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A conceptual framework for ecologically and socially sustainable land management and agricultural development in Africa

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Abstract: Agricultural development in Sub-Saharan Africa witnessed an initial period of growth in the few years after independence (1960s) and went into decline after the 1980s. This spurred many governments to embark on structural adjustment programmes that are only just showing the first signs of improvement. This raises some searching questions concerning the process of formulating and implementing reforms with a long-term vision of sustainable agricultural development in the continent. Drawing from past experiences, this paper explores the conceptual framework needed to achieve ecologically and socially sustainable agriculture in Africa. This paper argues that conventional agriculture has been severely limited by its disciplinary and reductionist approach. Despite the usefulness of modern agricultural technologies and insights, it has been applied in isolation and without sufficient concern for the indigenous knowledge-base of farmers and for ecological effects, which has rendered them debatable and sustainability unattainable. This paper, therefore, elaborates a holistic framework, which integrates various scientific disciplines, ecologically oriented and People-Centred Agricultural Development (PCAD) principles for achieving long-term impacts and sustainability under changing socio-economic, political and ecological framework conditions.

Keywords: sustainable land management; agricultural development; Africa.

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1 Introduction

Africa attained independence with high expectations. In the early years, many African countries successfully expanded their basic infrastructure and social services. After an initial period of growth, however, most African economies faltered, then went into decline. Sub-Saharan Africa as a whole has now witnessed almost two decades of falling per capita incomes, increasing hunger and accelerating ecological degradation. The earlier progress made in the social development is now being eroded and these countries are as poor today as before 40 years ago they were. This situation has spurred many governments to undertake far-reaching reforms. More than 50% of the countries embarked on structural adjustment programmes. Since the mid-1980s, countries that have persisted in these reforms such as Cameroon, Kenya, Malawi and Rwanda are showing the first signs of improvement (The World Bank, 1989). This declining per capita income, increasing hunger and ecological degradation raises some searching questions. Does Africa face special structural problems that have not been properly understood? Have the recent reform programmes been too narrow or too shallow? Could the process of formulating and implementing reforms be improved? Has the effect of external factors been correctly assessed? Are the external assistance and debt relief appropriate and adequate? More important, is there a long-term vision for achieving ecologically, socially and economically sustainable development through precautionary action, efficiency, social equity, partnership and systematic compatibility?

This paper explores a conceptual framework needed to achieve socially and ecologically sustainable land management and agricultural development in Africa.

The sustainability of agriculture in many parts of Sub-Saharan Africa is threatened by losses in the variety of species, reduction in land, forest and water resources, soil erosion, salinisation, acidification, desertification and environmental pollution. Moreover, the important objective of supplying the growing population adequately with locally produced food cannot be achieved. In many countries, the increase in food production no longer keeps pace with the population growth. Agricultural production and food security – under the aspect of resources conservation, local appropriateness and sustainability and with a view to the necessity of rehabilitating previously destroyed natural production bases -- requires in-depth knowledge and skills in scientific, ecological and socio-economic interrelationships and appropriate technologies. A process of rethinking

is necessary regarding theory and practice of development efforts. These have to consider needs at farm level and appropriate technology in view of their impact on the natural environment, apart from their dependence on natural, socio-economic, institutional and political conditions.

2 Trends in Africa agriculture

More and more Africans are going hungry. Severe food shortages were exceptional in 1990; now it is widespread. The World Bank (1989) estimated that about 25% of Sub-Saharan Africa's population-more than 100 million people -- faces chronic food insecurity. The rate of food production is not enough to feed the growing population of 2.75% a year. The World Bank study estimated that increasing food production by 4% growth per year would be enough to feed the growing population, improve malnutrition (1% per year) and progressively eliminate food imports (0.25% a year) between 1990 and 2020. But recurrent droughts will continue to cause famine for a residual core of the poorest.

Since independence, a closer look at the situation of Sub-Sahara African agriculture reveals that change has taken two main paths from the point of origin (traditional agriculture). Originally, agriculture depends on local natural resources, knowledge, skill and institutions. Diverse site-specific farming systems evolved out of a long process of trial and error in which balances were found between the human society and its resource base. In most cases, production was oriented mainly to the subsistence of the family and community (Reijntjes et al., 1992).

