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# Integrated soil improvement and Agricultural development in West Africa: why current policy approaches fail

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# Contents

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# Abstract

Integrated soil management is an essential condition for agricultural development in West Africa. Such an approach combines improved soil hydraulic measures, organic fertility measures, and inorganic fertilizers and soil amendments. The synergetic effects which result from this combination are indispensable for achieving the productivity increases needed to cope with the increasing pressure of population. Current (neo-liberal and ecological-participationist) policy approaches are unable to realize the transition towards integrated soil management technologies. The time lags involved in learning to use new technologies, in the adaptation of technologies to local circumstances, and in reaping the benefits of soil fertility investments call for (at least temporary) support of agricultural incomes.

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# 1. Introduction

Unlike other parts of the world, the relative incidence of undernutrition in Sub-Saharan Africa has not decreased but rather seems to have slightly increased over recent decades.[1] A prospective study undertaken for FAO in 1992-93 expected that this situation would hardly improve before 2010. Even this modest expectation was based on an optimistic assumption of a 3.0% annual growth in agricultural production, 2.0% in cereal yields, and 3.3% in fertilizer use per hectare (Alexandratos 1995: 80, 146, 164, 192). Recent developments, however, tell another story. In many countries, food crop yields increase too slowly for food production to keep up with population growth. Average annual growth of per capita food production has been minus 2.3% since 1990 (World Bank 1996: Tables 1-2 and 8-3; FAO data files). Fertilizer use stagnated at about 10 kg/ha in the 1980s and has even declined in recent years (World Bank 1996: Table 8-10; Bumb and Baanante 1996: 9). Besides, there are few signs that the rate of human-induced soil degradation is decreasing.

These disappointing trends have coincided with liberal economic reforms at national and international levels, and with attempts to introduce participatory strategies for encouraging farm progress on a 'low external inputs' base at the micro level. Many scientists and policymakers have expected these new policy approaches to create better conditions for sustainable agricultural development and food security in less-developed countries (LDCs). Neo-liberal economists have emphasized their belief that economic liberalization should improve the terms of trade for LDC farmers, and that the establishment of individual and secure property rights should facilitate farmer investments in land (*e.g.* World Bank 1986a, Krueger 1995). Others have argued that the introduction of a high external inputs agriculture (HEIA) has damaged the environment, neglected indigenous knowledge, and marginalized small farmers, and that much better results could be achieved by using participatory strategies to develop a low external inputs agriculture (LEIA) (*e.g.* Chambers *et al.* 1989, Hiemstra *et al.* 1992, Reijntjes *et al.* 1992, Pretty 1995).

These views stem from different circles, and reflect realms of thought which easily conflict with each other. Nevertheless, they also have some common ground. Like ecological-participationists, neo-liberal reformists are critical of the introduction of HEIA insofar as it depends on state intervention. Besides, the neo-liberal view is increasingly environmentally conscious, and acknowledges that measures are needed to prevent farming practices which lead to further soil degradation.[2] For their part, many ecological-participationists accept the price ratios resulting from liberal market policies as given. If agricultural prices are too low for farmers to buy agro-chemicals, they do not plead for protection, but use this circumstance as an argument for LEIA. In this way, the neo-liberal and ecological-participationist views form two poles of a new pattern in the international discourse on agricultural development in LDCs. This has partly displaced the consensual view of the 1960s-70s, which, encouraged by green revolution achievements, focused on a government-supported introduction of HEIA.[3]

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1 See e.g. Pinstrup-Andersen and Pandya-Lorch (1994: 4).

2 See e.g. World Bank 1992: Ch. 7, Warford *et al.* 1997.

3 There are signs of a further rapprochement between proponents of the two policy approaches, as e.g. the World Bank's new magazine 'Environment Matters' with articles such as 'Learning from the poor', or the attempt by University of East Anglia social scientists to win the World Bank over for their 'actor oriented' approach to land degradation without examining the impact on agricultural markets of the liberal reforms cherished by the Bank (Biot et al. 1995).

In the light of recent developments in Sub-Saharan Africa, the optimistic expectations attached to these approaches seem questionable. In this paper we explore why, under the circumstances which prevail in this region, effects on agriculture and food supply have been limited and partly negative. We concentrate on West Africa, where soils are rather poor due to a combination of natural processes and agricultural expansion, and prevailing agricultural systems are depleting the already low stocks of soil nutrients. In Section 2, we describe the biophysical and socio-economic constraints on agricultural development in West Africa. We argue that integrated soil management practices are crucially important for increasing farm productivity, but that structural difficulties and adverse price relations have blocked the shift to such practices. In Section 3, we survey the effects of liberal reforms on soil management and agricultural development under existing conditions. We point to the role which internal political structures and the dynamics of agricultural world markets play in the disappointing outcomes, and we suggest that these outcomes cannot easily be changed by an ecological-participationist approach. In Section 4, we use an "infant industry" type argument to argue that, as well as elements of the new policy approaches,[4] (temporary) support of farm incomes is essential for improving soil condition and increasing agricultural production in West Africa.

[4] Including public investments in infrastructure and institutional support (Reardon et al. 1997).

