
Mixed farming systems in sub-Saharan Africa

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Introduction

Development objectives for sub-Saharan Africa are moving towards resource conservation and natural resource management while striving for greater agricultural production. Economic growth must increase by 4-5 per cent annually if food security is to be achieved and a modest standard of living provided for the 1.3 billion people expected in the region by 2025 (World Bank, 1989). Rapid urban population growth (55 per cent of Africans will live in urban areas in 2025) and higher income will create a need for better quality food, particularly of animal origin, from a rural population that is expected to feed 592 million by 2025 compared to 350 million in 1990. This is an enormous challenge in a region that experienced a negative per caput GDP during the 1980s. The 3.2 per cent average annual population growth and severe financial and environmental crises portend an even gloomier future.

Agricultural intensification is inevitable in sub-Saharan Africa and livestock are critical to the development of sustainable and environmentally sound production systems. Intensification has occurred gradually over many years in other developing regions but in Africa it will need to happen over a very short time due to rapid population growth. Past research and development efforts which promoted crop-livestock systems have failed to bring about the desired agricultural transformation. Some of the problems to be tackled are:

- the role of mixed farming in sub-Saharan Africa's future agriculture;
- obtaining a better understanding of crop-livestock relations in an attempt to make mixed farming a favoured option for intensified land use;
- identification of knowledge gaps; and
- the needs for popularizing mixed farming.

This paper reviews the important position and role of mixed farming systems in land use intensification in sub-Saharan Africa.

The farming situation in sub-Saharan Africa

The origins of agriculture in sub-Saharan Africa remain unclear. Vegeticulture was probably practiced on the northern margins of the tropical forest as long as 7000 years ago but the beginning of cereal cultivation is less clear. Sub-Saharan Africa had a limited range of crops when Europeans first arrived in the 15th century, the most important being sorghum *Sorghum vulgare* and several millets. In parts of West Africa indigenous yams, rice and banana were grown. New food crops, including cassava and maize, were introduced after the discovery of the Americas. The first cattle entered Africa through Egypt about 7000 years ago. The plough, by then present over most of the Old World, did not reach Africa until the 19th century except in Ethiopia. Unlike Asia, animal and arable agriculture were generally separate in Africa and could have been a barrier to early intensification.

Sub-Saharan Africa is essentially a continent of small holders and its environments are very sensitive. At relatively low population densities traditional methods start to degrade the soil and threaten future production. Climatic realities result, except in the humid zones, in frequent crop failures from drought or dry spells in the growing season. Most African soils are derived from highly weathered granite and gneiss parent material. Soils are thus coarse with low contents of fine clay particles and organic matter and are deficient in most nutrients, especially nitrogen and phosphorus. The water holding capacity of African soils is poor so rainfall leaches out soluble nutrients. Soil organic matter is rapidly decomposed under high temperatures except in the cooler highlands. Once vegetation is removed water and wind erosion remove the top soil, the surface crusts easily and is then sealed against infiltration.

As cropped areas expand fallow periods shorten progressively. Short fallows do not allow regeneration of soil fertility, produce little fuel wood and are a poor grazing resource. The crop residues and dung that are so desperately needed to maintain soil structure and fertility are increasingly burnt for want of alternative fuel sources. Communal or uncertain land tenure over most of the continent only makes the development task harder.

Most farms in sub-Saharan Africa intercrop anything with everything. Growing a mixture of crops and varying land management are strategies for adjusting to different soil and water regimes. Intercropping provides a protective cover of vegetation which lowers soil temperature, increases water infiltration, helps to prevent soil erosion, lowers the incidence of pests and diseases and reduces labour needs for weeding. By combining different heights, root depths and maturity periods intercropped plants complement each other in the use of light, water and nutrients. The total output of intercropped areas is usually greater than monocrops but yields have stagnated or declined in the absence of soil fertility replenishment. Use of fertilizers compensates for shortening fallow periods but farmers in many countries have no incentive to use them because prices for farm produce are not sufficiently attractive or fertilizers are not readily available.

Why mixed farming?

The short and simple answer to this question is that it increases the bioenergetic efficiency of agriculture and preserves environmental quality. Production objectives should be to:

- optimize output over a long period;
- maintain diversified agroecosystems with components having complementary functions;
- build up soil fertility and prevent nutrient losses;
- provide continuous vegetative cover possibly by the use of legume based rotations or green manure; and
- limit imported fertilizer applications and pesticide use.

