Sustainable Agriculture

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Concept

Starving people in poor nations, obesity in rich nations, increasing food prices, on-going climate changes, increasing fuel and transportation costs, flaws of the global market, worldwide pesticide pollution, pest adaptation and resistance, loss of soil fertility and organic carbon, soil erosion, decreasing biodiversity, desertification, and so on. Despite unprecedented advances in sciences allowing us to visit planets and disclose subatomic particles, serious terrestrial issues about food show clearly that conventional agriculture is no longer suited to feeding humans and preserving ecosystems. Sustainable agriculture is an alternative for solving fundamental and applied issues related to food production in an ecological way.

Sustainability rests on the principle that we must meet the needs of the present without compromising the ability of future generations to meet their own needs.

According to Iowa Farmer “Sustainable Agriculture is a journey, not a destination”

A sustainable agriculture is one that, over the long-term, enhances environmental quality and the resource base on which agriculture depends; provides for basic human food and fiber needs; is economically viable and enhances the quality of life for farmers and society as a whole (FAO 1989).

It is a whole-system approach to food, feed, and fiber production that balances environmental soundness, social equity, and economic viability among all sectors of the public, including international and intergenerational people.

In short, Meeting the needs of the present without compromising the ability of future generations to meet their own needs

According to Farm Bill (1990) “Sustainable Agriculture is an integrated system of plant and animal production practices that will

- satisfy human food and fiber needs
- enhance environmental quality
- make the most efficient use of nonrenewable resources
- sustain economic viability
- enhance quality of life.”

Strengths and Weaknesses of our current agricultural system

Success

- Abundant food supply in the developed world
- Fresh fruits and vegetables available year-round
- Cheap food becoming available in some areas
- Luxury foods such as coffee, tea, chocolate, and spices easily available around the world
- Effective food preservation technologies (refrigeration, freezing, canning, packaging)
- Convenience foods
- Mechanization produces high labor efficiency
- Improvements in soil conservation
- Availability of agricultural inputs for quick solutions to production problems
Problems

- Continuing soil loss
- Food safety concerns (mad cow disease, food poisoning outbreaks, antibiotic resistance, toxins and pesticides)
- Water pollution, air pollution (& odors), habitat loss, water depletion
- Continuing hunger – and rise of obesity
- Failing farms, economic uncertainty and stress
- Declining communities
- Farm accidents, chronic diseases linked to agricultural chemicals
- Reliance on fossil fuels, global warming
- Farmland loss to development, ugly countryside
- Difficulty of starting in farming

Present state of agroecosystem

The onset of the industrial age brought about various trends that have led us to our present state.

- The quick rise in population.  
  - More people to feed.
- The greater need for production.  
  - Farms required to produce more.
- The increase in urbanism.  
  - Less farms to do more work.
- Wide-spread ecological impacts.  
  - Faith in technological, political and economic fixes.

Today, “less developed countries” are following a similar trend.  

- Many farmers in these countries choose to grow cash crops rather than subsistence crops.

Negative impacts of conventional farming on ecosystem

Our current mass production style of farming has resulted in numerous negative side-effects:

- Environmental damages
  - Reduced biodiversity
  - Habitat destruction
  - Deforestation
  - Water, air and soil pollution
  - Salinization, desertification
  - Decline in water resources and land subsidence
- Human impacts
  - Farm land destruction
  - Damage to soil fertility
  - Reduced nutritional value of food
  - Decreased economic, social and cultural values

For the past several years research has looked at sustainable agriculture as a potential solution to correct and prevent these problems.

Sustainable agriculture practices in traditional methods of farming

- Water harvesting and rainfall. Today 80% of crop production worldwide relies on rainfall.
- Some farms are often looked upon as proof of past functioning sustainable agricultural systems.
  - Crop Rotation
  - Natural Fertilizers
  - Raised Fields
  - Terraces
  - Irrigation Canals
Sustainable Agriculture

- Swamps/Lakes
- Home Gardens
- Tree Culture

Sustainable agriculture practices in today’s methods of farming

Today, sustainable farming practices commonly include:

- Crop rotations that mitigate weeds, disease, insect and other pest problems; provide alternative sources of soil nitrogen; reduce soil erosion; and reduce risk of water contamination by agricultural chemicals.
- Pest control strategies that are not harmful to natural systems or people, which include techniques that reduce the need for pesticides by practices such as scouting, use of resistant cultivars, timing of planting, and biological pest controls.
- Increased mechanical/biological weed control.
- Soil and water conservation practices.
- Strategic use of animal and green manures.
- Use of natural or synthetic inputs in a way that poses no significant hazard to man, animals, or the environment.

