Institute for Christian Teaching
Education Department of Seventh-day Adventists

SUSTAINABLE AGRICULTURE: GOD'S PLAN, MAN'S DISCOVERY

by
Grace Oluwatoyin Tayo
Babcock University
Ilishan -Remo,
Nigeria

483-00 Institute for Christian Teaching
12501 Old Columbia Pike
Silver Spring, MD 20904 USA

Prepared for the
28th International Faith and Learning Seminar
held at
Babcock University, Ilishan - Remo, Nigeria
June 17-29, 2001

Introduction

In many areas of the world, natural resources are under strong pressure. The nature and extent however differ from place to place. Agriculture and forestry as major human activities are significantly affecting regional soil conditions, water quality, biological diversity, climatic patterns and agricultural productivity. The effect is global in scale and has now become a matter of international concern. Resources are declining because of over-exploitation and improper management. (Reijntjes et al., 1992). Miller (1996) also reported that exponential growth in population and resource use has drastically changed the face of the planet.

Carls (1987) argued that inputs such as fertilizers, pesticides, irrigation water, soil amendments have greatly contributed to crop yields but little attention is being paid to understanding the biological and ecological bases of interactions occurring within the cropping system as long as such interactions were not considered detrimental to yields. Man driven by selfishness has over exploited habitats for personal gain. The situation is alarming and researchers and scholars call for urgent intervention measures.

Today, agriculture is faced with the need to assess the long-term sustainability of its practices. In essence, it is important to understand agro-ecosystem processes that promote productivity in the short term and sustain it over the long term. Agriculture must also consider availability, cost of input and impact of conventional practices on the environment and on food safety (Carls, 1987).

Ecosystems reveal the interrelationship between organisms and the environment. White (1959), stated that all created beings are interdependent. The Bible in Gen. 1:1 and Psalm 24:1 establish God as creator of the heavens, the earth and all its fullness. God in His infinite love created all things and committed the care and keeping of the garden to Adam and Eve (Gen. 2:15). He gave them the instruction to replenish the earth (Gen. 1:28). A call for sustainability today is a call to go back to Eden. The thrust of this paper is therefore to consider the conventional call for sustainable agriculture in the light of a system already put in place by God.

Agriculture and Sustainability

Agriculture stems from two words: *Agri* and *culture*. *Agri*, which is *ager* in Latin means land, while *culture, cultura* (Latin) means cultivation. In other words, agriculture is the deliberate cultivation of land for the production of crops and livestock. Harwood et. al, (1992) defined agriculture fundamentally as a process of converting solar energy through photosynthesis into useful biomass.

Miller, (1996) defined sustainability as meeting present needs without depleting the resources that supply these products. Serageldin (1995), viewed sustainability as opportunities currently available but which are left to future generations. Sustainable agriculture is therefore producing enough agricultural products to meet present needs without depleting the soil and other resources that supply them. This brings to mind the

slogan "farming for the future." Harwood et al.(1992) further defined sustainable agriculture to include a broad spectrum of food and fiber production systems suited to the environment. Sustainable agriculture also attempts to keep the productive capacity of natural resources in step with population growth and economic demands while protecting and where necessary restoring environmental quality.

The definition of sustainable agriculture may vary by discipline and area of concern, but the following characteristics are common: the long-term maintenance of natural resources and agricultural productivity; minimal adverse environmental impacts; adequate economic returns to farmers; optimal production with purchased inputs used only to supplement natural processes that are carefully managed; satisfaction of human needs for food, nutrition, shelter and provision for the social needs of farm families and communities.

God as the creator sustains the earth. He has also built in sustainability at creation when He pronounced every herb to bear fruit after its kind: (Gen. 1:11), thus signifying continuity in all His created work. However, sustainability is achievable when human beings as stewards, view God's handiwork as He saw it in the beginning -"good"(Gen. 1:10, 12).

Interrelationships within the Ecosystem

Ecosystems are made up of biotic and abiotic components. All organisms and the features are necessary for the system to be maintained and flourished. Homeostasis is maintained by self regulation because there is allowance for small changes which can be

countered by feedback mechanism to restore equilibrum. However, in the presence of large changes, the system moves from the original equilibrum, resulting in radical changes in the ecosystem. Such a change can be detrimental, for example the acid damage to lakes and forests.

Solar energy powers most ecosystems as the Holy Spirit empowers the Christian and Clausen (2001) in the same vein observed that nothing in creation is more important to life on earth than the sun. Only about 45% (5×10^6 KJ m^{-2} yr^{-1}) of the sun's energy penetrates the earth surface. (Taylor et. al., 1997). Below half of this is in the photosynthetically active range (PAR) and about 10% of PAR is converted in photosynthesis to gross primary productivity (GPP). Net primary productivity (NPP) which is the net gain of organic material in photosynthesis less losses due to respiration varies between 50-80% of gross primary productivity. Cultivated crops achieve higher rates of GPP and NPP during their short growing periods.