The case for integrating animal and crop systems is based on the premise that by-products

from the two systems are used on the same farm. Draught power, closed nutrient cycling, improved environmental quality and use of roughages and low quality feeds contribute to overall higher output per animal and per hectare. Soil fertility improvements result from the volume of organic components that circulate through the soil and plants and the animal manures that enrich the soil through long lasting carry over effects. Livestock also provide a ready means of acquiring cash and support the use of inputs in crop production which in turn generates higher levels of output from both crop and livestock (Brumby, 1986).

Land use changes in sub-Saharan Africa

Livestock have played a pivotal role in intensification of farming in most parts of the world. The biogeography of sub-Saharan Africa blocks the full promise of livestock in farming systems. Over much of the continent the tsetse fly vector of trypanosomiasis effectively separates crop and livestock production.

The two activities are properly integrated in the East African highlands where temperatures are too cool for tsetse (Table 1). Recent climatic changes, bush clearance for agriculture and specialized tsetse control programmes have increased areas that are free of tsetse and made them suitable for livestock-crop integration (Jabbar, 1992).

Table 1 Major agricultural systems in sub-Saharan Africa

Zone	Crop/livestock integration	Major agricultural systems	Major livestock outputs
Humid	Pure crop	Forest/permanent trees: roots/cereals (trypanotolerant livestock)	Periurban milk
Subhumid	Crop-livestock	Cereals (maize/sorghum)- livestock	Meat, milk, power
Highland	Well integrated crop-livestock	Cereals (wheat/teff)- livestock	Power, meat, milk
Semiarid	Livestock-crop	Cereals (sorghum/millet)- livestock	Milk, power
Arid	Pure livestock	Pastoral	Milk, meat

Most potential for fodder production is in the humid zone which currently has few livestock. Major concentrations of livestock are in the semiarid zone despite its low potential for supplying fodder all year round. Settled arable farmers in dense tsetse areas do own livestock but these are entrusted to professional herders in tsetse free areas and to avoid disputes over crop damage. The benefits of draught power, milk and manure from livestock integration are lost under these arrangements.

A general rule of agricultural development is that land is more intensively used as population density increases. In West and East Asia transition to intensive farming became possible with irrigation. Transition in the Middle Ages of Europe occurred with more sophisticated crop rotations involving legumes and integration of livestock with arable fanning. None of these conditions prevails in sub-Saharan Africa to assist in the transition process.

Crop-livestock integration seems to be a response to different supply and demand patterns in factor and output markets, agroclimate and population growth. The need for crop-livestock integration is low at low population density as there is little demand for animal power, manure or crop residues for fodder. Interactions by exchange of products take place without integration of livestock and crop enterprises on the farm. Soils, land form, market access and income create diversity within and between environments. Land use intensifies by reducing the fallow period to increase cropping frequency as land prices increase in response to population pressure. Where fertilizers are not easily accessible croplands are manured by paddocking animals or transporting manure from night pens. Mulching is practiced in areas

unsuitable for animals. Land able to store or provide water becomes a target for intensified use as populations increase. Demand for power encourages integration of animals in farming systems.

There is, however, no consistent association between agroclimate and population density. When animal traction is cheaper than hand cultivation the choice for the farmer is to rent or own draught power. When manuring is necessary to replace fallows the choice between manuring contracts and livestock integration depends on farming intensity and the transaction costs of substitutes (McIntire *et al*, 1992). As manure becomes scarce (herders also need it as they now use it on their plots) and fertilizers are unavailable farmers resort to manure-transported mixed farming. At high cultivation densities crop residues are more important because the area of natural pasture declines. Herders gain access to crop residues by entering into contract grazing with farmers or by producing crop residues directly. As farmers gain knowledge of livestock production they start keeping animals in pens and feed them crop residues to produce manure and to provide traction. Crop-livestock integration is thus encouraged at both ends of the spectrum of pure pastoralism and pure cropping (Table 1).

Constraints

Every zone in sub-Saharan Africa has a meat and milk deficit. The favourable market for these products could encourage livestock productivity improvements through land use intensification. Integration of crops and livestock has been the objective of past agricultural development in sub-Saharan Africa. Mixed farming was a development goal early in the 20th century in northern Nigeria as shown by selection for improved draught qualities as well as meat and milk (Straw and Colville, 1950).