Difference between Sustainable and Modern Agriculture:

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Sustainable agriculture</th>
<th>Modern agriculture</th>
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<tbody>
<tr>
<td>Plant Nutrient</td>
<td>Farm yard manures, compost, vermicompost, green manure, bio-fertilizer and crop rotation are used.</td>
<td>Chemical fertilizers are used.</td>
</tr>
<tr>
<td>Pest control</td>
<td>Cultural methods, crop rotation and biological methods are used.</td>
<td>Toxic chemical are used.</td>
</tr>
<tr>
<td>Inputs</td>
<td>High diversity, renewable and biodegradable inputs are used</td>
<td>High productivity and low diverse chemicals are used fragile ecology.</td>
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<tr>
<td>Ecology</td>
<td>Stable ecology</td>
<td>easily broken</td>
</tr>
<tr>
<td>Use of resources</td>
<td>The rate of extraction from forests, fisheries, underground water source other renewable do not exceed the rate of regeneration.</td>
<td>The rate of extraction exceeds threat of regeneration. Falling of trees, deforestation, overgrazing and pollution of water - bodied takes.</td>
</tr>
<tr>
<td>Quality of food material</td>
<td>Food material are safe</td>
<td>Food material contain toxic residue.</td>
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Goals of sustainable agriculture
Sustainable agriculture integrates four main goals:

1. Productivity,
2. Environmental stability,
3. Economic profitability, and

Many different terms have used to imply greater sustainability in agricultural systems than in prevailing systems (both pre-industrial and industrializes). Each emphasizes different values, priorities and practices.

1. Productivity:

One most important component of agricultural sustainability is productivity. Productivity means capability of farm production. It is related to judicial use of soil, water, propagation materials, labours, fertilizers and cost.
2. Environmental stability:

Interpretation of sustainable agriculture focuses on types of technology in particular setting, especially strategies that reduce reliance on non-renewable or environmentally harmful inputs. These include eco-agriculture, permaculture, organic, ecological, low-input, biodynamic, environmentally-sensitive, community-based, farm-fresh and extensive strategies. There is intense debate, however, about whether agricultural systems using some of these terms actually qualify as "sustainable". Ecological-the core concerns are to reduce negative environmental and health externalities, to enhance and use local ecosystem resources, and preserve biodiversity. More recent concerns include broader recognition for positive environmental externalities from agriculture.

3. Economic profitability:

Economic perspectives on agricultural sustainability seek to assign value to ecological assets, and also to include a longer time frame in economic analysis. They also highlight subsidies that promote the depletion of resources or unfair competition with other production systems.

4. Social and economic equity:

Socio-economical and political-there are many concerns about the equality of technological change. At the local level, agricultural sustainability is associated with farmer participation, group action and promotion of local institutions, culture and farming communities. At the higher level, the concern is for enabling policies that target poverty reduction.

Sustainable agriculture implies the capacity to adapt and change as external and internal conditions change. These four goals of sustainable agricultural are relative dimension depends on time, place, socioeconomical and political condition.

Sustainable agriculture model
A. Crop rotation keeps the soil healthy.
B. Mixed farms allows the uses of livestock manure.
C. Conserving natural areas protects our environment.
D. Small changes in practices can help, rather than harm, the environment.
E. Grass-fed livestock control weeds without chemicals or mowing.
F. Science can determine the right amount of fertilizers and pesticides.
G. Farming removes nutrients and fertilizers or manures replace them.
H. Farming multiple crops allows to reduce their financial risks by having multiple products to sell.

