Some Thoughts on Sustainable Agriculture

Mohammed Ataur Rahman, PhD, M.Sc. and DIC
Director, Centre for Global Environmental Culture (CGEC)
IUBAT—International University of Business Agriculture and Technology
marahman@iubat.edu; www.iubat.edu

Abstract

Agriculture is the most vital program for the livelihoods of the human being as well as of its dependents. It started with the date of civilization and is progressing very fast to feed and support the growing population of the world. Many early civilizations like Mohenjo-Daro collapsed due to adoption of inappropriate cultural practices, mainly agriculture. Now, conventional so-called modern agriculture has also been reached at its climax and ruining the biodiversity by polluting the habitat. Soil is being eroded continuously and its capacity is decreasing day-by-day. Agricultural pollutants are now one of the important causes of climate change and the plants and animals are loosing their capability to resist from the environmental vulnerabilities. Thus, food and nutrient security have been deteriorating despite of a huge research and technological advancements. Technology-driven trades are controlling the major production systems defying the genomic diversity, and unethical business has been controlling the whole economy. To overcome the situation, many organizations and researchers have started to raise voice against the techno-piracy politics. Researchers are devoting to find out smart-ways of agricultural practices especially, organic farming, permaculture, biodynamic, eco-agriculture or ecological farming emphasizing the traditional and indigenous knowledge incorporating with advance farming systems. Multiple and multistoried cropping culture, urban agriculture, mixed faming, home-centered short-cycle biomass recycling are also important practices towards sustainable agriculture to feed up the world population and to ensure food and nutrient security.

Agriculture

Agriculture is the science and art of producing crops and animals under supervision of humans in a specific location. It is obscure to determine precisely where, how, and when agriculture was started; and the views of origins are diverse, ranging from mythological to ecological. Whatever prompted humans to purposely raise their plants in a specific area and confine their animals did not happen overnight. It was an evolutionary process that eventually transformed plants from being independent, wild progenitors, to fully dependent and domesticated cultivars, with the concomitant evolution of agricultural economies.

Today, industrial crops are produced on huge monocrop farms, which rely extensively on chemical pesticides, synthetic fertilizers and genetically modified crop varieties. These practices deplete and degrade soil, reduce biodiversity, and generate air and water pollutants that degrade the environment and threaten the health of farm-workers, neighbors, and consumers.

Figs 1 & 2 Monocrops: Using Pesticides

Likewise, the majority of meat, eggs, and dairy products are now produced on enormous industrial livestock facilities. Also known as factory farms, these facilities confine thousands or hundreds of thousands of animals in cramped conditions without access to the outdoors. In addition to compromising animal welfare, factory farms generate a huge amount of waste, which pollutes air, water, and soil, degrading the natural environment and threatening public health.

Figs 3 & 4 Concentrated Farming

Therefore, present conventional agriculture has been passing very crucial days with environmental pollution, disrespecting social culture and integrity, and threat to the human health and biodiversity. In the name of modernization and so-called development, the agricultural science is under the captivity of trader-cum-entrepreneurs' control; defying the environmental, social and ethical aspects. Consuming adulterated food with heavy metals, fats and steroids but deficient with mineral nutrients and vitamins, millions are suffering from malnutrition and dying every year.

Industrial Agriculture

Unfortunately, most food produced in the US is no longer grown or raised on sustainable farms. During the mid-1900s, US agriculture began to industrialize, becoming increasingly mechanized and reliant upon resource-intensive inputs like synthetic fertilizers and chemical pesticides. Over time, farms became larger, more specialized, and centralized, creating a process of extreme consolidation that drove many small farms out of business, and ultimately resulted in market control by a handful of powerful corporations.

Although, industrial agriculture now produces great quantities of food at low prices, yet it is able to do so only by implementing practices that threaten the environment, human health, rural communities, and animal welfare.

The so-called Green Revolution package was introduced into Bangladesh agriculture system in mid 1960s. It promised to increase production of cereal crops, particularly rice by the introduction of HYV seeds, application of chemical fertilizer and pesticide, and irrigation. HYVs rice has contributed significantly to the progress towards the food-self sufficiency in Bangladesh. On the contrary, increased the environmental degradation, due to the intensive use of agrochemical and other modern technologies. The use of pesticide has been increased 400% per acre and its cost increased 600% during the last couple of decades. Between 1985 and 1990, the sales of pesticide became double (Fig. 1). At present, 84 active ingredients of pesticides belonging to 242 trade names have been registered in Bangladesh. Out of the total pesticide-use, over 80% are used in rice fields. The rapid increase of pesticide use is causing detrimental effect on environment and health of farm-workers and consumers. Pesticides are contaminating ground and surface water, which is causing depletion of inland fishing resources and of course coastal and marine ecosystems (Parveen and Nakagoshi 2001).