Loans have been provided under various development schemes to allow farmers to buy animals and field equipment. Where animal draught is used it allows an increase in the area cultivated. This has largely occurred as a result of the introduction of cash crops, the profit from which financed the purchase of draught animals and equipment. This process of expansion occurred when land was abundant in relation to labour by encouraging expansion into virgin lands and subsequently to fallow lands.

There are other examples of cropping systems incorporating livestock to take advantage of manure or crop residue feeding, transport and possibilities for wealth accumulation. The level of integration is a function of:

- environmental differences between the two enterprises;
- factor and input substitution;
- year round feed supply, stock feeding and management;
- high labour inputs reducing incentives to keep livestock until output prices rise in relation to the opportunity cost of family labour;
- alternative investment opportunities; and
- benefits from integrated systems.

Benefits to integrated crop-livestock systems are sometimes small from manure, crop residues and draught power (McIntire *et al*, 1992; Williams *et al*, 1994) implying that exogenous technical changes including improved seeds, fertilizer, water and nutrient management are needed to raise overall productivity.

The process of integrating livestock in crop systems is initiated when two independent complementary systems interacting through the exchange of byproducts compete for the key production factor, land. Competition for land and labour is between the end users of crops versus livestock, resident and immigrant farmers for crop land and village livestock owners and pastoralists (Speirs and Olsen, 1992). Population increase does not only take place by natural growth but also by migrant influx. The potential for conflict for labour between crops and animals will differ in land scarce and land abundant situations. Manure collection, for example, is labour intensive and manuring thus depends on labour availability. Land scarcity contributes to declining fertility as fallow periods are reduced, and rising land values lead farm households to escalate the process of securing land. As competition for land increases conflicts are inevitable, especially where traditional systems of verbal usufruct agreement are misinterpreted or owners have difficulty in recovering land from those claiming "squatters rights". Migrant inflow also accentuates conflicts over use of crop residues, fallows and access to dry season forage and water. Customary property institutions in Africa define different types of rights for the resources used and these constitute barriers to long term investment. Traditional leaders have also lost their authority to determine property rights and governments lack the capacity or the infrastructure to define and enforce them.

A certain level of population and reasonable market access are required for successful mechanization. Economic distortions in many sub-Saharan Africa countries since independence have affected the process of agricultural intensification. Cash crops and minerals continue to be the main sources of foreign exchange and government revenue. Fluctuating commodity prices contribute to variable trade balances and budgets and make long term planning impossible. Frequent changes in key personnel by donor governments and changes in aid or loan conditions have impaired the bilateral and multilateral development programmes. In the short period since independence the development consensus for sub-Saharan Africa has shifted from high to low to mixed technology, from project aid to aid designed to influence policy, from enthusiasm for populist approaches to privatization and from encouraging population growth to cuts in aid to those populations. These factors continue to impair independent long term policy formulations and implementation by sub-Saharan Africa countries.

Domestic production has also suffered from a policy priority to supply urban areas with cheap milk and meat as well as government price controls and over valued exchange rates. Technological innovation, infrastructure and extension services have not catered for the changing circumstances of the farmer. Farmers moving to marginal areas continue to use the traditional techniques which failed to sustain productivity even in the agriculturally better lands they abandoned.

The arid zone has the lowest capacity to supply human needs but ruminants in traditional nomadic and pastoral systems are well adapted to converting pasture and browse into food and income. Increasing human populations and the spread of cropping into marginal lands reduce the ratio of range to crop land and create serious environmental concerns. Integrated wild life-domestic livestock systems may be more sustainable in this zone. In the wetter part of the semiarid zone, however, favourable cropping conditions and the absence of trypanosomiasis are conducive to the expansion of mixed farming.

In the subhumid zone abundant cattle, low trypanosomiasis challenge, strong product demand, level terrain and proximity to areas of animal draught reserve and cultivation are factors that should have favoured wider use of animal traction and mixed farming. Lack of farmer knowledge has been identified as a major cause for the failure of animal traction to spread southwards in the subhumid zone. Soil hardness, trypanosomiasis and cropping patterns that were believed to constrain expansion of mixed farming were not, on the other hand, found to be important (Blench, 1987). The knowledge gap is not insurmountable, however, as people elsewhere have learnt to use animals and other technologies within a

short time. In the northern subhumid and the semiarid zones it is possible that mixed farming did not develop because early planting to make use of the short rains and growing period is a greater priority than tilling of the predominantly sandy soils.