**Classification of Sustainable Agriculture**

- **Regenerative Agriculture**: Enhanced regeneration of renewable resources to achieve a sustainable agriculture.
- **Permaculture**: Permaculture is a branch of ecological design, ecological engineering, and environmental design that develops sustainable architecture and self-maintained agricultural systems modeled from natural ecosystems.
- **Organic farming**: Is a form of agriculture that relies on techniques such as crop rotation, green manure, compost and biological pest control. Organic farming uses fertilizers and pesticides but excludes or strictly limits the use of manufactured (synthetic) fertilizers, pesticides (which include herbicides, insecticides and fungicides), plant growth regulators such as hormones, livestock antibiotics, food additives, genetically modified organisms, human sewage sludge, and nanomaterials.
- **Natural farming**: Is an ecological farming approach which is related to fertility farming, organic farming, sustainable agriculture, agroforestry, ecoagriculture and permaculture but should be distinguished from biodynamic agriculture.
- **Biological Farming/Ecological Farming**: Biological and Ecological Farming are terms commonly used in Europe and developing countries. Although sometimes strictly defined, e.g., "Biological farming is a system of crop production in which the producer tries to minimize the use of 'chemicals' for control of crop pests".
• Biodynamic Agriculture/Biodynamic Farming: Central to the biodynamic method are certain herbal preparations that guide the decomposition processes in manures and compost.

Characteristics of sustainable agriculture

Sustainable agriculture is a way of raising food production that is healthy for men and animals, does not harm the environment, is humanitarian for workers, respects animals, and provides a fair wage to the farmer.

1. Conservation and preservation: Output of the environment is put back in, so land and resources such as water, soil and air can be replenished and are available to future generations. The waste from sustainable farming stays within the farm’s ecosystem and cannot cause buildup or pollution. So, judicial use of fertilizer, water, minimum emission of GHGs is needed. In addition, sustainable agriculture seeks to minimize transportation costs and fossil fuel use, and is as locally-based as possible. Technical intervention with minimum hazard.

2. Biodiversity: Farms raise different types of plants and animals, which are rotated around the fields to enrich the soil and help prevent disease and pest outbreaks. Chemical pesticides are used minimally and only when necessary; many sustainable farms do not use any form of chemicals.

3. Animal welfare: Animals are treated humanely and with respect, and are well cared for. They are permitted to carry out their natural behaviors, such as grazing, rooting or pecking, and are fed a natural diet appropriate for their species.

4. Economically viable: Farmers are paid a fair wage and are not dependent on subsidies from the government. Sustainable farmers help strengthen rural communities.

5. Socially just: Workers are treated fairly and paid competitive wages and benefits. They work in a safe environment and are offered proper living conditions and food.

6. Productivity/Capacity: Increased productivity to feed the people with minimal environmental hazards.

Benefits of Sustainable agriculture

Sustainable agriculture is an approach of farming that includes a wide range of methods of ranching and farming, which result in the benefits for farmers, their families, the environment, and farm animals. The methods involved in sustainable agriculture produces food, which is healthy for users, causes no harm to the environment, humanitarian for workers, and treats animals with respect. It also gives financial benefits to the farmers, and boosts up the rural communities.

1. Contributes to environmental conservation

The environment plays a major role in fulfilling our basic necessities of life. It is therefore out duty to return some of these things back so that our future generations may not remain deprived. Sustainable farming helps in putting back some of these things back to the environment. This helps to replenish land and other resources like soil, water, and air to make them sufficiently available for the coming generations.

2. Improved soil and water conservation

Organic production methods increase soil carbon (organic matter), water infiltration rates and water holding capacity, making more water available to plants per inch of rainfall received. Soils with less organic matter allow more surface runoff (removing topsoil and nutrients with the water), permit higher surface evaporation, and retain much less water within the soil structure.
3. Prevents pollution

When sustainable farming is carried the waste so produced remains inside the farm’s ecosystem. Thus it cannot in any way cause pollution or buildup in the external environment.

4. Reduction in cost

Sustainable agriculture minimizes the use and cost of purchasing fossil fuel and reduces the transportation costs. This helps in reducing the overall cost involved in the process of farming.

5. Biodiversity

Sustainable agriculture results in biodiversity as the farms produce different kinds of animals and plants. Plants are seasonally rotated about the fields, which results in enriched soil, prevention of diseases and outbreaks of pests.