Traditional farming systems continued to develop in constant interaction with local culture and local ecology. As conditions for farming changed, for example, because of population growth or the influence of foreign values, the farming system was also changed. Where adaptation to the new pressure was not fast enough, the natural resource base was eventually destroyed as the society was depending upon it. Many farming societies disintegrated because the lack of local capacity to manage change led to severe environmental degradation (Lawton and Wike, 1997; Weiskel, 1989).

Many traditional Africa farming systems were sustainable for centuries in terms of their ability to maintain a continuing, stable level of production (TAC/CGIAR, 1988). However, these systems have had to cope up with particularly rapid changes during and since the colonial period; introduction of foreign education and technology in agriculture and healthcare; increasing population pressure, changes in social and political relations; and incorporation into an externally controlled international market system. Originally, subsistence-oriented systems have become increasingly market-oriented, and improved communication has increased the demand for consumer goods.

In response to the above foreign influences and the needs and growing aspirations of increasing numbers of people, farming systems changed towards one of two extremes: excessive use and dependence on external inputs such as fertilizers, pesticides, hybrid seed, mechanisation based on fossil fuels and often also irrigation. It is capital – intensive and highly market-oriented and the cash needed to buy the inputs is often obtained by selling farm products.

According to Sachs (1987) this development path was pursued after independence by most of the governments that had two major misjudgments:

- The increase in prices of chemical fertilizers and fuel and the general increase in international prices (World market prices). The main beneficiaries have been the suppliers of the fertilizers and fuel.
- The ever-increasing dependence on pesticides and fertilizers was not forever. These apart from pollution of streams water tables and causing serious hazards for the population are now not affordable as a result of the economic recession that started since the 1980s.

Undervalued resources agriculture (Chambers et al., 1989) or Low-external input agriculture (OTA, 1988) was and is still practiced by the majority of African farmers (the majority) who were passed by programmes promoting excessive use of external inputs. Here, the properties of the physical environment and/or the commercial infrastructure (poorly developed rural transportation and input distribution system, inadequate savings, lending institutions) do not allow a widespread use of purchased inputs. Often, only low quantities of, for example, artificial fertilizers, pesticides and improved planting material are sporadically used and then only for a few cash crops and by a small group of elite farmers. Wolf (1986) estimates that some 300 million people in Sub-Saharan Africa depend for their livelihood on this form of agriculture. It is widespread in Sub-Saharan Africa as rural populations in many countries become increasingly impoverished, as external inputs become more expensive, and as many deeply indebted governments, which do not manufacture chemical fertilizers, pesticides, herbicides and cannot produce hybrid material can no longer afford to import them. For most of Africa, production therefore lags behind population growth. As new technologies to intensify land use in a sustainable way have not been developed or are not known to the farmers, they are often forced to exploit their land beyond its carrying capacity. The over use of land under demographic pressure and the expansion of farm boundaries and small holding to new, often marginal farming areas leads to deforestation, soil degradation and increased vulnerability to pest attacks, diseases, torrential rains and extended droughts. Many African land use systems are in the midst of such downward spiral of nutrient depletion, loss of vegetation cover, soil erosion and economic, social and cultural disintegration.

3 Implications for land and agricultural development

To understand what implications these trends have for sustainability we must justify the survival of low-external input agriculture as opposed to agriculture based on the excessive use of external inputs. In a well-functioning low-resource agricultural system:

- Crops, trees, herbs and animals have not only been productive but also ecological functions, such as producing organic matter, nutrient pumping, creating a nutrient reservoir in the soil, natural crop protection and controlling erosion. These functions contribute to the continuity and stability of farming; they produce internal inputs.
- Can be compared with matured natural ecosystems, in which nearly all biomass produced is reinvested to maintain fertility and biotic stability of the system.

By replacing natural internal inputs such as manure and compost by external inputs such as artificial fertilizers, more products can be extracted from the agro-ecosystem. By replacing natural processes by human-controlled processes, such as irrigation, variability in production can be reduced. By selecting and breeding crops and livestock, people enhance their ability to convert inputs into useful products. In this process, other characteristics such as natural resistance or competitive ability are lost. These functions of nature that have been sacrificed must be assumed by human (Conway, 1987; Edwards, 1987; Swift, 1984).