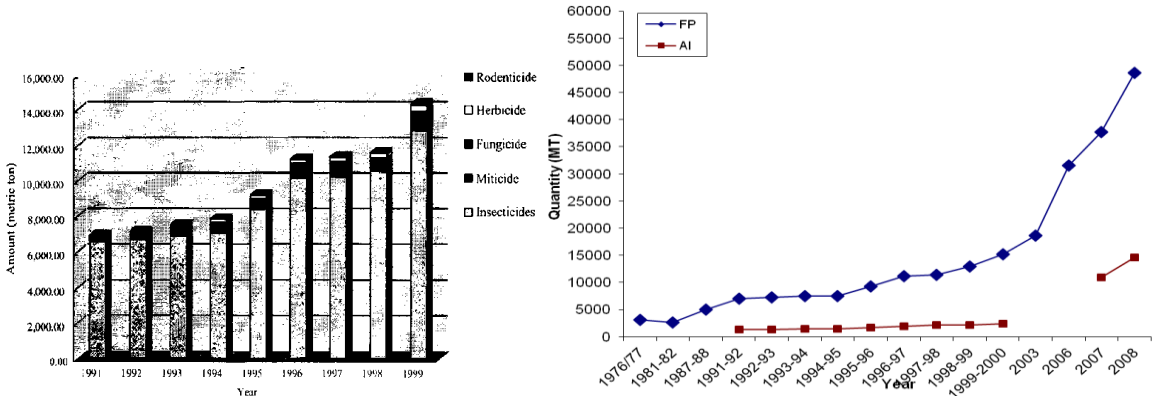


Fig. 5 & 6 Pesticide consumption trend Bangladesh 1976 to 2008 (BPCA 2010) (FP: formulation product, AI: active ingredient)

Era of segregation and Dangers of Genetic Uniformity

Monoculture: Industrial agriculture favors genetic uniformity. Typically, vast areas are planted to a single, high-yielding variety using expensive inputs such as irrigation, chemical fertilizers and pesticides to maximize production. Genetic uniformity invites disaster due to vulnerability of pest and diseases. Unique example is the Irish Famine of 1840s which wiped out potato crop and over one million people died in starvation. In 1970, genetic uniformity left the USA maize crop vulnerable to a blight that destroyed almost USD 1000 million worth of maize and reduced yields by 50%. Over 80% of the commercial maize varieties grown in the USA, are susceptible to virulent disease e.g., southern leaf blight.

Separation of Family: Male calves are separated from the female for meat; female cows are reared for milk, oxen are for artificial semen collection and for the chicken and even for the fishes similar separations are practiced for more growth and production defying the natural bindings. Application of sex hormones is a very common practice in monosex fish-culture for induced growth; these practices only increases the quantity but not the quality, rather diminishes social life with harmony. Moreover, these are hampering human health and inviting serious diseases like cancer, anthrax or mad-cow (BSE of bovine spongiform encephalopathy) jumping the species barrier to produce the human virulent CJD (Creutzfeldt-Jacob disease) etc. (Blewitt 2008).

Concentrated Animal Feeding Operation (CAFO): Animal Feeding Operations (AFO) are agricultural facilities that congregate animals, feed, manure, urine, dead animals, and production operations on a small area of land. By definition, AFOs confine animals for at least 45 days in a 12-month period with no grass or other vegetation in the area during normal growing season. Animals in AFOs are fed unnatural diets on

site instead of allowing them to roam and graze. Concentrated Animal Feeding Operations are AFOs that are considered particularly hazardous based on concentration of animals, sanitation practices, location, and potential to pollute waterways and other natural resources. The EPA determines whether an agricultural business is a CAFO based on regulations created by the Clean Water Act, and special permits are required to operate a CAFO legally. Enforcement of these regulations has not been very strict, which has caused many problems. CAFOs exist in all regions of the U.S., but are concentrated along the eastern seaboard, the plains and the west coast. The vast majority of all animal protein raised and consumed in the U.S., comes through the CAFO system. If you buy meat, you should be aware that CAFO facilities vary widely, with huge variations in size, sanitation, humane treatment practices, the number of animals involved, management of wastewater and manure, and whether the operation is "a significant contributor of pollutants." They may also vary in their use of antibiotics and hormones. CAFOs, which are also known as Confined Animal Feeding Operations or Factory Farms, are prohibited under Animal Welfare Approved standards (AWA). Animal health and waste management are key issues in confined livestock operations. The moral and ethical debate taking place today regarding animal welfare is particularly intense for confined livestock production systems. The issues raised in this debate need to be addressed.