6. Beneficial for animals

Animals are cared for, treated humanely and with respect. All animals living in the farm are facilitated to exhibit their natural behaviors like grazing, pecking or, rooting. This helps them to grow in a natural way.

7. Economically beneficial for farmers

When farmers engage themselves into sustainable agriculture they receive a fair wage for their effort. As a result their dependence on government subsidies is reduced, thereby strengthening the rural communities.

8. Social equality

When sustainable agriculture is practiced workers are offered competitive salaries and benefits. They are treated with humanity; provided with safe work environment, food and proper living conditions.

9. Beneficial for environment

Sustainable agriculture decreases the use of non-renewable environmental resources and is thus quite beneficial for the environment.

10. Increased food nutrient density

Organically grown foods often contain more nutrients than conventionally grown foods. Conventional nitrogen fertilizers tend to increase the water and sugar levels of foods while diluting the phyttonutrients and minerals.
Fig. Vitamin and mineral concentrations tend to be higher in organically grown foods (Benbrook et al. 2008)

11. Better conditions for farm workers

The people who currently apply pesticides, breath dust from tilled fields, and drink polluted ground water would obviously benefit from a healthier environment provided by sustainable agriculture.

This special type of agriculture and farming technique makes utmost use of the environment and that too without causing any harm to it. Products obtained do not contain any inorganic chemicals like insecticides and pesticides. All these factors make sustainable agriculture a preferred choice of farmers all over the world.

Foley et al. (2005) compared three hypothetical landscapes: a natural ecosystem (left), an intensively managed cropland (middle), and a cropland with restored ecosystem services (right). The natural ecosystems are able to support many ecosystem services at high levels, but not food production. The intensively managed cropland, however, is able to produce food in abundance (at least in the short run), at the cost of diminishing other ecosystem services. However, a middle ground—a cropland that is explicitly managed to maintain other ecosystem services—may be able to support a broader portfolio of ecosystem services.
Forces that discourage the adoption of sustainable agricultural practices

- Agricultural subsidies that favor excessive production of a single commodity.
- Economic incentives that reward growers for externalizing environmental costs to the rest of the society. For example, policies that do not penalize water contamination due to pesticide run-off or soil erosion.
- Political pressure to minimize environmental restrictions
- Consumers insufficiently or wrongly trained about agricultural issues.
- Large populations seeking inexpensive food.

Forces acting to re-couple agriculture with ecological integrity

- Knowledge about the resources and process provided by agriculture such as clean water, soil conservation and recreation. Collectively, these benefits are known as ecosystem services
- Understanding of the impact of agricultural management practices on ecosystem services
- Policies or incentives that pay or reward producers for providing ecosystem services
- Policies that help alleviate pressure on marginal lands
- Public education to inform consumers and those involved in policy making about the environmental costs and benefits of alternative management scenarios

Strategies of sustainable agriculture

The strategies are grouped according to three separate areas of concern:

1. Management of Natural Resources,
2. Production Practices (crops, livestock and fisheries), and

1. Management of natural resources

Agriculture is the most important user of natural resources like soil, water, air and energy, and its sustainability depends upon their availability.

Soil: A common philosophy among sustainable agriculture practitioners is that a "healthy" soil is a key component of sustainability; that is, a healthy soil will produce healthy crop plants that have optimum vigor and are less susceptible to pests. Crop management systems that improve soil quality often
result in greater inputs of water, nutrients, pesticides, and/or energy for tillage to maintain yields. In sustainable systems-

- The soil is a fragile and living medium that must be protected and nurtured to ensure its long-term productivity and stability,
- To protect and enhance the productivity of the soil include using cover crops, compost and/or manures, reducing tillage, avoiding traffic on wet soils, and maintaining soil cover with plants and/or mulches,
- Regular additions of organic matter or the use of cover crops can increase soil aggregate stability and diversity of soil microbial life.