# 2. West-African conditions

## 2.1 Agro-ecological potentials and constraints

Generally speaking, West Africa is not blessed with rich natural resources for agriculture. Without investments, most soils can only support a limited agricultural population within extensive farming systems (Breman 1997). Nevertheless, sufficient room exists for expansion and improvement of agricultural production.

The agricultural resource base of the region includes a wide range of tropical climates and soil conditions. The main agro-ecological zones are, in the order of increasing humidity, the Sahara desert, the Sahel steppe, the Sudan savanna, the Guinea savanna and the Equatorial rain forest. Figure 1 summarizes the conditions of the zones with respect to potentials and constraints for agricultural production; (for details, see Appendix). In the Sahara desert, the climatic constraint is too severe to allow agro-pastoral land use. The other zones have varying potentials for farm production. The production capacity of tropical rain forest and humid savannas remains a controversial issue. Whereas some authors consider these zones as potentially high-yielding food production areas, others believe that no technology is available for high-yielding agriculture on a large scale (see Appendix).

The four zones have major soil-related and climate-related production constraints which can, in theory, be loosened by human intervention. These constraints can be summarized under three headings: shortage of moisture, low soil fertility, and land degradation. Measures for overcoming these constraints are often closely connected.

- In the Sahel and savanna zones, insecure rainfall requires careful water management. In rain-fed agriculture, there is room for applying water-saving techniques, like mulch, bunds, and water harvesting measures. An important step would be the abandoning of the practice of burning vegetation and crop residues. Besides, the irrigation potential could be more fully exploited, even allowing for the technical difficulties of dam construction and other complications which lead to unfavourable cost-benefit relations (Weischet *et al.* 1993). However, irrigation requires careful introduction, with due regard for cultural and social organization aspects, if poor performance or even the disappearance of the systems is to be avoided.[5]
- Up to now, valley bottoms in West Africa are agriculturally underexploited. These bottoms have considerable potential for agricultural production. In particular, various institutions have explored the feasibility of small-scale irrigated or water-controlled wetland rice cultivation (Windmeyer *et al.* 1993).
- Fertilization of West African soils is crucially important for sustainable development, and several techniques for restoring soil fertility are available. However, they have not been utilized on a large scale (Mokwunye et al. 1996).
- Human-induced land degradation is a serious threat to land productivity. Available data indicate that 62 million hectares are affected by wind erosion, 39 million by water erosion,

[5] E.g., the majority of small dams constructed in Northern Ghana after independence have broken down (Kasanga, 1992).

12 million by chemical deterioration,[6] and 2 million by physical deterioration (see the general mapping of degradation types in Figure 1). Techniques for overcoming soil degradation do exist but have not been widely adopted (WOCAT 1997). Several measures for overcoming soil moisture shortage and low soil fertility are effective in combatting or preventing land degradation as well.

Realizing the agronomic potential of existing soil types, and preventing the reduction of this potential by further soil degradation requires a simultaneous application of water and soil conservation measures, organic fertility measures, and inorganic fertilizers and soil amendments (including local by-products and rock phosphate). The synergism of the various elements of such an *integrated soil management approach* is especially important (Breman 1997; Kauffman 1996). Without improved soil hydraulic measures and organic measures for improving the organic matter status of the soils, nutrient recovery rates of crops are restricted by leaching, bad rooting and suchlike. Their lack makes the application of inorganic fertilizers much less attractive to farmers. Conversely, without inorganic fertilizers and amendments, the scope for organic fertility measures is reduced, because the organic matter for producing compost or dung,[7] or the nutrients needed for improving the effect of leguminous species, are not available in sufficient quantities. This is especially true where bush and grazing lands have been strongly reduced, so that the fertility of arable fields can no longer be maintained by fallowing, or by the syphoning off of nutrients from surrounding lands by manuring or other means. In such situations, only limited improvements can be achieved without the use of inorganic inputs. This is the more so because many soils are not only deficient in nitrogen (which could be remedied by green manuring), but also in other nutrients such as phosphate.

An integrated soil management approach involves considerable investment. For soil and water conservation and organic fertility measures, these consist mainly of labour time; for inorganic fertilizers, mainly of money. The full benefits of these investments only appear after a considerable time lag. This is partly caused by learning effects: farmers may need several years to become acquainted with new technologies involved in integrated soil management, and to adapt them to local circumstances. Moreover, there are considerable time lags in the physical process of soil improvement itself. For example, nutrient recovery is very low; an average of only 30% of nitrogen from applied fertilizer is used at present by crops in West Africa. An improved soil condition can at least double this nutrient use efficiency, but to realize this potential, farmers must keep investing for many years in soil improvement measures, including the application of fertilizers, in spite of much lower initial recovery rates (Breman 1997).

Translated into economic terms, this means that soil condition is not only a natural resource, but also a capital resource (*soil capital*). Like human capital, it can only be built up gradually if investments are maintained over a long enough time span. Whether this will happen depends on the feasibility of the investments in the short run. The lower initial productivity reduces the profitability for farmers. In addition, the feasibility for farmers is affected by time horizons, by the physical benefits realized in the course of time, by the ratio of input and output prices, by (in)security of title and other risks, and by limitations in labour input and finance. These are examined in the next section.