In the humid zone the major factor limiting ruminant production is trypanosomiasis. Livestock expansion by clearing forests is not environmentally desirable but there are opportunities for integrating trypanotolerant livestock into permanent tree systems.

The highlands ought to favour field mechanization because of high population density, continuous cultivation and relatively heavy soils. Very steep slopes and erosion risk impose, however, a certain cropping pattern and very small farm sizes do not require mechanization or individual ownership of draught power. Hiring is thus a cheaper way of using animal traction. Production increases in the highlands must come, however, from further intensification of the crop-livestock land use systems.

Disease can be a major constraint to integrating cattle in crop farming. Trypanosomiasis is the most important disease in sub-Saharan Africa and is followed by tick transmitted and tick associated diseases and internal parasites. Diseases whose importance increases as production systems intensify include soil borne bacterial diseases such as anthrax, infectious diseases of the reproductive tract including brucellosis, diarrhoea, pneumonia, mastitis and mineral deficiencies. These must be controlled to assure farmers that intensification will yield adequate returns to their investments (Winrock, 1992). The inability of many countries to maintain effective surveillance and control measures and ineffective delivery of veterinary services throughout sub-Saharan Africa are major impediments to effective disease control. Indigenous ruminant sources of resistance or tolerance to disease are currently poorly characterized and inefficiently used.

In all sub-Saharan countries population density has yet to reach the level where intensive farming becomes unavoidable. It has, however, reached the level where massive ecological damage will occur if traditional methods continue to be used. Governments can assist the intensification process by supporting new technology generation and transfer and by favourable policies to improve markets, infrastructure and other facilities for agriculture.

Research

Countries in sub-Saharan Africa must seriously consider agricultural intensification, before population density compels them to do so, in order to meet future food needs. Intensification can be accelerated through research which should consider socio-economic, natural resource, technical and institutional factors that influence productivity and sustainability. Inability to feed animals adequately throughout the year is the most widespread technical constraint for livestock producers. Seasonal feed availability from natural resources is affected by land competition resulting from population growth.

Commodity research programmes have neglected mixed farming systems. Extension services split into crop and livestock sectors have exacerbated the problem. The possible benefits from crop-livestock integration have thus not been fully exploited. In many cases technologies have been extended beyond the ecological limits and to areas where returns to labour were inadequate or where there were other promising opportunities (McIntire *et al*, 1992).

Socio-economic and biophysical flows run in parallel and are interdependent on a farm. Socio-economic inputs are land, labour, capital, culture and knowledge whereas outputs are fulfilment of life needs including income, health, knowledge, social stability and a sense of community. Physico-chemical inputs include energy for operations such as tillage, harvest, fertilization and pest control. Biological inputs include organic matter such as crop residues, animal manure, legume nitrogen, cover crops, rotations and cropping patterns (Grove and

Edwards, 1992). In mixed farming systems there are opportunities to increase land productivity by optimizing the value of biophysical inputs. Use of genetically improved crops for high photosynthetic rates and animals capable of converting cellulose tissues in the rumen are examples of this.

Biophysical considerations

Plants have the ability to capture and use solar energy. The range of life in any particular location is limited by temperature and moisture. Within the bounds of varying climate, season and terrain the diversified biomass interacts among itself and with the soil to establish a self-regulating ecosphere. The desired cyclic relationship is distorted in modern agriculture and the fight against pests and diseases -normally kept in balance in natural ecosystems -requires major effort. Wastes in modern agriculture have also become a practical and social problem and recycling them has not been seen as an ecological resource renewal procedure.

Biological diversity and nutrient cycling are common processes in the functioning and persistence of agroecosystems (Grove and Edwards, 1992). Development of sustainable mixed farming systems therefore depends on understanding the mechanisms controlling the kind and amount of biodiversity and the factors governing rates of mineralization and recycling of the organic matter fractions that stabilize the systems. Crop-livestock integration increases diversity in farming systems and provides a management tool for improving net production, stabilizing agriculture and protecting the environment.