**Water:** Water is the principal resource that has helped agriculture and society to prosper, and it has been a major limiting factor when mismanaged. There is no proper guidelines and management actions of water use in agriculture. But water supply and use is very important in sustainable agriculture in both wet and dry season. We can practice some actions in sustainable agriculture-

- Improving water conservation and storage,
- Providing incentives for selection of salt tolerant crop species,
- Increasing water use efficiency, and
- Managing crops to reduce water loss, or not planting at all.

The most important issues related to water quality involve salinization and contamination of ground and surface waters by pesticides, nitrates and heavy metal. Salinity has become a problem wherever water of even relatively low salt content is used on shallow soils where the water table is near the root zone of crops. Tile drainage can remove the water and salts, but the disposal of the salts and other contaminants may negatively affect the environment depending upon where they are deposited. Temporary solutions include-

- The use of salt-tolerant crops,
- Low-volume irrigation, and
- Various management techniques to minimize the effects of salts on crops.

In the long-term, some land may need to be

- Removed from production or converted to other uses,
- Other uses include conversion of row crop land to production of drought-tolerant forages,
- The restoration of wildlife habitat or the use of agro-forestry to minimize the impacts of salinity and high water tables.

**Energy:** Modern agriculture is heavily dependent on non-renewable energy sources, especially fossil fuel. The continued use of these energy sources cannot be sustained indefinitely, yet to abruptly abandon our reliance on them would be economically catastrophic. However, a sudden cut off in energy supply would be equally disruptive. In sustainable agricultural systems, there is reduced reliance on non-renewable energy sources and a substitution of renewable sources or labour to the extent that is economically feasible.

**Air:** Many agricultural activities affect air quality. These include emission of GHGs and smoke from agricultural burning; dust from tillage, traffic and harvest; pesticide drift from spraying; and nitrous oxide emissions from the use of nitrogen fertilizer. Options to improve air quality include-

- Incorporating crop residue into the soil,
- Using appropriate levels of tillage,
- Planting wind breaks,
- Cover crops or strips of native perennial grasses to reduce dust, and
- Reducing the emission of GHGs from industries and transport and mechanical agricultural.
**Efficient use of inputs:** Many inputs and practices used by conventional farmers are also used in sustainable agriculture. However, maximize reliance on natural, renewable, and on-farm inputs is the prerequisite. Equally important are the environmental, social, and economic impacts of a particular strategy. Converting to sustainable practices does not mean simple input substitution. Frequently, it substitutes enhanced management and scientific knowledge for conventional inputs, especially chemical inputs that harm the environment on farms and in rural communities. The goal is to develop efficient biological systems which also maximize the efficiency of input use to maintain productivity and profitability.

### 2. Production practices

#### Crops

Sustainable production practices involve a variety of activities/approaches such as topography, soil characteristics, climate, pests, local availability of inputs and the individual grower’s goals. Despite the site-specific and individual nature of sustainable agriculture, several general principles can be applied to help growers selecting appropriate management practices:

- Selection of species and varieties that is well suited to the site and to conditions on the farm,
- Intensification and diversification of crops (including livestock and fisheries) and cultural practices to enhance the biological and economic sustainability of the farm,
- Proper agronomic management,
- Efficient use of inputs, and
- Consideration of farmers’ goals and lifestyle choices.

#### Livestock

Bangladesh agriculture is characterized as mix farming which integrated crop, livestock and fish. This is the result of a trend toward separation and specialization of crop and animal production systems is dominating day by day. The actual management practices will, of course, be quite different. Some of the specific points that livestock producers need to address are listed below.

- Management/planning including the mobility of the stock, daily feeding, health concerns, breeding operations, seasonal feed and forage sources, and complex marketing are sources of this complexity.
- Animal enterprise must be appropriate for the farm resources. Farm capabilities and constraints such as feed and forage sources, landscape, climate and skill of the manager must be considered in selecting which animals to produce.
- There is a wide range of breeds available in each of the major ruminant species, i.e., cattle, sheep and goats.
- Use of quality germplasm to improve herd performance is another key to sustainability. In combination with good genetic stock, adapting the reproduction season to fit the climate and sources of feed and forage reduce health problems and feed costs.
- Animal nutrition feed costs are the largest single variable cost in any livestock operation.
- Animal health greatly influences reproductive success and weight gains, two key aspects of successful livestock production. A herd health program is critical to sustainable livestock production.
- Most adverse environmental impacts associated with grazing can be prevented or mitigated with proper grazing management.