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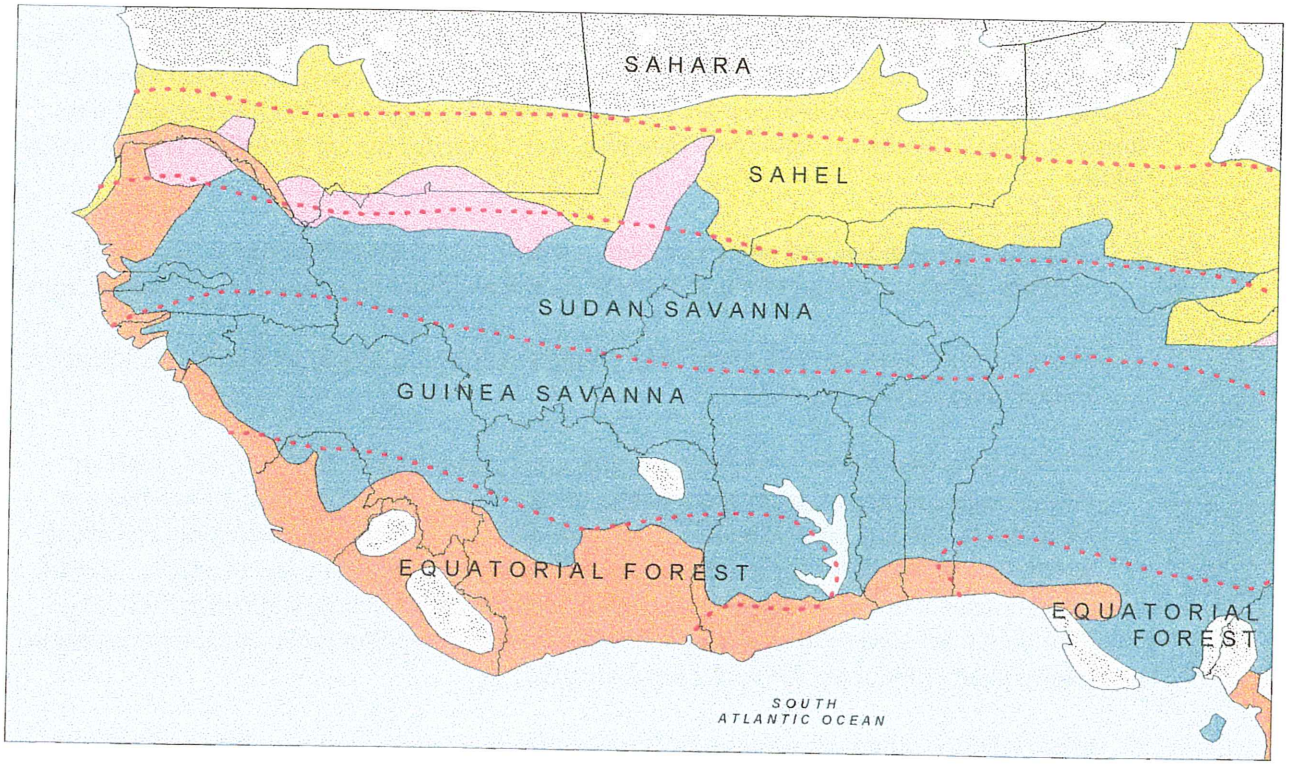
[6] Chemical detioriation is underestimated, because soil mining was not adequately recognized at the time of map compilation.

[7] Shortage of transport and water can also limit the production of compost (Zanen, 1996).

Figure 1: Agro-ecological zones and dominant land degradation types




## Agro-ecological zone

| Agro-ecological zone | Annual rainfall (mm) | Length of growing period (days) | Dominant soils (FAO, 1988) |
|---|---|---|---|
| Sahara | <250 | <60 | Arenosols, Regosols |
| Sahel | 250-550 | 60-90 | Arenosols, Regosols |
| Sudan savanna | 550-900 | 90-165 | Lixisols *) |
| Guinea savanna | 900-1500 | 165-270 | Acrisols *) |
| Equatorial forest | >1500 | >270 | Ferralsols, Acrisols |

*) Including Fluvisols, Gleysols, Vertisols and Leptosols

## Land degradation type

- Water erosion: loss of topsoil, terrain deformation/mass movement
- Wind erosion: loss of topsoil, terrain deformation, overblowing
- Chemical deterioration: loss of nutrients and organic matter, salinization/alkalinization, acidification, pollution
- Physical deterioration: compaction/crusting, waterlogging, subsidence of organic soils
- Other: water, non-used wasteland, stable under natural conditions, stable without vegetation, stabilized by human intervention
- Major agro-ecological zone

Sources: Oldeman et. al, 1991, Windmeyer et. al, 1993 - Prepared by ISRIC, May 1997

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## 2.2 Socio-economic constraints

Socio-economic factors explain why integrated soil management has not been achieved in West Africa in the post-indepence period. For one thing, on-farm investments have been hampered because many farmers are living on the edge of subsistence and, therefore, have a short time horizon. Also, a number of 'structural' handicaps have impeded farmer investments (cf. Platteau 1990):

* Property rights on land are often insecure, not only as a result of traditional land tenure systems, but also because of contradictions between official land laws and traditional titles.