We conclude now the foregoing discussion that despite concerted efforts made by governments and development agents to convince farmers that 'modern' inputs will increase production, the majority of African farmers have not adopted them. About 80% of agricultural land is farmed with little or no use of chemicals, machinery or improved seeds (Dover and Talbot, 1987). Yet the tendency is towards increased extraction of products and decreased re-investment of internal resources. This is leading to soil impoverishment in many areas and rendering the farming systems non-suitable. Conventional agricultural research as promoted by most governments is biased towards high potential areas, export crops and better-off farmers. This has produced results that are out of the reach for most farmers and are inappropriate for their indigenous farming systems. The problems of agricultural research and extension include:

- Focus on single commodities and not on total farm production. This has hindered the study and enhancement of positive interactions between different plants, animals and man.
- Primarily market-oriented and associated nutrient drain. Lack of nutrient recycling.
- Disregard of environmental effects. This is driven by research procedures and political pressures to focus on short-term productivity. Research has tended to externalise longer-term environmental effects to the future or other sectors.
- Neglect of rain-fed areas and local resources. Research content and design has had little relevance to major concerns and methods of resource-poor indigenous farming systems.
- Neglect of local farming knowledge as a result of the top-down approach to technology development.
- Emphasis on station-based research instead of participatory on-farm research/learning process.
- Gender bias as a result of the importation of Western models of division of labour. This scenario is inappropriate considering that over 80% of agricultural labour is female. As a result, agricultural research has given little attention to solving the problems of female farmers.
- Extension of incomplete products. Researchers have failed to appreciate the complex aggregation level of the farm. As a result, the 'products' delivered for extension are often incomplete and often represent only an answer to a disciplinary technical problem.

The dangers of conventional research and the promotion of the excessive use of external inputs to African farmers include:

- loss of biodiversity in indigenous farming systems, rendering them unstable and more vulnerable to ecological and economic risks
- irretrievable loss of local genetic resources and traditional knowledge about ecologically oriented husbandry and local alternatives to purchased inputs
- social and cultural disintegration, and marginalisation of poorer farmers, particularly women and
- environmental damage, particularly as a result of excessive use of agrochemicals.

Africa, therefore, needs a socially and ecologically appropriate agricultural development concept based on its indigenous knowledge, socio-cultural environment, physical environment, economic environment, its agro-ecology and farming practices. Agroccosystems are communities of plants and animals and their physical and chemical environments that have been modified by people to produce food, fibre, fuel and other products for human consumption and processing. Reijntjes et a1. (1992) define agroecology as the holistic study of agroecosystems, including all environmental and human elements. It focuses on the form and dynamics and functions of their interrelationships and the processes in which they are involved. An area used for agriculture production; for example, a field, is seen as a complex system in which ecological processes found under natural conditions also occur, for example, nutrient cycling, predator/prey interaction, competition, symbiosis and successional changes. Implicit in adapted agroecological work is the idea that, by understanding these agroecological relationships and processes, agroecosystems can be manipulated to improve production and to produce more sustainability, with fewer negative environmental or social impacts and a fewer external inputs (Altieri, 1987).

Agroccologists are now recognising that intercropping, agroforestry, compound farms and homegardens and other traditional farming methods mimic natural ecological processes, and that the sustainability of many local practices lies in the ecological models they follow. By designing farming systems that mimic nature, optimal use can be made of sunlight, soil nutrients and rainfall. The major strength of indigenous farming system, lies in their functional integration of different resources and farming techniques, for example, producing fibre, food, medicine wood, etc. conserving soil and water, protecting crops, maintaining soil fertility and the use of different biological components (large stock, small stock, food crops, fodder crops, natural pasture plants, trees, herbs and green manure).

Indigenous knowledge is therefore an important source of information for the design of a sustainable farming system because it includes traditional practices that have fallen into disuse, age-old experiences, institutions, culture and above all, farmers knowledge and skills in adapting new ideas to their local conditions and needs. These constitute the basis for change in the farming community.