Confinement livestock production is increasingly a source of surface and ground water pollutants, particularly where there are large numbers of animals per unit area. Expensive waste management facilities are now a necessary cost of confined production systems. Waste is a problem of almost all operations and must be managed with respect to both the environment and the quality of life in nearby communities. Livestock production systems that disperse stock in pastures so the wastes are not concentrated and do not overwhelm natural nutrient-cycling processes have become a subject of renewed interest (ASI 2013).

Genetic Modification (GM) The science, business and politics of GM has been a highly controversial field of activity. The big bio-tech corporations have invested millions and expect to make millions more with terminator technology, that is GM seeds that do not germinate, requiring increased sales of specialized herbicides and pesticides and preventing farmers from saving seeds for next year's crop. Traditional farming could be destroyed and environmental damage could occur if artificially produced sterile genes transfer o wild plants and non-GM crops. A single-minded approach to patenting new developments even when they are effectively based on traditional ecological knowledge could effectively steal the modest harvest of many local people in the developing world (Shiva 2000; Blewitt 2008). This "biopiracy" and the corporate buyout of many small biotech companies is sometimes seen as a cynical attempt by the trans-national biotech corporations to secure control of the world's food industry, estimated to be worth in excess of USD 2,000 billion a year (Godrej 2002).

Geopolitics of Plant Genetic Resources

Historically, scientists of the industrialized countries have ventured southwards in search of exotic plants for breeding. Seeds found in tropical centres of diversity have been collected and later deployed in plant breeding and thus, much of the collected diversity of the third world origin has become to be stored in the developed countries and established gene banks there. The disparity between unrestricted access to genetic resources, including farmers' land races, and the existence of proprietary rights such as breeders' right on improved varieties has fueled intense debate over the inequity in the flow of germplasm from the developing to the industrialized world. This unethical piracy is a danger to sustainability of the whole agriculture system. Some facts are given below:

1. Several thousand plant species have been used for human food history, but now only about 150 are cultivated and no more than three (rice, maize and wheat) supply almost 60% of the calories and protein derived from plants.

2. Since the beginning of the twentieth century, about 75% of the genetic biodiversity of agricultural crops has been lost.

Sustainable Agriculture

According to the US Code Title 7, Section 3103 the term "sustainable agriculture" means an integrated system of plant and animal production practices having a site-specific application that will cover the long-term: Satisfy human food and fiber needs, enhance environmental quality and the natural resource base upon which the agriculture economy depends, make the most efficient use of nonrenewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls, sustain the economic viability of farm operations and enhance the quality of life for farmers and society as a whole. In simplest terms, sustainable agriculture is the production of food, fiber, or other plant or animal products using farming techniques that protect the environment, public health, human communities, and animal welfare. This form of agriculture enables us to produce healthful food without compromising future generations' ability to do the same.

The primary benefits of sustainable agriculture are:

Environmental Preservation

Sustainable farms produce crops and raise animals without relying on toxic chemical pesticides, synthetic fertilizers, genetically modified seeds, or practices that degrade soil, water, or other natural resources. By growing a variety of plants and using techniques such as crop rotation, conservation tillage, and pasture-based livestock husbandry, sustainable farms protect biodiversity and foster the development and maintenance of healthy ecosystems.

Protection of Public Health

Food production should never come at the expense of human health. Since sustainable crop farms avoid hazardous pesticides, they're able to grow fruits and vegetables that are safer for consumers, workers, and surrounding communities. Likewise, sustainable livestock farmers and ranchers raise animals without dangerous practices like use of non-therapeutic antibiotics or arsenic-based growth promoters. Through careful, responsible management of livestock waste, sustainable farmers also protect humans from exposure to pathogens, toxins, and other hazardous pollutants.

Sustaining Vibrant Communities

A critical component of sustainable agriculture is its ability to remain economically viable, providing farmers, farm-workers, food processors, and others employed in the food system with a livable wage and safe, fair working conditions. Sustainable farms also bolster local and regional economies, creating good jobs and building strong communities.