Table 2 Nutritive value (per cent) of barley, wheat and teff straws

Component	Crop and maximum and minimum value					
	Barley		Wheat		Teff	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Crude protein	1.8	5.4	1.5	2.5	2.9	5.6
IVDMD	40.7	73.1	41.7	59.1	33.7	69.8

Feed development

Feed supply is a primary constraint in sub-Saharan Africa. Seasonal shortages are determined by the length of the growing period, cropping intensity and stock numbers. In mixed farming systems feed for livestock can be improved by:

- selection of crops having higher nutritive values in their residues;
- intercropping herbaceous and tree legumes with grain crops for higher fodder biomass production and nutritive quality per unit area; and
- creating fodder banks as supplementary source of seasonal feed.

Past efforts in crop improvement have increased the grain value of crops for all the target zones. Crop residues are an important livestock feed and replace natural pastures at high cropping intensities. There is inter and intra species variation in the nutritive value of crop residues at similar grain yields (Table 2) and selection for higher feed quality among crops capable of adapting to several ecozones should be a priority in crop improvement programmes.

Intercropping is a well established land use technique in sub-Saharan Africa. Where land is in short supply and feed is deficient, as in the Ethiopian highlands, human food and animal feed production must be maximized on the same land. Compatible associations are possible between food and forage crops (Table 3, Table 4) where forages in the mixture benefit from

husbandry practices on crops. Concurrent management for different outputs from the same land is, however, difficult as forages have better nutritive value in the vegetative state and grain formation in cereals starts only after completing the normal vegetative growth. Spatial and temporal complementarity are achieved by reducing competition for the same growth resources among the different components in the mixture. Crop-forage combinations therefore need to be adapted for different ecozones. Forage species need to be selected for complementary growth and maturity. Deep rooted trees are a good source of fodder during the dry seasons and their integration into farming systems, particularly in the humid zones to serve multiple needs, is a valid research area.

Table 3 Grain and fodder yields of crop-forage combinations on drained vertisols

Crop rotation	Yield (tonnes/ha)	
	Grain	Fodder
Oats/vetch- roughpea		
Oats/vetch	-	6.00
Roughpea	0.88	1.01
Wheat-chickpeas		
Wheat (variety Enkoy)	1.60	3.20
Chickpeas	1.39	2.16
Intercroppe wheat/clover		
Wheat (variety Enkoy)	1.01	2.84
Clover	-	2.50
Maize/Leucaena alley crop		
Maize	2.27	3.19
Leucaena	-	2.56

Table 4 Yields of sorghum and various inter-sown forage legumes cut twice per year

Crop	Component (tonnes/ha)	
	Grain	Fodder
Sorghum	2.0	8.7
Forage legume		
Vetch	2.3	8.5
Clover	1.4	6.9
Cowpeas	2.9	8.5
Lablab	1.8	9.1

Cultivation intensities tend to change the pattern of feed availability. At low population and cropping intensities the dry season is critically short of quality feed, especially protein, in all ecozones. Energy is also short in the arid, semiarid and at the drier end of the subhumid zones. At higher population densities with expanded areas of crop land the large amounts of biomass available after harvest compensate for the loss of natural dry season pastures. There is, however, a feed constraint during the wet season as most land is occupied by crops and livestock have limited access even to fallow lands because they are locked up within cropped areas. Providing a renewable source of feed supplement by establishing fodder and protein banks is possible. Research is needed in this context to predict future land use changes and to be able to tailor feed production and utilization strategies to the various ecozones and production systems.

Nutrient management

An important link in mixed farming systems is the cycling of natural vegetation and crop residue biomass between livestock and soil via faeces and urine. Nutrient deficiencies are common in sub-Saharan Africa and livestock can contribute to imbalances by excessive removal of vegetation while grazing and in harvested feeds and by not recycling nutrients or depositing them unevenly on the land. Seasonal and annual fluctuations of feed quantity and quality affect the number and type of animals that farmers keep and thus affect manure quantity and quality and its effects on crop production, especially in the semiarid zone. Because nutrient mineralization and losses are influenced by manure handling, storage and application there is a need to develop techniques to improve manure quality and nutrient recovery. In view of the competition between livestock and soil for cereal stovers and crop residues long term trends need to be assessed in terms of plant, animal and soil productivity. The value of legumes in improving feed quality and in contributing to the total nutrient economy of mixed farming systems also needs to be understood.