* Many African states are characterized by a high degree of political instability, which gives further insecurity for farmers.

* The bureaucratic culture is oriented towards a top-down approach to rural development, which creates incentive problems for farmers, and makes no use of local knowledge and local initiatives. E.g., opportunities for developing informal credit circles into rural credit co-operatives have been underutilized, so that most farmers lack access to efficient credit. Another aspect is that the implementation of techniques for raising soil productivity has often failed because of insufficient consideration of socio-cultural and economic conditions (Hurni et al., 1996; Reij 1996; Scherr et al. 1996).

* Many African staple foods have not benefited from green revolution type technological breakthroughs. Research into these foods is not able to profit from prior research results in western countries. Moreover, research investments have been disproportionably oriented towards export crops which are organized by parastatal societies, related, in many cases, to enterprises in the former colonial powers. Research on and extension efforts for food crops have been modest. Improved varieties of grains and legumes have been introduced, but sometimes possess undesirable attributes (difficult to store, inferior taste), and their overall impact remain rather limited. With other foods, especially the roots and tubers which are the staple foods in the coastal and subhumid zones, science-based production of new varieties has been very limited (Venkatesan 1994).

* Low population densities have hampered the development of markets and raised the cost of physical and social infrastructure per head. This partly explains why transport remains underdeveloped. Besides, infrastructural investments have often been ill-conceived, and there has been a lack of adequate organization of maintenance.[8] Lack of infrastructure has increased the difference between agricultural product prices in rural and urban markets (e.g. Ahmed and Rustagi 1987) and has raised acquisition costs of purchased inputs.[9]

* Work ethics in Africa have been formed through a history of long-fallow agriculture and pastoral nomadism, and, especially with male workers, have not always been conducive to an intensification of agricultural production. Adjustment of these labour attitudes is not easy, except where the intensification process is sufficiently attractive.

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[8] See e.g. the case study by Kasanga (1992) for North Ghana.

[9] This has been increased by the small quantities of inputs used and outputs produced per unit of land (Breman 1997).

These structural handicaps have reduced the feasibility of investments in soil capital for farmers. Insecure property rights and political instability have increased investment risks, while high transport costs, lack of improved techniques, and the malfunctioning of institutional support systems have reduced the benefits of investments. Lack of credit and work ethics have complicated investments in own-family labour and external inputs.

On-farm investments have further been hampered because African farmers have been faced with unfavourable terms of trade during most of the post-independence period. There are several reasons for this situation.

* In part, unfavourable agricultural output (and input) prices have been related to the above constraints. In particular, high transport and information costs have fostered market imperfections and depressed farm gate prices, while indebtedness, lack of credit, and poor storage facilities have often forced farmers to sell food crops immediately after the harvest for low prices, and buy food at much higher prices some months later.

* Domestic policies have also contributed to the squeeze on agricultural prices. In many cases, overvaluation of currencies has kept agricultural prices below world market levels. Also, export crops have been heavily taxed to raise state revenue (World Bank 1986a, 1986b, Timmer 1988, Krueger 1995). Behind these policies have been attempts to appease urban populations by low food prices, inflation of government costs resulting from clientelism, and lack of farmers' movements which could counteract these tendencies.

* Finally, external factors have added to unfavourable prices for West-African farmers. World market prices of their products have been strongly fluctuating and, for some decades, declining in real terms. Prices of export crops have often been depressed by global overproduction and competition by industrial substitutes, and prices of food crops by global overproduction and dumping policies of DCs. Food aid by western countries was often been given in a way that harmed local producers and trade structures (and partly continues to be so)[10] and, in many cases, has served as a trail blazer for increased commercial imports (Maxwell 1991).

Short time horizons of farmers, structural handicaps, and unfavourable agricultural prices have blocked the shift to sustainable intensive farm technologies and the build-up of soil capital. In export crops, where new varieties have increased yields, and where marketing boards have guaranteed product prices and provided subsidies and credit for inputs, fertilizer use has often been at an adequate level. However, in traditional food crops, where fertilizers, although subsidized, have not been provided on credit, fertilizer use has typically remained below 10 kg/ha. Where export crops have been integrated into rotations with food crops, the latter have benefited from the residual effect of the fertilizers provided for export crops. In addition, export crop farmers have diverted some of the fertilizer directly to food crops. Nevertheless, fertilization of food crops has generally remained very restricted, and crop yields have stagnated.

[10] Unlike food aid policies of the EU, those of the US have not shifted to triangular transactions and local buying (see data in FAO 1996).

Throughout the post-independence period, a rapid increase in the rural population in West Africa has led to an expansion of the area under cultivation,[11] and so to a decrease in the length of the fallow period and in pasture. However, investments in soil capital have been insufficient to sustain a productive type of intensified agriculture (Lele and Stone 1989; Paarlberg 1996; Reardon et al. 1997). The result has been erosion, soil mining and involution (Pieri 1989, Stoorvogel and Smaling 1990, Van der Pol 1992). In parts of the Sahel zone, this has led to Malthusian situations and ecological fragility which has turned climatic fluctuations into disaster. This has prompted foreign aid, both by government and private channels, but much of it has been relief aid rather than development assistance.

[11] See e.g. World Bank 1996: Tables 8-12.