#### Fisheries

Rice and fish have been an essential part of the life of Bangladeshi people from time immemorial. The staple foods of the people of Bangladesh are rice and fish. Rice is the foremost agricultural crop in Bangladesh with an annual production of over 25.0 million tons per annum (BRRI, 2010), while annual
fish production is 2.70 million tons (DoF, 2010). The demand for rice and fish is constantly increasing in Bangladesh with nearly three million people being added each year to the population of the country (Chowdhury, 2009). Nevertheless, integrated crop-livestock-fish farming offers a solution to this problem by contributing to food, income and nutrition. The carrying capacities of these lands and waters are not fully utilized, but there exists tremendous scope for increasing fish production by integrating aquaculture-farming because of the availability of low-lying rice fields, warm climate and fertile soil. Sustainable fish production practices involve a variety of activities/approaches such as soil characteristics, local demand. Despite the site-specific and individual nature of sustainable fish farming system, several general principles can be applied to help growers selecting appropriate management practices:

- Selection of species that is well suited to the site and to conditions on the farm,
- Intensification and diversification of fishes (including crops),
- Proper management,
- Efficient use of inputs, and
- Consideration of farmers’ goals.

3. The economic, social & political context

In addition to strategies for preserving natural resources and changing production practices, sustainable agriculture requires a commitment to changing public policies, economic institutions, and social values. Strategies for change must take into account the complex, reciprocal and everchanging relationship between agricultural production and the broader society.

Government policies sometimes often obstruct the goals of sustainable agriculture. New policies are needed to simultaneously promote environmental health, economic profitability, and social and economic equity.

Issues/constrains for Sustainable Agriculture in Bangladesh

- No single approach can be applied uniformly, heterogeneity in agro-climatic environment (agro-ecology, local and regional biophysical factors, and farmer characteristics), conditions need to adopt and the type of sustainable agriculture practice adopted,
- Amount and availability of biomass (e.g. crop residues, animal dung) is crucial element for the most Sustainable Agriculture practice for moisture conservation, soil fertility enhancement. Competing uses for biomass e.g. as cooking fuel or as fodder for cattle. Biomass constrained by limitedness of resource endowment,
- Economic incentives (e.g. prices) determine the profitable Sustainable Agriculture,
- Availability of information on net benefits of adoption, technical details on implementation of Sustainable Agriculture practices,
- There is no updating of extension workers skill to boost technical competence for sustainable agriculture, There is no updating of extension workers skill to boost technical competence for Sustainable Agriculture,
- Policy environment not conducive to widespread adoption of Sustainable Agriculture, both at the national and international level. There is lack of awareness by the policy maker on the benefit of Sustainable practices to possible resistance from agrochemical industries and other traditional actors in intensive agriculture supply,
- There is no policy exist that directly support sustainable agriculture. Even in Agriculture Policy (2010) have no specific clause or agenda on sustainable agriculture. Also National Seed Policy (1993) has no specific clause or agenda on sustainable agriculture.

Principles of Sustainable Agriculture

1. A sustainable agricultural system is based on the prudent use of renewable and/or recyclable resources.
A system which depends on exhaustible (finite) resources such as fossil fuels cannot be sustained indefinitely. A sustainable system would use renewable energy sources such as biological, geothermal, hydroelectric, solar, or wind. Use of recyclable resources such as groundwater at rates greater than recharge depletes reserves and cannot be sustained.

2. **A sustainable agricultural system protects the integrity of natural systems so that natural resources are continually regenerated.**

Our current thinking focuses on reducing the rate of degradation of natural and agricultural ecosystems. A system will not be sustainable as long as the goal is simply to decrease the rate of its degradation. Sustainable agricultural systems should maintain or improve groundwater and surface water quality and regenerate healthy agricultural soils.

3. **A sustainable agricultural system improves the quality of life of individuals and communities.**

In order to stem the rural to urban migration, rural communities must offer people a good standard of living including diverse employment opportunities, health care, education, social services and cultural activities. Young people must be afforded opportunities to develop rural enterprises, including farming, in ways which care for the land so that it may be passed onto future generations in as good or in better condition than it was received.

