture.**

Way Forward for the Future-2

- **Farming is also undergoing transformation with the advent of precision farming, aided by cutting-edge technologies such as GIS, GPS, GNSS and LIDAR.**
- **Growing crops in the cities (Vertical farming), and in controlled growth chambers, without soil or natural light is already becoming popular.**
- **With cheaper agricultural robots in the future, farmers in developing countries can become managers of land instead of toiling entire day in their fields, and practice "Secondary Agriculture"**
- **Hence the need to harness the synergies of amalgamating the best practices from traditional knowledge and modern science and technologies**

Thanks for your attention