# 3. New policy approaches and West-African agriculture

## 3.1 Impact of new policy approaches

Both agricultural prices and structural constraints have been affected by the recent liberal reforms at national and international levels: the Uruguay Round of GATT-negotiations and the structural adjustment programmes (SAPs) supported by the World Bank and the IMF.

The (partial) liberalization of international trade in agricultural products will, in theory, increase the world market prices of many of these products through the reduction in dumping by countries which protect their agricultural sectors. These effects should not be over-estimated, however. With respect to beef, the curtailment of export subsidies by the Uruguay Round agreement has sealed the reduction in beef dumping by the EU, which had already been realized under pressure from European NGOs some years before.[12] It has contributed to a substantial improvement of livestock prices in West African markets, but the devaluation of the CFA franc in 1994 probably had a larger effect (Moll and Heerink 1997; Quarles van Ufford and Klaasse Bos 1995; Ruben et al. 1994). The effects of the Uruguay Round agreement on other West-African products (or substitutes for these products) remain to be seen. Forecasts are modest, e.g. a 6% rise in world market prices of wheat, or a 4% rise in those of coarse grains (Safadi and Laird 1996). The recent rise in grain prices in world markets was not so much caused by the Uruguay Round agreement but by harvest failures, and a corrective downward movement has already set in.

Structural adjustment has significantly reduced taxation[13] of export crop producers in countries like Ghana and Burkina Faso. In other West-African countries, particularly Guinea-Bissau and Sierra Leone, taxation of export crops has increased in spite of SAPs (World Bank 1994: 79-80, 244-245). Moreover, structural adjustment has generally involved a reduction in the subsidization of farm inputs, which has caused rises in input prices. These have been reinforced by currency devaluations which also conform to the liberal package.[14] While the effects of devaluations on the prices of (imported) agro-chemicals have mostly been complete and immediate, the effects on farm product prices have more often been partial and/or retarded (Kempkes 1997, Reardon et al. 1997).

The absence of compensating increases in producer prices means that increases in input prices often have serious effects, because such rises make the use of these inputs less attractive for farmers. In export crops, where agro-chemicals are indispensable, production itself is sometimes threatened. In Ghana, use of insecticides and fungicides dropped by almost 90% following the removal of subsidies at the end of the 1980s. Because these chemicals are crucial for controlling capsid and swollen shoot disease, which are widespread in the country, subsidies have been reintroduced in recent years (ISSER 1995: 86-87). In the savanna region in Togo and some other West-African regions with low cotton yields, the area under cotton has

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12 In Côte d'Ivoire, a system of compensatory levies protecting the domestic beef market was introduced in 1991. As a result, beef imports from the EU declined by more than 50% in the period 1991-93 (Moll and Heerink 1997).

13 Including implicit taxation resulting from overvalued exchange rates

14 See e.g. Bumb et al. (1994: 38-41) for fertilizer in Ghana.

decreased in spite of a favourable development of cotton prices in the world market.[15] Since parastatal companies still pay rather low prices to farmers, increased prices of agro-chemicals have made the production of cotton unattractive for farmers. Food crops are also affected, as the residual effect of fertilizer used for cotton in rotational systems is lost and the opportunity to divert part of this fertilizer to food crops disappears.

The direct effects of increased input prices on food crop production are even more dramatic. In a recent seminar on the economics of agro-chemicals it was observed that 'removal of fertilizer subsidies in most West-African countries has, at best, resulted in a stagnation of fertilizer use in the food crop sector' (De Jager et al. 1998). In many regions, farmers are actually buying less fertilizer for food crops and, in some cases, like maize in Ghana, this reduction has gained dramatic proportions. The explanation can be found in the evolution of value-cost ratios (VCRs).[16] Available evidence indicates that, in Ghana and Mali, the VCR for maize has fallen below 2, while in the latter country, the VCR for rice has fallen to 4 (Gerner et al. 1995). In Burkina Faso, the VCR for sorghum and millet fell from 5.3 in 1981 to 2.6 in 1989 and 2.9 in 1996 (Breman 1997).[17] For Togo, Koffi-Tessio (1996: Table 3) indicates that VCRs for food crops (maize, cassava, sorghum, yam, millet) fell from 6 - 16 in 1983 to 1 - 4 in 1994. This author concludes that the recent devaluation of the CFA franc and the on-going structural adjustment programme undermine food security in Togo (Koffi-Tessio 1998).

Another common element of SAPs, the privatization of input supply, may also have negative side-effects. Privatization is meant to increase the economic efficiency of the supply sector. However, private firms are only interested in providing inputs when they are able to realize a reasonable profit. Poor farmers and farmers in remote regions are often not reached by private suppliers, because financial risks are too high and returns too low. Moreover, input markets risk being dominated by a few firms because of the continued involvement of marketing boards in the provision of inputs for export crops, the small size of the market for agro-chemicals for food crops, and the high capital costs of importing, storing and distributing foreign-produced inputs. In Ghana, for example, it has resulted in a fertilizer market that is dominated by one company (Heerink et al. 1997; Kempkes 1997).