4. **A sustainable agricultural system is profitable.**

Transition to new ways of knowing, doing and being require incentives for all participants. Some of these incentives are necessarily economic. Systems and practices that do not include profitability as one of the prime motivators will not be voluntarily implemented.

5. **A sustainable agricultural system is guided by a land ethic that considers the long-term good of all members of the land community.**

Holistic or whole-system analysis views an agroecosystem as a dynamic community of soil, water, air and biotic species. All parts are important because they contribute to the whole. This ethic strives to protect the health of the land community, that is its capacity for self-renewal.

The Evolution of Sustainable Agriculture

- A growing movement has emerged during the past two decades to question the role of the agricultural establishment in promoting practices that contribute to these social problems.
- Today, this movement for sustainable agriculture is garnering increasing support and acceptance within mainstream agriculture.
- Not only does sustainable agriculture address many environmental and social concerns, but it offers innovative and economically viable opportunities for growers, laborers, consumers, policymakers and many others in the entire food system.

Milestones in the history

- 2500-1500 BC: Mention of organic manures, green manures in Vedas.
- 1400-1500 BC: Ramayana and Mahabharata: Water management and mention of Kamadhenu, the celestial cow and its role in human life and fertility.
- 300 BC: Arthashastra, mention of soil management, commodity trade and mention of several manures.
- 590 AD: Holy Quran – stressed on recycling i.e. at least one-third of what is taken out from soils must be returned to it.
- 1924: Rudolf Steiner’s development of biodynamic agriculture was probably the first comprehensive organic farming system beginning of which was a lecture Steiner presented.
1930: Natural farming was developed in Japan by Mokichi Okada.

1939: Lady Eve Balfour launched the Haughley Experiment on farmland in England which was the first scientific side-by-side comparison of organic and conventional farming. It was published as a book “The Living Soil (1943)”.

1940: Sir Albert Howard published a book ‘An Agricultural Testament’ which influenced many scientists and farmers and he is often referred as the father of modern organic agriculture.

1950s: Sustainable Agriculture was a research topic of interest, but science tended to concentrate on the new chemical approaches.

1962: Rachel Carson published ‘Silent Spring’, chronicling the effects of DDT and other pesticides on environment. Then DDT was banned by US Government in 1972. The book and its author are often credited with launching the environmental movement.

1967: High yielding paddy varieties from IRRI.

1968: William Gaud of the USDA coined the term ‘Green revolution’

1970: Worldwide movements concentrated with the population and the environment increased attention on organic farming.

1972: Report from Rome Club “Limits to Growth” wherein proposals for sustainable agriculture development was made.

1972: International Federation of Organic Agriculture Movement (IFOAM) was established by six organizations of three countries

1978: Bill Mollison, an Australian forest ecologist coined the term permaculture.

1980: US Government announced its “Global 2000” special report wherein there is an indication of sustainable agriculture in these topics.

1980: The International Union for Conservation of Nature (IUCN) proposed the concept of sustainability in the context of world conservation strategy.

1980s: Various farming and consumer groups began producing organic products.


1984: The agricultural committee of the US national Research Council (NRC) established a sub-committee for the role of alternative agricultural methods in modern agricultural production, and started deliberations.

1985: The Technical Advisory Committee (TAC) of the CGIAR indicated that it was necessary to continuously monitor sustainability in agriculture.

1987: The report “To protect the future of the world” from the World Committee on Environment and Development (WCED) defined the term sustainability.

1989: The white paper on Global Agriculture by the FAO emphasized “sustainable development and management of natural resources”.

1989: Board of Agriculture of National Research Council of U.S. published a major study called “Alternative Agriculture”.

1990: Farming Act of U.S. defined sustainable agriculture and renamed LISA to sustainable agriculture and education (SARE)

1991: World Sustainable Agricultural Association was established and has activities in U.S., India, Japan, Thailand, Taiwan, Australia and Beijing.