Upholding Animal Welfare

Sustainable farmers and ranchers treat animals with care and respect, implementing livestock husbandry practices that protect animals' health and wellbeing. By raising livestock on pasture,

these farmers enable their animals to move freely, engage in instinctive behaviors, consume a natural diet, and avoid the stress and illness associated with confinement.

A Sustainable Food Future

Although, industrial agriculture currently dominates the US food system, public awareness of the problems caused by this model has grown rapidly, building extensive support for sustainable agriculture, creating a robust market for sustainable foods, and inspiring formidable demand for agricultural policy and regulatory reform.

Sustainable Table works to support the transition to a sustainable food future by educating people about the benefits of sustainable agriculture, and by providing tools and resources to help consumers make better food choices that definition is a central element of the legislation of the Sustainable Agriculture Research and Education (SARE) program of NIFA.

Energy

Solar energy is the main source of lives on earth. Except some bacteria, life at any level depends on photosynthesis, the process by which plants use light energy to synthesize food molecules and thus the plants are the primary producers, the ultimate source of food for all life on earth. The energy stored in petroleum and other fossil fuels was originally converted from sunlight by photosynthesis in the distant past (Phillips, 1995). Plant photosynthesis takes place only in the presence of visible light (400-700 nm). However, solar light contains both visible and infrared components. Since visible light accounts for about 45% of all solar energy, the maximum achievable energy efficiency for CO_2 fixation using solar radiation is approximately 13%.

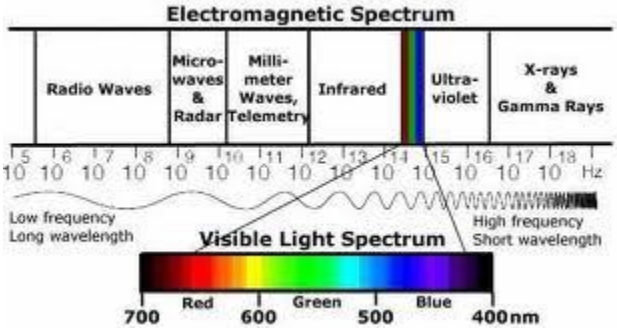


Fig 6 Solar radiation and visible light

Earlier some scientists believed that about 90% of the world's total photosynthesis is carried out by marine algae, but studies conducted later confirmed that only one-third of the total global photosynthesis could be attributed to oceanic algae (Sah 2008).

All living system is dependent on the earth taking in energy as sunlight, using it, and then reradiating it back to the outer space. Energy is continuously and rapidly lost, although a certain amount of energy may pass through the ecosystem more than once before it is entirely dissipated.

World Regions

According to the geographic location, availability of light and day length the whole earth has been divided into several geographic regions;

1. **Equatorial Zone:** 5° N to 5° S, High humidity, high rainfall, moderate temperature with no season; Rain Forests, Swamp Vegetation, Savannah are the special biomes.
2. **Tropical Zone:** 5° N to 30° N and 5° S to 30° S, Very high temperature in the summer and low temperature in the winter, climax weather, mostly deserts, oasis, monsoon and some alpine zones. In the monsoon region special weather prevails due to position of enclosed Bays and mountains. Therefore, wet and hot summer and dry and cold winter this provides ample scope for biodiversity with different adaptations.

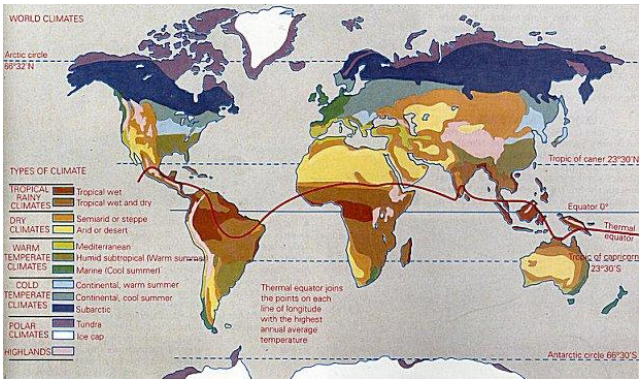


Fig 7 Climatic zones of the world

3 **Temperate Zone:** 30° N to 60° N and 30° S to 60° S: Moderate temperature and no climax weather; mountains, Alpine zone, Prairie, Steppe are the regions/biomes of the temperate zone. Crops mainly grown in the summer; winter temperature is low even goes down below 0° C. Mediterranean climatic region lies in temperate zone with special rainfall in the winter. Very important for biodiversity and fruit crops.