4 Sustainable agricultural development framework

Briggs (2005) has defined sustainable development generally as a perpetual change process that ensures continuous improvement of people's welfare, balancing societal

values and equity while ensuring economic growth with consideration for future generations. NEST (1991) considered sustainability to be a notion; a movement and an approach that developed out of global concerns, study, political mobilisation and organisation around the twin issues of environmental protection and economic development.

The World Development Report of 1992 clearly stated that sustainable development is meeting the needs of the present generation without compromising the needs of future generations. NEST (1992) identified five (5) key elements of sustainable development, namely, ecological integrity and sustainability; equity and distributive justice at all levels; socially relevant economic productivity and technological development; popular participation and collective autonomy; prevalence and institutionalisation of human and democratic rights. Embedded in this concept are equity, ecological integrity, social responsibility, resource conservation, capacity building, maximisation of economic growth and so on. Two other concepts that appear close and relevant to the discussion of sustainability in Africa are 'ecodevelopment' and 'endogenous development'. The former 'ecodevelopment' as outlined by Miles (1983) rest squarely on the assumption that for the development of any one person, group, country or whatever, to be its even good, that development must be sustainable either from within or from its developmental environment. On the other hand, the latter, 'endogenous development' is a development based mainly but not exclusively on locally available resources, such as land, water, vegetation, local knowledge as well as the values and preference of local people.

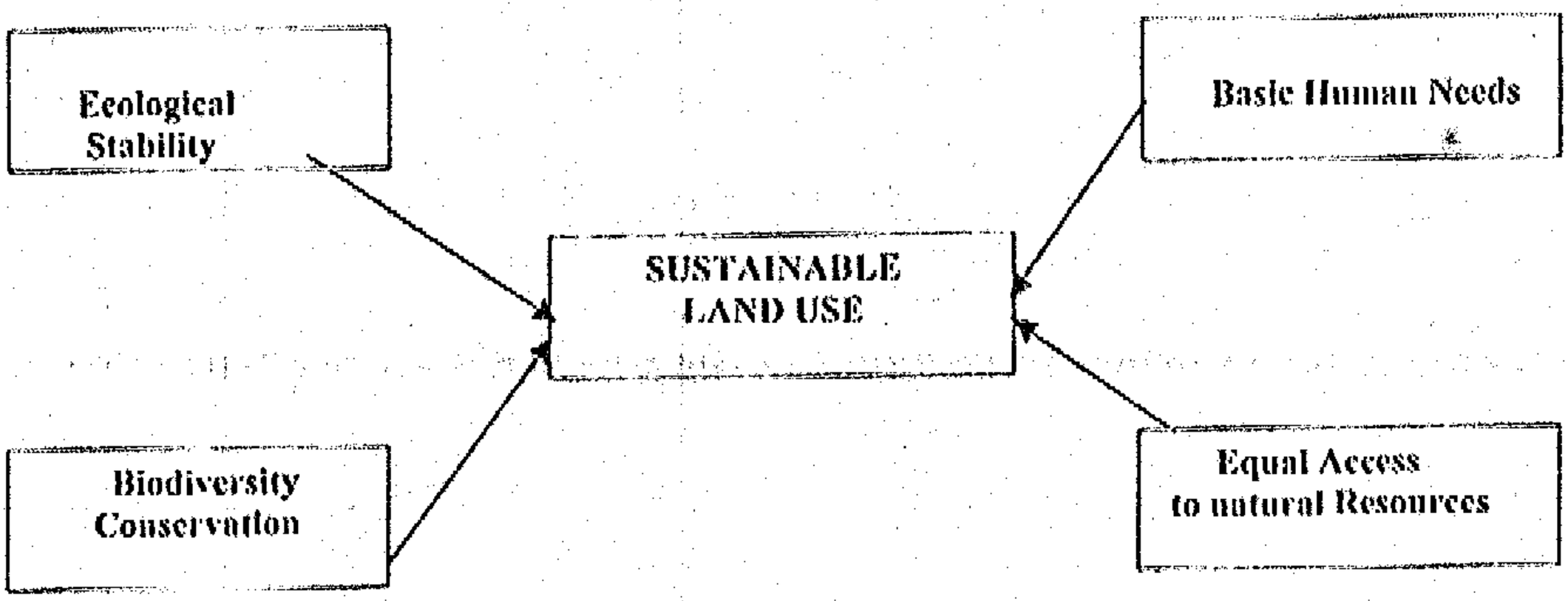
If sustainable development implies a union between economic development and environmental protection, then Africa must adopt eco-development and endogenous development. As Khor (1995) aptly summarised sustainability to incorporate environmental protection and the meeting of human needs. Sustainability is therefore not a set of independent sector policies on issues like growth on per capita income, improved healthcare delivery, social security, literacy level and other human development indices, but an integrated package, which is aimed at improving the environment in the face of economic advancement. The package according to Rasmussen (1995) must include principles of democracy, good governance, solidarity and assigning priority to individuals' basic needs and participation. It is in the area of meeting the basic needs of the individual that sustainable agriculture has a major role to play. But with a predominantly poor, rural and uneducated crop of farmers, African agriculture is nowadays leading to the deterioration of the quality of the environment and steady depreciation of soil, water and vegetation systems. It is therefore unsustainable. Poverty, for example, is one constraint to sustainable development in the agricultural sector in Africa. Like one African adage says; only those who have enough to eat for today can think of keeping some food for tomorrow. Desperate, abject, abstract poverty and ignorance are definitely responsible for the conversion of tropical rainforest to banana plantations and for overgrazing, the use of fire in agricultural operations, professionalism in hunting, continuous dependence on fuel wood and general overexploitation of ecological resources. However, if natural resources are to be conserved for the future, then the people must be given appropriate environmental education in the language they understand, at least to reveal the concealed economic and ecological benefits of sustainable agriculture.