The photoautotrophs (plants which manufacture their own food by photosynthesis), in turn form the food source of other organisms in the system. Chemicals in these organisms are returned back to their soil through decomposition by fungi and other microorganisms. The result is a constant bio-geochemical cycle.

A typical example of what happens in the moist forest was described by Harwood et al, (1992) who explained that vegetation within tropical moist forests thrives by retaining and efficiently recycling scarce but essential nutrients within the ecosystem. When litter

(leaves, branches and trees) fall on to the forest floor they decompose, the decomposition returns nutrients to the soil, and such nutrients are mineralized and absorbed by forest roots. Most of these nutrients are therefore efficiently recycled with nutrient additions through rain, dust and biological nitrogen fixation balancing losses through leaching, denitrification and volatilization. Losses of nutrients in the pristine rain forest also provide nutrients to streams and rivers that support large aquatic populations. All these occur by God's design without man's intervention. No wonder the Psalmist marvels at the work of His fingers (Psalm 8:3-8).

Need for Sustainable Agriculture

Traditional agricultural systems have been characterized by use of simple implements and low-external inputs. The drive to intensify production to meet the rapidly growing global population has caused the dislocation and replacement of traditional systems by modern agricultural systems and technologies that are not usually compatible with the prevailing ecological and socio-economic conditions (FAO, 1980).

Agricultural production practices in the tropical regions are usually unsustainable because the capacity of land to support crop production is being rapidly exhausted. The pressure is exacerbated as a result of poverty and demand for food. Other factors affecting crop production particularly in the tropics include the following:

1. Deforestation: This is the depletion of crown cover to less than ten percent (Harwood et al; 1992). It lowers the regenerative capacity of the forest. Lean

et al; (1990) reported that Africa has lost 52% of its original moist forests, followed by Asia (42%) and Latin America (37%). This occurs as a result of unsustainable logging practices and continuous slashing and burning of land for crop production as in shifting cultivation with short fallow periods. The practice exposes the soil to erosion, compaction and crushing. It has climatic consequences and on the global scale affects concentration of carbon-dioxide, methane and other green house gases. Trees use carbon-dioxide and water in photosynthesis to produce glucose and oxygen. According to Lockton (1991), one tree can remove as much as 48 pounds of carbon-dioxide from the air each year. A full grown birch tree produces enough oxygen for a family of four.

2. Use of high external inputs such as fertilizers, herbicides, and pesticides in crop production . These chemicals, apart from constituting health hazards, tend to affect the soil pH, cause nutrient loading and destroy the soil.
3. Overgrazing: This occurs in parts of the world where animals are reared on extensive system, when the land is overgrazed it causes deforestation and exposes the soil to erosion.
4. Bush burning as practiced in some developing tropical countries does not allow recycling by decomposition of organic materials. It burns off the materials returning nutrients only through the ash.

5. The issue of human population : The unprecedented increase in human numbers and activity have major impacts on the environment (Amerena, 1991). With high population growth rate, there is a faster conversion of land to agricultural uses and greater demands for wood for fuel and building materials. Sustainable land use cannot be achieved as long as high rate of population growth continue. According to Population Reference Bureau (1991), the world's population is expected to increase by 1 billion each decade into the 21st century and most of this growth will occur in developing countries. Human population density exerts additional pressure on the available land and natural resources. It has also forced the shortening of the fallow period.

The global consequence of these unsustainable practices as observed by Amerena (1991), includes the loss of six million square kilometers of forest, three fold rise in sediment load from soil erosion into major river basins, disturbance of atmospheric systems threatening the climate to which all forms of life have been adapted and an increase in methane and carbon-dioxide concentration which has significantly damaged the stratospheric ozone layer. In fact, the whole world groans and travails in pain together until now (Romans 8 : 22).

The question however is, if practices that produce more food in the short term but involves long term social, economic and environmental costs were to be discontinued, would

we still be able to feed the increasing world population?

E . G. White (1898) has this to say " If men (women) today were simple in their habits, living in harmony with nature's laws as did Adam and Eve in the beginning, there would be an abundant supply for the needs of the human family. There would be fewer imaginary wants, and more opportunities to work in God`s ways. But selfishness and the indulgence of unnatural taste have brought sin and misery into the world, from excess on the one hand and from want on the other."

This paper does not throw technology out of the window but it emphasizes technology that is environment and user friendly.