4 **Tundra and Polar Zones:** 60° N to 90° N and 60° S to 90° S: Receive diffuse sunlight, snowfall in the most of the period, the tundra remains under snow for six to nine months and the polar region almost throughout the year. The Axioms, Rein deer, Polar bear, Seal, Sea lion, Penguin are the dominant animals live in these regions.

Both flora and fauna are adaptive with the climatic conditions. The characteristics and livelihoods are also influenced by the climate. It is very difficult or impossible to grow rice in the tundra or temperate zones likewise rein deer and polar bear or penguin will not survive in the tropics.

Undulation and Landscape

Undulation is the beauty of nature; it keeps the earth systems running. Without undulation, every thing would have been remained stand still. It provides the opportunity for diverse landscapes *viz*., mountains and hills, plateau, valleys and catchments, foothills and watersheds, plains and low-lying ditches, rivers and streams, seas and oceans etc.

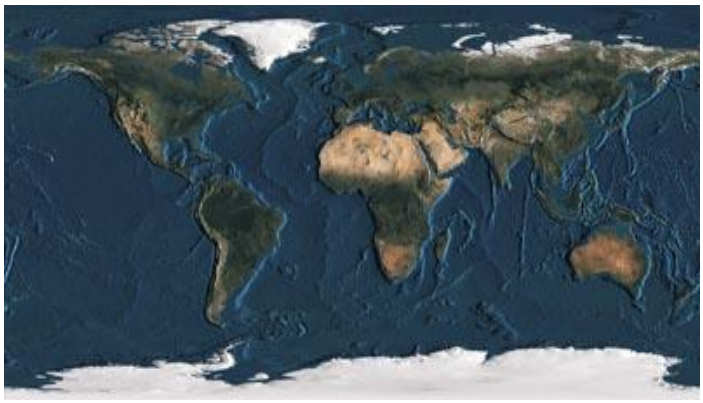


Fig. 8 World Physiography

At present, natural landscapes are rare: human activities have their mark everywhere. Almost every landscape contains a village, city or other community, fields, land where trees have been felled down, roads and bridges, and many other features reflecting human activity. Man-made landscapes especially the agricultural landscapes are the most widespread include fields, pastures and fish ponds etc which arise as a result of deliberate human activity. Associated man-made landscapes are mostly complexes as a result of non-rational economic management e.g. gullies in the fields, irrigated oases, swamps along the bank of reservoirs etc. However, man-made landscapes should not oppose to the natural ones rather respect the laws of nature.

Diverse landscape provides opportunities with different habitat and eco-niche for different species. Moreover, undulated landscapes possess increased surface area thus giving more scope for increasing production by properly managing them according to habit and habitat of the plants and nature of the land.

Adaptation

Some crops grow in high intensity light e.g. rice; some are partial shade loving e.g., tea, coffee, turmeric and yams etc; some are shade loving e.g. mushrooms, orchids, arums etc. Some crops are long day plants e.g. Amon rice, some are short day e.g. Aus, and some are day neutral e.g. Boro flowering and reproductive behavior also influenced by the temperature and duration of light and dark periods. This environmental adaptation becomes the genetic behavior.

- **Habit:** Each and every species has its own habit. Some prefer hot weather some prefer cold; some thrive well in wet conditions but some do not like; some can pass cold weather for months together but some can not tolerate. There are differences in liking food habits in both plants and animals.
- **Habitat:** Lives can not exist without a habitat, nor is a habitat likely to remain long without a community developing it. The functional interrelationships between community and habitat are many and complex, constituting an ecosystem, nutrient recycling and energy flow. The habitat offers a variety of unique conditions to which living organisms must be apted before they can occur. We must understand these conditions in order to interpret how they are distributed.

Succession

Ecological succession is the gradual process by which ecosystems change and develop over time. Nothing remains the same and habitats are constantly changing.

Figs. 9 & 10 Successions

The species living in a particular place gradually change over time as does the physical and chemical environment within that area. Through the processes of living, growing and reproducing, organisms interact with and affect the environment within an area, gradually changing it. Each species is adapted to thrive and compete best against other species under a very specific set of environmental conditions. If these conditions change, then the existing species will be outcompeted by a different set of species which are better adapted to the new conditions. The structure or 'architecture' of the plant communities will also influence the animal species which can live in the microhabitats provided by the plants.