The reform of public expenditure during structural adjustment may also work out differently from what had been expected. According to the philosophy behind the reforms, an increase in government efficiency leads to an improvement in infrastructural efforts in spite of economizing on government budgets. However, in most cases, this expectation has not been fulfilled. Structural adjustment has usually entailed a decrease in capital rather than in recurrent expenditures.[18] As a result, in many countries, investments in physical rural infrastructure have

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15 In the savanna region of Togo, the ratio between the price received by farmers for first quality cotton and the price they paid for agro-chemicals decreased by 15% between 1991 and 1995. In the same years, the area under cotton decreased from 15,141 to 12,683 hectares. (Data from the Société Togolaise du Coton.)

16 VCR = ratio of value of increased yield to the cost of fertilizer per unit. A VCR of 2.0 can be seen as the absolute minimum for fertilizer use to be efficient. If risks for farmers (weather, prices) are considered, VCRs should be considerably higher, something like above 4.0 (Koffi-Tessio 1998).

17 In the calculation of these data, a response rate of 10 kg per kg fertilizer is assumed. In the same period, the VCR for cotton decreased from 6.6 in 1981 to 4.2 in 1989 and 4.0 in 1996.

18 Unlike other adjusting countries, public capital expenditure as well as recurrent expenditure increased in Ghana during the first years of structural adjustment as a result of increased government revenues from tax system reforms (Leechor 1994). The share of agriculture in public (capital and recurrent) expenditure, however, drastically declined during that period (Fosu 1993).

declined, and new deficiencies have emerged in official research and extension services for agriculture, especially where food production is concerned (Reardon et al. 1997).

Meanwhile, the weakening of official extension services is making farmers more dependent on NGOs for support. This is reinforced by the growing amount of international development aid which is being spent through these organizations. Among NGOs, it is ecological and participationist views that prevail. Some of the more serious NGOs are expanding their agronomic activities and building up good contacts with farmers. The participatory approach tends to make these organizations' communication with farmers more effective than that of official services. In regions where long fallow periods are precluded by population pressure, now that chemical fertilizers have become unaffordable, farmers are becoming more open to the organic techniques propagated by these organizations. So apparently, the ecological-participationist view is making some headway. However, up to now, it has not been able to reverse the declining trend in food production per capita. Moreover, the adoption of organic methods as it occurs in some places appears to be insufficient to compensate for the deterioration of nutrient balance, or the loss in farm incomes. Indeed, it may be doubted whether these methods can support the kind of sustainable intensification which is needed to accommodate the rapid population growth in West Africa. Technologies based on organic fertilizers, biological pesticides and indigenous seeds, which have been developed by farmers in a long process of trial and error, are relatively efficient at low productivity levels. However, they are unable to exploit the still unused agronomic potential of soils in West Africa. As argued above, this requires an integrated soil management approach that utilizes the synergetic effects of water and soil conservation, organic fertility measures, and inorganic fertilizers. Similar arguments are used by Reardon who believes that exclusive reliance on low-input sustainable agriculture will be unable to meet the 3% to 5% projected growth in food demand in Africa (Reardon et al. 1997; Reardon 1997). Besides the reduction in fertilizers, the decreased use of pesticides cannot easily be compensated by more organic methods. Integrated pest management requires considerable institutional support for data collection, training of farmers and suchlike. This will not easily be realized in the context of structural adjustment.

The adoption of low-input methods can be better seen as a defensive reaction of farmers to adverse economic conditions, rather than as a road to sustainable intensification. Economic analysis shows that low-input farming becomes more attractive to farmers when prices of outputs are lower, prices of inputs higher, and infrastructure more underdeveloped. When the input-output price ratio faced by farmers improves, farmers are expected to switch to more productive agricultural techniques that require a relatively high share of external inputs (Ruben et al. 1996; Heerink and Ruben, 1996). This switch can be explained from the fact that, although ecological production based on traditional technologies is relatively more efficient at low levels of input, modern, high-yielding production technologies are more efficient at high input levels. If farm-gate prices of external inputs are low in comparison with output prices, the synergetic effects of integrated soil management technologies with fertilizer-responsive, high-yielding varieties can be fully exploited.[19]

On balance, it is questionable whether 'liberalization', as it has come in the form of the GATT agreement and structural adjustment, has had any positive effects on agricultural development and food security in West Africa. The (limited) agricultural growth that resulted from these

[19] See also Hayami and Ruttan 1985: 133-136, McGuirk and Mundlak 1991, Mundlak 1992 on differences in production functions between traditional and modern agricultural systems in LDCs.

policies was a result of area expansion rather than an increase in yields, and it is even possible to indicate clear cases where food crop production has been negatively affected. In several cases, these policies seem to have contributed to further soil degradation rather than better soil management. In this situation, the adoption of organic methods by farmers seems to be more a defensive reaction for minimizing their income loss, than a positive development toward more sustainability and food security.

### 3.2 Getting prices "right"

Important assertions by neo-liberals are that the (external and especially internal) terms of trade have been against agriculture in many developing countries; that an improvement of these terms will contribute to agricultural progress; and that such an improvement is precisely what liberal reforms will bring about. This idea has been criticized by authors like Alcántara (1993) or Platteau (1990) who emphasize that, as well as by price ratios, agricultural progress is also hampered by structural constraints (like those mentioned in Sections 2.1 and 2.2). However, many of these authors (including Platteau) still admit the need for adequate prices. This gives rise to another kind of doubt: do liberal reforms deliver the favourable price ratios they profess to bring? This question can be answered on different levels.