The biological processes regulating nutrient inflow in mixed farming systems are mediated mainly by socio-economic factors. As most aspects of intensified manure management depend on the labour available to collect, process, transport and spread it on crop land and the availability of cash to build pens and for purchase of animals and carts, development policies need to consider these factors. Assessment of temporal and spatial total factor productivity by quantifying changes in stocks and soil nutrient flows and the effect of material inputs and outputs on productivity may assist in understanding the sustainability of the systems.

Dual purpose livestock

Where mixed crop-livestock farming is well integrated, particularly in the Ethiopian highlands, further intensification and productivity can result only from improving energy use efficiency by livestock. Work oxen provide farm power but are used for only 8-10 weeks in the year. Ethiopia has up to seven million work oxen and there are 3-4 times more cattle than this for oxen replacement. All these compete on the same communal feed resource with other livestock. Use of cows for both milk and draught can potentially reduce the large herd kept for work oxen replacement and reduce overall grazing pressure. In order to integrate dual purpose cows into mixed farming systems there is a need to understand the functional relationships among milk production, reproduction, feed energy utilization and draught work and then to test the on-farm technical and economic performance and social acceptability of using cows for traction.

On-station experiments with F₁ Friesian × Boran and Simmental × Boran cows carried out by ILRI and the Ethiopian Institute of Agricultural Research show that both milk and work output are satisfactory if nutrition is adequate (Table 5). Limited on-farm tests are showing substantial increases in household incomes and farm outputs as a result of milk sales, cow traction and reduced numbers of work oxen.

Animal health

The major animal health problems in sub-Saharan Africa are parasitic and viral diseases, some of which are transmitted by arthropod vectors. These are widely distributed but their severity is strongly influenced by environmental conditions (Winrock, 1992). A large group of infectious and noninfectious diseases will become more important as production systems intensify. Interactions among disease, genotype, management and environment in the various production systems must be understood in order that integrated disease control strategies can be developed.

Genetic improvement

Most indigenous livestock in sub-Saharan Africa have evolved to cope with the harsh environmental conditions. The research challenge is to improve productivity without losing the adaptive traits essential to survival (Winrock, 1992).

Natural resource management

Research must develop technologies that maintain effective interactions among crop, fallow and rangelands. Most damage outside the crop land that disturbs the ecological balance is caused by soil erosion as the protective plant cover is removed. Grazing can incapacitate plants by preventing seed formation and reducing regenerative ability. Data on the effects of grazing impact on vegetation dynamics and nutrient flow and transfers are needed to design management strategies for sustaining crop and livestock productivity and rangeland and soil quality in the mixed farming agroecosystems.

Table 5 Cumulative milk yields of crossbred cows under various work and nutritional treatments

Treatment	Milk yield (kg) in specified number of days		
	0-365	0-730	0-1095
Not worked, not supplemented	849	1226	-
Not worked, supplemented	1792	3186	4502
Worked, not supplemented	802	927	-
Worked, supplemented	1770	3044	4050

Policy research

Identifying policies to facilitate the development of sustainable land use systems deserves high priority. Autonomous intensification as a result of the effects of population growth on factor scarcity and the free play of market forces is by itself unlikely to achieve the expected gains in per caput agricultural production and rural income (Lele and Stone, 1989). Land use planning needs to be guided by a knowledge of land suitability potential so that higher value and higher yielding crops can be grown on the most productive land. Land use rights, production incentives and market strategies are important policy issues. There is a need to evolve a management process for integrating several land use options at the geographical catchment level to serve the multiple needs of communities. Cooperation by the whole community should be fostered for management of the common resources that affect crop lands. The mechanisms needed to effect changes in common resources governance and for technology transfer are also issues for policy research.

Conclusions

Strategies designed to raise the productivity of specific mixed crop-livestock systems must consider the stage of development of the target area in relation to intensification and the nature of crop-livestock interactions, the availability and cost of inputs, and whether or not policies favour mixed farming. No single set of actions is applicable to all situations. Mixed farming systems are an option for increasing agricultural productivity while ensuring environmental safety in the semiarid, subhumid and highland ecozones of sub-Saharan Africa. Past efforts to encourage mixed farming failed because of the wrong policies and issues that were pursued and promoted by scientists and development agents.

Mixed farming is developing naturally in many areas of sub-Saharan Africa. At present economic levels livestock seem a viable alternative to manual labour, help to replenish soil

fertility and provide cash income for household needs. Production increases need to be rapid and sustainable and guarantee the well being of all. In order for this to be achieved political will and national commitment need to enact the required policy changes to intensify agriculture.

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