Many thousands of different species including the microbes are involved in the community changes taking place over the course of a succession. The actual species involved in a succession in a particular area are controlled by such factors as the geology and history of the area, the climate, microclimate, weather, soil type and other environmental factors. Succession occurs on many different timescales, ranging from a few days to hundreds of years. It may take hundreds of years for a climax woodland to develop, while the succession of invertebrates and fungi within a single cow pat (cow dung), may be over within as little as three months. By this time, the dung has been transformed into humus and nutrients and has been recycled back into the soil. The holes clearly visible in the cow pat have been made by the animals which have colonized it.

Fig. 11 Cow dung decomposition

Durva or Bermuda grass (*Cynodan dactylon*), mints, ground nuts and sweet potato grow well in the sand or char lands but gradually loss their habitat as the biomass increases with their growth and another sere

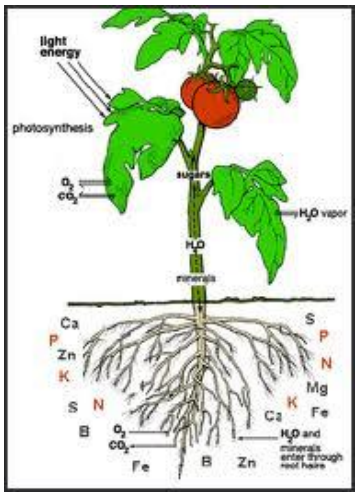
appears. Therefore, during the succession biomass is added, new nutrients are made available by the plants. For every succession of habitats different nutrients are up taken by the plants for their specific needs. Mere application of some so-called known chemical fertilizers can not fulfill the specific demands to maintain the characteristics of each and every species. Some plants have the ability to fix nitrogen through microbial association; Mycorriza provides nutrients and support many plants from adverse conditions. There are many more evidences for association between plants and animals like symbiosis, commensalism, antagonism etc. even for pollination and supporting in hazardous situations.

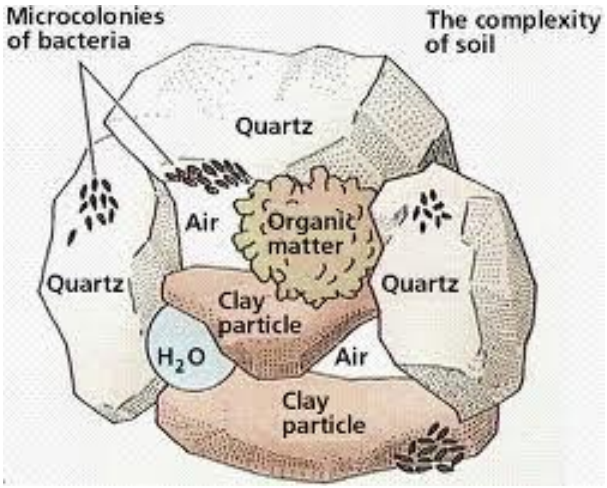
Soil and its Capacity

According to Encyclopedia Britannica, "soil is the biologically active, porous medium that has developed in the uppermost layer of the Earth's crust. Soil is one of the principal substrata of life on Earth, serving as a reservoir of water and nutrients, as a medium for the filtration and breakdown of injurious wastes, and as a participant in the cycling of carbon and other elements through the global ecosystem. It has evolved through weathering processes driven by biological, climatic, geologic, and topographic influences". In fact, most of the land's biodiversity lives in the soil, not above ground. The abundance of life, habitats, and opportunities for human occupation mirror the tremendous variety of soils that are the Earth's living skin. Soil is a living thing; very slowly moving, changing and growing all the time. Just like other living things, soil breathes and needs air and water to stay alive. Healthy, living soil provides us with our everyday needs. Soil supports all kinds of living activities. It nourishes crops that we use for food and trees that we use for building materials. Wildlife and livestock survive by eating plants that grow on the soil. Soil sequesters carbon as a great carbon sink and thus contribute to reducing global warming by storing carbon and keeps the planet cool.