On one level, it can be seen that structural adjustment and the Uruguay Round agreement have only been partly successful in achieving liberalization. It was somewhat naive to expect that an adjustment programme adopted under pressure from international agencies would be enough to achieve internal liberalization. It did not reckon with the toughness of political realities in West Africa.[20] As a product of colonial and postcolonial underdevelopment, many states have evolved into clientelist structures, with power elites that try at all cost to monopolize control over state resources which they use for maintaining their political base by distributing favours (including nationalized enterprises) among their supporters (Clark 1997; also Davidson 1992). It has eroded democracy, and encouraged inflated and little competent state services, the ever-increasing cost of which are paid for by foreign aid and by bleeding the productive parts of society. Agencies of restraint that could correct such practices have been virtually absent since colonial times (Collier 1996).

At the moment, some governments are trying to break away from this pattern. The economic effects are certainly positive in some cases. However, whether these attempts will succeed in permanently changing the underlying political structures remains to be seen. Moreover, under the economic conditions currently prevailing in West Africa, democratic governments can often expect a short life. They may therefore show little commitment in fulfilling conditions set for the continuation of foreign aid (Collier 1996). Meanwhile, in several other countries, clientelist formations persist unabated. If put under pressure by structural adjustment programmes, these formations tend to remain intact as long as possible, shifting the burden to the executive level and the population. Long before the dysfunctional structures at the core of the state are seriously affected, the remaining positive functions of the state may be eliminated. By the same token, the sources of state revenues are defended by any means. Structural adjustment may alter the form in which cash crops are taxed, but reducing taxation is not so easy. In some cases, taxation may even be raised as a reaction to pressure by international

[20] See also Morrisson *et al.* (1994) for an integrated political-economic model analysis of the political feasibility of adjustment measures in Sub-Saharan Africa.

agencies for more balanced government budgets. This is not to say that political structures in these countries cannot be changed for the better, but that such a change may take considerable effort and time. According to Collier (1996), the abuse of government power and public corruption in Africa can only be overcome gradually, moving from a strategy of donor conditionality, cash budgets, system correction and elite ring-fencing to a more sustainable, but not directly attainable system of reciprocal international threats, scrutiny and democracy.

As for the Uruguay Round, many neo-liberals fail to realize that, in agricultural trade politics, 'liberalization' is more a flag of expansionist agribusiness interests in DCs than a cause pursued for the sake of global welfare. Not surprisingly, the Uruguay Round agreement was not quite so liberal. It gave LDCs only a limited increase in access to DC markets.[21] Moreover, the agreement hardly restricted the real scope for DCs dumping of farm products. Although it limited direct export subsidization, it allowed disguised dumping by R&D subsidization and direct allowances. Significantly, the US is now combining such allowances with a relaxation of production restrictions in the frame of its new 1996 farm act, while the EU is contemplating a similar course (Commission of the EU 1997).

On a more fundamental level, it can be questioned whether it is possible for West Africa to develop its agriculture under free trade conditions. Model studies indicate that global liberalization would restore agricultural prices in the world market, but in a declining secular trend.[22] Even in the inplausible case of complete liberalization, it is not certain that world markets will generate agricultural prices which are high enough to enable adequate agricultural development in LDCs (or in DCs, for that matter). Liberal economic thinking sees the economy as a communicating vessels model, in which the mobility of production factors (the fluid) leads to equal factor returns in different sectors (the vessels). In reality, labour mobility is limited by market imperfections, imperfect knowledge, fixed assets, and cultural feedback mechanisms. Experience shows that, even in DCs, these limitations cannot be entirely removed by policy interventions or institutional reforms. As a consequence, as has already been explained by Schultz (1945), the evolution of international agricultural markets is sensitive to the broad demographic, technological and economic forces which affect the relative growth rates of demand and supply of farm products. From the last quarter of the 19th century, the international expansion of commercial agriculture which responded to a fall in transport prices, the boosting of yield growth rates by agro-chemicals, and the displacement of farm-produced materials by minerals have squeezed the world market prices of agricultural products. In connection with this, all DCs have protected their farm sectors - many from the late 19th century, and all from the 1930s (Koning 1991).[23]

Unlike West-African countries today, western agriculture has never had to develop itself within a context of low market prices. The 'agricultural revolution' of the 18th and 19th centuries (new rotations, convertible husbandry, and simple mechanization) was facilitated by high agricultural prices in world markets resulting from demographic pressures and an increased

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21 Hathaway and Ingco (1995). At the WTO Ministerial Conference in Singapore (December 1996), however, a Plan of Action was adopted that aims at granting duty-free access for the exports of the least-developed countries to DC markets.

22 Even this relative improvement can be questioned, as these studies can not deal adequately with the dynamics of the farm sector (Hoogh 1987). For example, the effect of direct allowances on the supply of farm products is hardly known.