The Way Out

Sustainable agriculture can provide opportunities to address productivity and environmental goals simultaneously. Several ideas and solutions have been put up by advocates of sustainability . Generally, these solutions include the following:

i. Adaptive research on the introduction of new technologies in traditional agricultural systems. This involves testing the technology on small plots to verify their sustainability and impact on the environment before adoption. The State Agricultural Development Programmes (ADP) in Nigeria practice similar activity under a system known as "SPAT" Small Plot Adaption Technology. Agricultural extension officers acquire small plots within their client's farm, they employ new technology and innovations that they wish to pass on to farmers on this small plot. During harvesting

a comparison is made between the small plot and the client's plot, this usually favours the extension officers and speeds up the rate of adoption of new technology by farmers. This system can also be adapted to test the effect of new technologies on the environment.

ii. Integrated land use planning involving a variety of land uses that allows flexibility and time for natural processes of ecosystem recovery. The land uses could include, mixed cropping, agro-forestry system, perennial tree plantations, managed pastures and forest reserves. An example of this is practiced in Ghana, where a system of mixed cropping involving plantation crops such as citrus intercropped with arable crops (for example, maize and cassava) is being propagated by the University of Ghana Agricultural Research Station, Kade. This slows down deforestation arising from shifting cultivation. The system allows a farmer to utilize the same plot of land for years until the plantation crop begins to fruit. Other systems also involve intercropping forage for livestock with plantation crops. Livestock are therefore allowed to graze on the forage under the tree crops.

iii. Concentrating intensification of agricultural production as far as possible in most suitable areas. This will slow down soil degradation.

iv. Promotion of well adapted systems of production that integrate modern technology with the traditional systems of resources management.

v. Education of farmers and farm families on the better management and conservation

of the natural resources used in agriculture. It could be done informally by agricultural extension agents.

vi. Campaign against overpopulation especially in the developing countries.

Specific practices associated with sustainable agriculture are:

- Low tillage planting techniques :

  Tilling of the soil during cultivation should be reduced to the minimal possible level to avoid unnecessary exposure of soil to erosion.

- Cultivation of legumes, other cover crops and mulching :

  Legumes are known to fix nitrogen back into the soil, they are considered as fertility crops. Most legumes and trailing crops help to maintain continuous ground cover thereby minimizing soil erosion.

- Contour cropping and terracing :

  This involves planting of crops across slopes to slow down erosion.

- Bio-control and other integrated pest management strategies :

  Natural predators that have no destructive effect on crops are sometimes introduced to control the spread of insect pests.

- Use of hybrids that are tolerant of acidic and salinized soil :

  Hybrids that are less sensitive to acidic or salinized soil can be planted on such soils.

- Substitution of organic for inorganic fertilizers :

  This will prevent nutrient loading and soil acidity due to the use of inorganic fertilizer

- Low impact land clearing techniques
- Intercropping and mixed cropping methods that allow for more efficient use of on-farm resources : This is achieved by employing more than one cropping system.
- Encouraging alternative feed for livestock :

This will reduce competition between man and livestock for feed. Other farm by-products and forages that are not palatable to humans can be fed to livestock. It will reduce the pressure on agricultural products and consequently land.

It is necessary to observe that no single system can simultaneously meet all the requirements for sustainability or fit the diverse socio-economic and ecological conditions. Researches are still on-going with regards to these solutions. However, Amerena (1991) further noted that a development that provides real improvement in the quality of human life and at the same time conserves the vitality and diversity of the earth is what is needed. Can this be realized by mere human effort? A high powered delegation of scientists gave a stern warning in 1992 that:

> "massive tampering with the world's interdependent web of life coupled with the environmental damage inflicted by deforestation, species loss and climate change could trigger widespread adverse effects including unpredictable collapses of critical biological systems whose interactions and dynamics we only imperfectly understand."[1]

[1]On November 18, 1992, some 1,680 of the world senior scientists from 70 countries including 102 of the 196 living scientists who are Nobel Laurates signed this warning.

This is a confessional statement which confirms:

1. The ingenuity of God's creation, (Prov. 3:19 and Eccl. 3:11). He has by wisdom and understanding established the earth and no man can find the work that God made from the beginning to the end.
2. Even as Christians for now, we only see darkly as through a glass (I Cor.13:12), we cannot perfectly understand the workings of the systems of the universe but God has perfect knowledge of all we ever sought to know, because all truth is God's truth wherever it be found (Holmes 1987). Therefore, the answer to the question posed above, can be found in Maurice Strong's (1995) observation :

> "Actions that do not flow from our deepest spiritual, ethical and moral values cannot succeed in building a secure, sustainable and hopeful future."

Boughman (1994) in agreement, also observed that civilization is unsustainable if our scale of values is held within the present patterns. The real nature of the relationships between man, his environment and neighbors will be discovered and restored only when human character and nature are restored in the likeness of Christ, when "we all come to the unity of the faith and of the Son of God, to a perfect man, to the measure of the stature of the fullness of Christ" in accordance with what was planned by God in Eden.