Soil is the indicator of productivity and the carrying capacity of the earth. The volume of the soil is directly proportional to biomass production. The biomass production depends on multiple factors like minerals, organic matter, light intensity, humidity and precipitation, presence and activities of living organisms in the soil etc. Although Assam soil contains around 1% organic matter but the growth of plants is the highest in the world

More than 50 chemical elements have been identified among the inorganic substances present in plants. There are nine macronutrients in all, including the six major ingredients in organic compounds: carbon, oxygen, hydrogen, nitrogen, sulfur, and phosphorus, the other three macronutrients are potassium, calcium, and magnesium. Eight micronutrients are iron, chlorine, copper, zinc, manganese, molybdenum, boron, and nickel and most of these functions as cofactors, non-protein helpers in enzymatic reactions; iron is a metallic component in cytochromes, proteins that function in the electron transfer chains of chloroplasts and mitochondria however a deficiency of a micronutrient can weaken or kill a plant (Campbell/Reece Biology: Plant Nutrition). Some plants viz. tea need aluminum as an essential element for their growth. However, only carbon dioxide, oxygen and some occasion water are taken from the atmosphere but the rest chemicals including water are taken from the soil.





Figs. 12 & 13 Nutrients up taking and microbial activities on rocks converting soil

So, the each and individual species has their special needs and having different characters or properties. These nutrients are the ultimate source of nutrients of human being to prevent malnutrition and to increase immunity against many including cancers.

Conserving and protecting the soil is the best way to make sure the soil stays alive and healthy. When growing crops, the unused parts of the plants return to the soil as organic matter. Food scraps and grass clippings can be composted and put back into the soil.

- **Soil creation** and development is a dynamic process. Weathering is an integral part of soil development. Depending on the soil-forming factors in an area, weathering may proceed rapidly over a decade or slowly over millions of years. Five soil-forming factors have been identified that influence the development of a specific soil. Wherever these five factors have been the same on the landscape, the soil will be the same. However, if one or more of the factors differ, the soils will be different. The factors are: parent material (rock or sand), climate, living organisms, topography and time. Soil without living organism is absolutely dead. Living organisms like earthworms, slugs, woodlice and insects and millions of micro-organisms actively and break down rocks, stones, dead plants and help to create humus. Different kinds of soil are spread across different landscapes – not randomly but in predictable patterns first identified 125 years ago by pioneering Russian pedologist Vasiliy Dokuchaev (1846-1903) as functions of parent material, climate, relief and living organisms acting over time - or, as he put it, the “age of the landscape”.
- **Degradation:** Lester Brown, Founder of Worldwatch Institute and the Earth Policy Institute, identifies modern agricultural technologies including the use of petroleum-based fertilizers which have artificially raised the productive capacity of agricultural land which is not sustainable at all and causing serious soil erosion and degradation. Approximately one-third of global agricultural land is loosing top soil faster than it is being replaced (Brown 2009). Drought and agricultural practices that include intensive tillage result in soil erosion which is anticipated to worsen in the face of climate change (Brown 2009). It takes about 500 years for one inch of topsoil to regenerate in the temperate wheat growing areas of North America (National Geographic 2010).

- **Soil Management:** 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. While many crops have key

pests that attack even the healthiest of plants, proper soil, water and nutrient management can help prevent some pest problems brought on by crop stress or nutrient imbalance. Furthermore, crop management systems that impair 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 viewed as a fragile and living medium that must be protected and nurtured to ensure its long-term productivity and stability. Methods 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. Conditions in most soils (warm, irrigated, and tilled) do not favor the buildup of organic matter. Regular additions of organic matter or the use of cover crops can increase soil aggregate stability, soil tilth, and diversity of soil microbial life.

Short-cycle biomass recycling, organic farming, permaculture, Biodynamic, climate smart agriculture, traditional and ethnic farming etc., which ensures zero nutrient depletion are considered as eco-friendly systems for sustainable soil management.

Biodiversity

Biodiversity provides the raw materials, combinations of genes, that produce the plant varieties and animal breeds upon which agriculture depends. Thousands of different and genetically unique varieties of crops and animal breeds owe their existence to 3,000 million years of natural biological evolution and to careful selection and nurturing by our farming and herding ancestors during 12,000 or so years of agriculture. The wealth of living things on the earth is the product of hundreds of millions of years of evolutionary history. Since the emergence of *Homo sapiens* from the ranks of humanoid primates, biodiversity and humanity have become inextricably linked. Human cultures have adapted to many diverse habitats. They have used, altered and nurtured biological resources to meet countless needs. As a result of plant and animal domestication, and resource harvesting, a tremendous interdependence has evolved between "natural" and "human-induced" biodiversity.