Furthermore, the term sustainability is now used by scientists, technicians, development planners, politicians, etc. in many different ways and meanings, for example, what is the difference between sustainable development and sustainable

land and water resource management? There is a key ideological and sometimes intellectual or academic battle of the definitions and criteria of these terms. There is little or no consensus what this term means, and there is lack of operational focus, there is lack of monitoring and evaluation at the local level. Consequently, the scope and content of agricultural sustainability is rarely defined in its site-specific (land use) context (Sahle and Hartmut, 1999). Therefore, any analysis of sustainable use of agricultural land has to recognise the multi-dimensional nature of the subject.

In the past, it was the biophysical dimension that has received most attention. There are several indicators to make the term more operational. However, the biophysical dimension is only part of the story, because land and water degradation has become an issue of concern. Hence, there are social, cultural, financial and economic dimension to consider when addressing the problem. This is illustrated by the model of sustainable land use (after ISCO conference, 1982 cited by Sahle and Hartmut, 1999) (Figure 1).

Figure 1 Dimensions of sustainable land use



It follows that on a specific object level, any definition of sustainability must be interpreted against a set of continuously changing framework conditions:

- time frame
- target group or objective (questions are: who acts, what, for whom)
- political and cultural value system
- economic potentials and constraints and
- technical potentials.

Ecologically and socially sustainable or appropriate agriculture, therefore, involves a comprehensive management of natural resources in a sustained form. It is oriented towards the long -term and stresses the human being as a factor in the ecosystem thus allowing for conservation and replenishment of these resources. It uses appropriate, economically viable and socially just technology and emphasises the use of local resources. It becomes possible for people living in their environment to conserve and replenish these resources. They thus obtain social, economic and spiritual benefits. As agriculture is dependent on nature, it must constantly change. One of the most important factors in this change is the human being. If change does not occur, agriculture will come into conflict with the environment. The concept of ecological agriculture development tries to avoid such conflicts, and designs a form of agriculture in harmony

with all living creatures, and compatible with the resources found on earth. It is sustainable on the basis of existing resources, and thus describes a balance that is constantly being renewed.

Bunch (1990) defines ecological farming as any farming system that tries to use more local resources and fewer external inputs to develop a more positive relationship or balance between humans and the environment. By assaulting the ecosystem less and preserving or improving life support systems, such as soil quality, water and biodiversity, it aims to maximise productivity while maintaining those factors of production that will allow posterity to do the same.