Perfection will be achieved in the new heaven and the new earth. Redeemed people will aspire to be good stewards of God's earth. But until then, we cannot give up the hope

of a conducive environment and of sustainable development because even in man's fallen, sinful state, a little good is still left in him that could help us address the problem of activities that foster environmental degradation. By capitalizing on what is left of God's image in man, by choosing to be good stewards, we can make our environment a better place and not jeopardize the ability of future generations to feed themselves.

Each individual must make a choice to destroy or to protect the earth. Sustainable agriculture will not be limited to this present world but it will extend to the world to come where we will plant vineyards and eat their fruit (Is 65:21).

Conclusion

The call for sustainable development in agriculture is crucial and genuine. The solutions offered by experts are laudable, but are temporal until we see ourselves as reflective, valuing and responsible stewards of God's creation. God cares about the way we treat the earth, since everything in it belongs to him (Psalm 50:10, 11). The charge to have dominion over the fish of the sea, the birds of the air ...(Gen. 1:26) is not a charge to plunder earth's resources. Rather, it is to keep and protect the earth, to tend the garden, just like Adam did in the beginning.

This paper therefore encourages teachers and students of agriculture to

a. appreciate the beauty of God's creation and contribute actively towards preserving it;

b. see themselves as stewards of God's creation, livestock and crops inclusive;

c. pursue activities that protect the environment in the practice of their profession;

d. see involvement in sustainable agriculture as an individual choice which is best achieved as we view it in the light of God's plan for the earth.

In view of the fact that the Adventist education stresses the physical, spiritual and mental development of man, agriculture, which is a vocational course should be encouraged in our institutions. It will not only train the students physically but also help them in discovering the dignity of labour as well as the joy of participating in producing their own food.

To achieve this, in Babcock University, all students in their second year enrol in a general education course in agriculture. The curriculum is designed to expose them to practicals involving cultivation of arable crops on individual basis. Activities that promote sustainable agriculture are promoted, demonstrated and encouraged among students.

The same idea can be introduced to our high schools to train students in addition to Ness (1993)'s suggestion on teaching elementary and secondary students on how to care for the earth. His suggestion includes the use of videos, field trips, class projects and resource books and magazines in teaching caring for the earth.

Adventists should not only maintain a clean environment but also a green environment, keeping our campuses clean and green. Lockton (1993), in agreement observed that Adventists should be the greenest Christians.

REFERENCES

Amerena P. (1991). *Caring for the earth - a strategy for sustainable living.* Publ. IUCN/WWF Gland, Switzerland.

Boughman, L. W. (1994) *Campus Beautification: A factor in integration of faith and learning.* Christ in the classroom Vol. 14

Carls J. (1987) *Species interaction and community ecology in low-external-input agriculture.* American I. of Alternative Agriculture II No. 4

Clausen B. (2001) *A believing scientist approaches the sciences.* 28th faith and learning seminar, Babcock University, Nigeria.

FAO 1980 *Natural resources and the environment for food and agriculture.* FAO Environment Paper No. 1, FAO Rome, Italy.

Harwood et al, 1992 *Sustainable Agriculture and the Environment in the Humid Tropics.* Humanity Development Library. Global Health Project, Belgium.

Holmes A. F. (1987) The Idea of a Christian College. W. B. Eerdmans publishing company. Michigan.

Holy Bible, King James' Version

Lockton, H. A. (1993) *Seeing Green: Adventist and Environment,* Christ in the classroom Vol. 8, pp. 171 - 174

Miller, G. T. (1996) Sustaining the Earth. Wadsworth Publishing Company.

Maurice Strong, (1995) as cited by *Noah Angwenyi in: Consevation of Biodiversity; Biblical Concept.* (Christ in the Classroom vol. 23, 1999).

Ness Bryan, (1993) *Teaching Elementary and Secondary Students how to care for the Earth.* Christ in the classroom Vol. 8, pp. 201-203

Population Reference Bureau (1991) as cited in : *Sustainable Agriculture and the Humid Tropics* Humanity Development Library. Global Health Project, Belgium.

Reijntjes et al. (1992). *Making Haste Slowly: Strengthening local environmental management in agricultural development.* Abstracts of Sustainable Agriculture.

Serageldin I. (1995) Effective Financing of Environmentally Sustainable Development.

Taylor D. J. et al. 1998. Biological Science. Cambridge University Press.

White E. G. (1905): *Conservation of Biodiversity: Biblical Concepts As cited by Noah Angwenyi.* Christ in the Classroom vol. 23. 1999.

White E. G. (1898). The Desire of Ages, pp 346: Pacific Press Publishing Association, Califonia, U. S. A.