Everyone depends in someway on the world's biological resources for survival. Their diversity offers the possibility of increasing food supplies and adapting to changing conditions. Every nation, developing or developed, is impoverished by the continuing loss and degradation of biodiversity. Human being is the most biased animal in the world that encourages his beneficial things to grow and discourage or destroy the less beneficial ones.

We live in an age of plenty; we live in an age of hunger! Global resources are sufficient to feed an ever-growing population, yet millions live without adequate nutrition or are dying outright of malnutrition or starvation. But even as population growth slows, the current quantity of the world's food resources is more than adequate for the needs of all persons. The U.N.'s World Food Programme (WFP) states flatly, "There is enough food in the world today for everyone to have the nourishment necessary for a healthy and productive life" (WFP-2012). Still, the myth of food shortages due to overpopulation is widespread. But it is just that—a myth. According to the World Hunger Education Service, "In raw volume, the world's farmers produce enough food for everyone."

World agriculture produces 17 percent more calories per person today than it did 30 years ago, despite a 70 percent population increase. This is enough to provide everyone in the world with at least 2,720 kilocalories (kcal) per person per day according to the most recent estimate that we could find (FAO-2002). The principle problem is that many people in the world do not have sufficient land to grow, or income to purchase, enough food (World Hunger 2012)". Clearly, many of the world's poor have

insufficient access to arable land or have incomes that are too meager to provide for their needs. Moreover, widespread corruption is another factor. FAO estimates that since the beginning of twentieth century about 75 percent of the genetic biodiversity of agricultural crops has been lost and people are becoming increasingly dependent on fewer crop varieties and, as a result, a rapidly diminishing gene pool. The primary reason is that commercial, uniform varieties are replacing the traditional ones- even, and most threateningly, in the centres of diversity. With beginning of development of high-yielding grains in the 1950s by the international crop breeding institutions led to the Green Revolution spread newly developed varieties or cultivars and by 1990 they covered half of all wheat lands and more than half of all rice lands- a total of some 115 million hectares, thus resulted increase in yield but at the cost of huge varieties i.e. crop diversity. This erosion of genetic diversity poses serious threat to food and nutrient security including loss of huge forests and wet- bodies bringing under cropping culture.

Moreover, to maintain pest and disease resistance in major food crops or to develop desirable traits such as drought or salinity tolerant, or improved flavor, plant breeders require fresh infusions of genes. Developing the high-yielding elite cultivars of modern agriculture depends on a steady stream of new, exotic germplasm and continuously trying to develop new varieties to keep one step ahead of thousands of pests and diseases but driving modern agriculture towards a danger. To get high yield or growth through hybrid vigor, inter- or intra-species or inter-genus hybridization forcing many species endangered. Although hybridization in the nature is a continuous process but adaptation needs time which may be hundreds or thousand years. Without providing adaptation period it is impracticable to continue the new breeds or to protect them from the vulnerabilities of pests and diseases or other environmental and climatic stresses.

Fig. 14 Homestead Permaculture

Conventional agriculture has affected the status of native biodiversity. To halt the decline in this priceless heritage requires urgent action at local, national and international levels. Biodiversity conservation should be a target of every organic, biodynamic or agro-ecological multiple and multi-storey farming systems. Urbanization also a great threat to biodiversity and sustainable agriculture, therefore urban agriculture: kitchen or roof top gardening should be considered as prime necessity to recycle the green refuses and to have fresh and healthy food from own garden.

Conclusion

We are at a crossroads. Our generation has inherited a rich biological legacy, but what will we pass on to the next generation: a secure biotic heritage or a genetically impoverished world? Global, national and local action to conserve and utilize biodiversity will influence the future evolution of both human civilization and life on earth. Biodiversity for human development, based on equitable and sustainable use, is the path to sustainable livelihoods today, while ensuring that future generations have the resources they will need to survive and prosper. Sustainable agriculture is a very powerful tool in land and resource management for providing humanity with clean, healthy food and at the same time contributes to the goal set out in international conventions like Kyoto protocol. We must understand the cheating behavior of techno-traders e.g. superiority of molasses or brown sugar over table sugar, brown bread over white bread,

coarse unpolished rice over the polished ones etc. Increased production volume like broiler chicken does not provide the nutrient value as like as a pigeon chick. Industrial zones should be planned as green city planting with crops and considering the recycling of green garbage and also for a fresh breath, healthy food with nutrients. So, there is nothing like sustainable agriculture which only can provide a healthy life with nutrient-rich food.

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