2000s: The market for organic products, including organic food, beauty, health, bodycare, household products and fabrics, continue to grow rapidly worldwide. More countries are established formal, government-regulated certification of organic food.
Present status of sustainable agriculture in Bangladesh

- Before the advent of Green Revolution during 60's Bangladeshi farmers did not use any chemical fertilizers or pesticides. Since then the farmers gradually had used chemicals in their farms. As the consequences of chemical farming were emerging some organizations started their activities (PROSHIKA, CARITAS, and UBING etc.). The government also started integrated crop management (ICM) and integrated pest management (IPM) project to minimize the use of chemical fertilizers and pesticides.

- However, the extent of sustainable agriculture is too low till today. Sustainable agriculture emerged as an issue during 1976 when PROSHIKA (a leading NGO of Bangladesh) started its ecological farming program.

- The government through Department of Agriculture Extension (DAE) implemented few projects with support from different aid agencies during 90's. Since climatic diseases are occurring crop loss every year and also for the change in agricultural pattern (from subsistence to heavily dependent on input oriented agriculture.

- There are several other NGOs and commercial organizations are dealing with farming and marketing of organic agriculture and products. CARE-Bangladesh had few projects to address sustainable agriculture issue such as GOLDA, GO-INTERFISH, and NOPEST, which contributed much in this regard.

- Currently they have SHABGE, LMP and Akti Bari Akti Khamar project in operation with some components of sustainable agriculture. There was a networking organization (currently inactive) called Forum of Regenerative Agricultural Movement (FoRAM) and Bangladesh Rural Reconstruction Association (BARRA) worked in this field.

Role of Government on sustainable agriculture

There is no structural support on sustainable agriculture in Bangladesh. Extension Education Department of Bangladesh Agricultural University has minor course on sustainable agriculture. This department is also available in the other Universities (Public/Science and Technology University).

Little initiative has been taken by the NGOs like PROSHIKA, UNINIG, BARCIK, and Hunger Free World CARITAS in research and extension of sustainable agriculture (DFID, 2001). A number of NGOs (both local and international origin) implement (Farmers Field School) FFS and FFS type activities in Bangladesh.

The Department of Agricultural Extension (DAE) of the Government also operates limited FFS. The FFS highlights the need for more location specific and broader extension approach with the farmers taking the lead role. This is a relatively new approach where farmers are protagonists and they have key role in technology development and testing. Integrated Pest Management (IPM), a new farm technology has a few methods under the technology being implemented by DAE and NGOs through FFS for sustainable agriculture.

The government in its New Agricultural Extension Policy (NAEP) 1996 defined strategies to attain the prime objective of integrated environmental support defined that it would integrate environment into the overall agricultural policy to ensure a policy of sustainable agricultural development.

Agronomical Research for Sustainable Agriculture

Agronomy was first defined as the science of crop production. It was mainly focused on the study of relationships between climate, soil, cultural practices and crop yield and quality. Agronomy therefore integrates sciences such as biology, chemistry, soil science, ecology and genetics. Agronomists then enlarged their studies to the individuals performing the cultural practices, namely farmers. This approach raised new issues on the modelling of farmers’ practices, and on the consequences of farmers’ choices on crop production.
Meynard et al. (2006) identified four different ways to design innovative agricultural systems for sustainable development:

- Inventing new farming systems, breaking off with the current ones;
- Identifying and improving farming systems built by the local stakeholders;
- Giving tools and methods to stakeholders to improve their own systems or evaluate those proposed by scientists;
- Identifying the economic, social and organization conditions that may help the actors to adopt alternative farming systems.
Suggested readings:

**Sustainable Agriculture: Principles and Practices**
John Williams Barrow (Editor)
1st Edn.; 2018
Syrawood Publishing House

**Sustainable Agriculture and Food Security**
Gyanindra Dash
1st Edn.; 2017
Regal Publications

**Sustainable Agriculture**
Ramesh Umrani and C.K. Jain
1st Edn.; 2010
Oxford Book Company

**Green Technologies for Sustainable Agriculture**
Perlatti Bruno (Contributor)
1st Edition; 2017
Koros Press Limited

**Sustainable Agriculture: Technology and Management**
Thelma Bosso
2nd edition; 2015
Callisto Reference

**Organic and Sustainable Agriculture**
Jordan Berg