SUSTAINABLE ENVIRONMENT OF VERTICAL FARMING

Sustainable agriculture is the act of farming using principles of ecology, the study of relationships between organisms and their environment. It has been defined as "an integrated system of plant and animal production practices having a site-specific application that will last over the long term", for example:

- Satisfy human food and fibre needs.
- Enhance environmental quality and the natural resource base upon which the agricultural economy depends
- Make the most efficient use of non- renewable resource and on-farm resources and integrate, where appropriate, natural biological cycles and controls
- Sustain the economic viability of farm operations
- Enhance the quality of life for farmers and society as a whole

FARMING AND NATURAL RESOURCES

Sustainable agriculture can be understood as an ecosystem approach to agriculture. Practices that can cause long-term damage to soil include excessive tilling of the soil (leading to erosion) and irrigation without adequate drainage (leading to salinization). Long-term experiments have provided some of the best data on how various practices affect soil properties essential to sustainability.

The most important factors for an individual site are sun, air, soil, nutrients, and water. Of the five, water and soil quality and quantity are most amenable to human intervention through time and labor.

Although air and sunlight are available everywhere on Earth, crops also depend on soil nutrients and the availability of water. When farmers grow and harvest crops, they remove some of these nutrients from the soil. Without replenishment, land suffers from nutrient depletion and becomes either unusable or suffers from reduced yields. Sustainable agriculture depends on replenishing the soil while minimizing the use or need of non-renewable resources, such as natural gas (used in converting atmospheric nitrogen into synthetic fertilizer), or mineral ores (e.g., phosphate). Possible sources of nitrogen that would, in principle, be available indefinitely, include:

1. recycling crop waste and livestock or treated human manure
2. growing legume crops and forages such as peanuts or alfalfa that form symbioses with nitrogen-fixing bacteria called rhizobia
3. industrial production of nitrogen by the Haber process uses hydrogen, which is currently derived from natural gas, (but this hydrogen could instead be made by electrolysis of water using electricity (perhaps from solar cells or windmills)
4. Genetically engineering (non-legume) crops to form nitrogen-fixing symbioses or fix nitrogen without microbial symbionts.

WATER

In some areas sufficient rainfall is available for crop growth, but many other areas require irrigation. For irrigation systems to be sustainable, they require proper management (to avoid salinization) and must not use more water from their source than is naturally replenish able. Otherwise, the water source effectively becomes an on-renewable resource. Improvements in water well drilling technology and submersible pumps, combined with the development of drip irrigation and low-pressure pivots, have made it possible to regularly achieve high crop yields in areas where reliance on rainfall alone had previously made successful agriculture unpredictable. However, this progress has come at a price. In many areas, such as the Ogallala Aquifer, the water is being used faster than it can be replenished.

Several steps must be taken to develop drought-resistant farming systems even in “normal” years with average rainfall. These measures include both policy and managementactions:1) improving water conservation and storage measures, 2) providing incentives for selection of drought-tolerant crop species, 3) using reduced-volume irrigation systems, 4) managing crops to reduce water loss, or 5) not planting crops a tall.

INDICATORS FOR SUSTAINABLE WATER RESOURCE DEVELOPMENT ARE:

- Internal renewable water resources. This is the average annual flow of rivers and groundwater generated from endogenous precipitation, after ensuring that there is no double counting. It represents the maximum amount of water resource produced within the boundaries of a country. This value, which is expressed as an average on a yearly basis, is invariant in time (except in the case of proved climate change). The indicator can be
  expressed in three different units: in absolute terms (km3/yr.), in mm/yr. (it is a measure of the humidity of the country), and as a function of population (m^3/person per yr.)
- Global renewable water resources. This is the sum of internal renewable water resources and incoming flow originating outside the country. Unlike internal resources, this value can vary with time if upstream development reduces water availability at the border. Treaties ensuring a specific flow to be reserved from upstream to downstream countries may be taken into account in the computation of global water resources in both countries.
- Dependency ratio. This is the proportion of the global renewable water resources originating outside the country, expressed in percentage. It is an expression of the level to which the water resources of a country depend on neighbouring countries.
- Water withdrawal. In view of the limitations described above, only gross water withdrawal can be computed systematically on a country basis as a measure of water use. Absolute or per-person value of yearly water

withdrawal gives a measure of the importance of watering the country's economy. When expressed in percentage of water resources, it shows the degree of pressure on water resources.

SOIL

Soil erosion is fast becoming one of the world greatest problems. It is estimated that "more than a thousand million tons of southern Africa's soil are eroded every year. Experts predict that crop yields will be halved within thirty to fifty years if erosion continues at present rates.'' Soil erosion is not unique to Africa but is occurring worldwide. The phenomenon is being called Peak Soil as present large-scale factory farming techniques are jeopardizing humanity's ability to grow food in the present and in the future. Without efforts to improve soil management practices, the availability of arable soil will become increasingly problematic.

SOME SOIL MANAGEMENT TECHNIQUES

1. No-till farming
2. Keyline design
3. Growing wind breaks to hold the soil
4. Incorporating organic matter back into fields
5. Stop using chemical fertilizers (which contain salt)
6. Protecting soil from water run off (soil erosion)