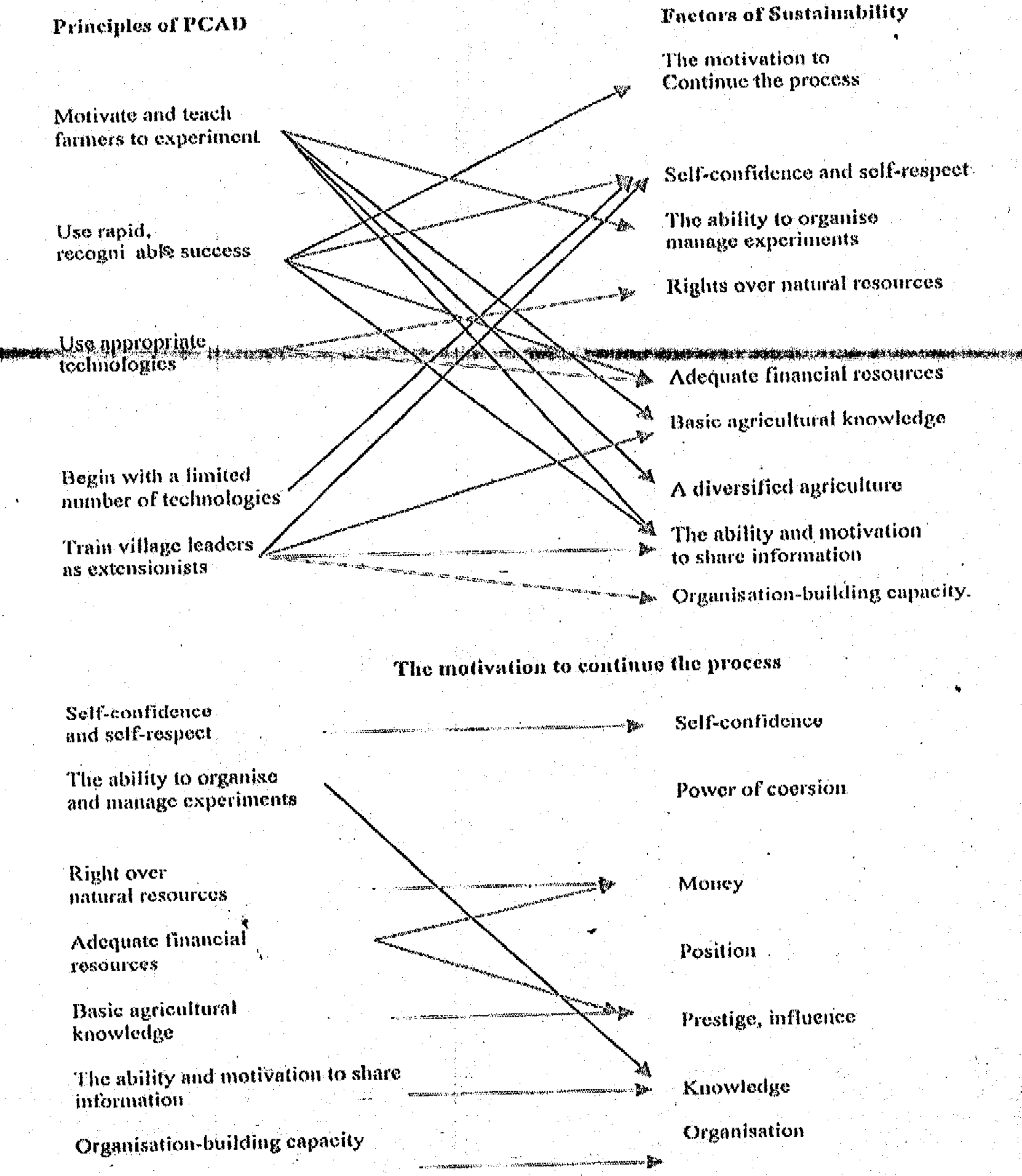
From a different perspective, ecological farming could mean that the farmer and his farming environment are being viewed as an ecological system. The ecological system in this regard is not only seen as the natural conditions of soil and water but also includes other variables such as the physical, social, economic and cultural factors that affect the growth and development of any organic system. The priority is to identify and develop the resources available to a region rather than to rely on external inputs. It is a dynamic process reliant on people's participation in the management of natural resources, whereby land users and farm families take responsibility for the management of their environment in an economically viable manner with the long-term aim of maintaining the natural resource base's continuity. The definitions given above make it clear that sustainable agriculture depends not only on events and processes at farm or village level, but also by processes and event at the regional level in a country, the national level and the global level. Seeking sustainability requires action on several different level. Actions that promote sustainable agriculture include:

- promotion of self-help and responsibility of target groups
- design and implementation of small and manageable projects
- encourage target groups to take decisions concerning agricultural projects
- identify problem solutions in projects and multiply the solutions
- provide education and training of farmers-based indigenous knowledge base systems and traditional institutional structures
- promote the limited use of external inputs
- identify and promote local problem solutions
- the approach of project should be integrated, that is, consider the economic, social, cultural and ecological aspects
- the activities of projects have to maintain economic viability and environmental protection and
- maintenance of economic and social justice. Before any measure is taken, a cost-benefit analysis should be made.

Bunch (1995) in developing an extension methodology for sustainable agriculture emphasised 'People-Centred Agricultural Development (PCAD)' for achieving long-term impacts. Generally speaking, PCAD embodies a series of principles. As long as these basic principles are employed there is room for tremendous amount of adaptation to local circumstances, farmer needs and institutional imperatives, without causing any major decrease in the effectiveness of the overall approach. The basic principles are outlined as follows.

Figure 2 present the principles of PCAD. Most of the various principles now included in PCAD were tried in the highlands of Guatamala during the 1960s. In 1972 World Neighbours, with OXF AM/UK'S support PCAD was employed with remarkable success. External evaluators confirmed the success in agricultural productivity, health, improvement and organisational quality.

Figure 2 Principles of PCAD after Bunch (1995)



5 Conclusions

African Agriculture has some distance to travel to achieve sustainable growth and development. The poor performance of the agricultural sector is a reflection of many years of unsustainable practices. For agriculture in the continent to be sustainable, it must incorporate basic ecological principles and be people-centred.

We must go back to work with nature but not against it. This means going back to work with, for and not against nature. Traditional agriculture in the continent before the 1960s approximated very closely to this condition. No wonder it made minimal impact on the environment. The current agricultural scenario in the continent is a mosaic of traditional and intensive (modern) practices. However, a system of agriculture that is progressing at the expense of forest lands, replacement of species, monoculture, the use of chemicals, large amounts of energy inputs and other elements of intensive market-oriented cultivation, is progressing into an unsustainable system. To build a sustainable agricultural base for the continent, we strongly recommend the recognition and adoption of endogenous agricultural development, which is an infusion of traditional and modern agriculture via the use of mixed crops, crop rotation, rationalised grazing, reliance on natural fertility regeneration processes, agro-forestry and the use of environment friendly technology.

Although conventional agricultural science in Africa has been severely limited by its disciplinary and reductionist approach, it has undeniably made valuable contributions to agricultural development. It would be a mistake to suggest that Africa can do without modern agricultural technologies and insights. Rather, it is the way in which they have applied since the 1960s – with isolation without sufficient concern for ecological effects that has rendered them debatable.

Conventional agricultural development policies failed to be people-centred. Within a holistic framework, that integrates various scientific discipline and is ecologically oriented, many of the conventional agriculture technologies could contribute to the 'modernisation' and sustainability of indigenous farming system in the context of changing socio-economic and ecological framework conditions. In recent years, thinking in terms of systems has been increasingly accepted in agriculture sciences. The Farming System Research and Development Extension approach is the most obvious example. The PCAD approach used in some projects in African countries has not only proven itself capable of achieving high rates of farmer adoption and increased productivity, but, even more important, has done so at much less cost than other extension systems. At the dawn of the third millennium, new developments in biotechnology can also contribute to the productivity of indigenous farming systems. But the criticisms of the dangers of biotechnology are justified, for example, possible depletion of genetic diversity, limited access to genetic materials through patenting, control by multinational companies and substitution of tropical products by synthesised ones. Biotechnology can only benefit Africa if research were to be done with a view to the needs of the variables contributing to sustainable agricultural development. The process of combining local farmers knowledge and skills with those of external agents to develop site-specific and socio economically adapted farming techniques is known as 'participatory technology development or PTD' combines indigenous and scientific knowledge to identify, generate, test and apply new techniques. The experience shows that it is capable of transforming Africa's resource – poor agriculture to low-external input and sustainable agriculture.

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