23 Only New Zealand eliminated its support of farm incomes after 1984.

demand for farm-produced inputs in non-agricultural sectors. The 'second agricultural revolution' in the 20th century (agro-chemicals, new seeds, imported fodder, and more far-fetched mechanization) passed off behind walls of protection. In contradiction of what has been asserted by liberal economists (e.g. Tracy 1989), economic historical studies suggest that agricultural protection in western countries contributed to the successful development of their farm sectors and, because of the significance of agriculture for domestic markets and the factor base of economies, their wider economies as well (Bairoch 1976; Koning 1991, 1994; Webb 1978). Similarly, Japan and new industrial countries in East Asia (Korea and Taiwan) have protected their farm sectors by means of targeted subsidies, concessional credit (usually tied to prescribed input packages for high-yielding varieties and output support packages) and protective trade policy arrangements.[24] It seems plausible, therefore, that the lack of farm income support in African countries reduces their opportunities for agricultural and economic development. This is even more so, since the successful development of DCs agriculture has strongly increased the productivity gap between DCs and LDCs. In spite of their low wages, LDCs now even seem to have higher labour costs per unit of production in agriculture than DCs (Bairoch, forthcoming).

In this situation, it seems unlikely that the encouragement of 'low external inputs agriculture' will enable farm production in countries like those in West Africa to keep pace with population growth. Within a 'liberalizing' environment, the ecological-participatory approach tends to become a mere palliative. As we have already pointed out, the adoption of organic methods by farmers seems to be a defensive reaction induced by lack of alternatives. It helps farmers to subsist, but, without input of external nutrients, improved seeds and the like, this approach cannot achieve the necessary increase in farm production.[25]

While 'ecological' methods seem incapable to increase productivity and counter soil degradation, 'participation' can only to a limited degree improve the prices for farmers. Co-operatives can increase the efficiency and performance of the economic environment of farming, but a more far-reaching protective organization of agricultural markets would require the forming of co-operative cartels, which is precluded by free-rider problems (Galbraith 1952: 165-170). In DCs, all attempts at a protective organization of agricultural markets on a private co-operative basis have failed.[26] There is no reason for such efforts to succeed in LDCs. Therefore, so long as a participatory approach accepts a policy environment which one-sidedly pursues liberalization, it will at best be little more than liberal poor relief based on 'self help'.[27]

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[24] The rise in agricultural protection in East Asia is documented in Anderson and Hayami (1986). Here it is seen as a brake on industrialization caused by the effect of the latter on political markets. However, nothing in the account precludes the reverse hypothesis that agricultural protection actually contributed to industrialization.

[25] In promoting sustainable agricultural technologies, it is important to bear in mind that the environmental risks in Western countries (where fertilizer input is high and limitations may be desirable to reduce environmental problems) differ fundamentally from those in many regions in LDCs. In the latter, fertilizer use is too low to avoid nutrient depletion, and a further reduction only risks to exacerbate processes of soil degradation.

[26] The most important of these failures was a campaign in the US in the 1920s for building nationwide co-operative monopolies (see the description of this episode in Benedict 1953: 194-198). After its failure, the farmers' organizations in the US turned to the government for protection. Under Roosevelt's New Deal policy, it resulted in the famous Agricultural Adjustment Act (1933), which became a model for agricultural protection in western countries in the post-World War II period.

[27] At worst, participation may serve local elites, expose vulnerable groups in ways that are harmful, and transfer the responsibility for sucess or failure from policy makers and project staff to the farmers themselves. See the warnings in Hurni et al. 1996 p. 59 (after J.N. Pretty). That participation may work out like this has long been known; see e.g. Selznick's (1966) classical study of a 'grass roots' rural project in the US in the 1930s.

# 4. A way out?

For agricultural progress and adequate soil management to be realized in West Africa (and several other LDCs), not one but several conditions must be met. Adequate property rights and support services are needed, otherwise even favourable prices will not stimulate integrated soil management. However, these provisions will only be helpful if farming is remunerative, so that investments become attractive for farmers and more easy to finance (Reardon et al. 1997). The fulfilment of this condition requires reducing transport costs, eliminating imperfections in local markets, and strengthening the bargaining position of farmers by rural credit and co-operative storage.[28] However, it also requires an adequate level of agricultural prices in national markets. It is sometimes suggested that lack of transport and local market imperfections make national prices of little importance for farmers (e.g. Alcántara 1993), but this premise separates two things that are actually more closely related. An improvement of national prices will increase the premium on improving transport, competing local monopolies, or organizing cooperative selling, thereby encouraging the improvement of these local conditions. Historical experience in DCs shows, e.g., that farmers' co-operatives were mostly not established in the deepest of farm depression, but when agricultural prices started to recover (Stuijvenberg 1980).

So, it is certainly true that the terms of trade for farmers should be improved to make sustainable agricultural development possible. However, the improvement needed for this goes further than an elimination of the bias against agriculture by reducing cash crop taxation and correcting overvalued exchange rates. As argued above, agricultural development in West Africa is vitally dependent on the synergetic effects of an integrated soil management approach. Such an approach requires considerable investments by farmers, in terms of finance as well as labour. As we have explained in the preceding sections, the full benefits of these investments can only be reaped after several years, whereas various factors restrain these investments in the short term. Farmers have short time horizons caused by poverty. The initial effects of measures to improve poor or degraded soils are limited. Farmers need time to learn new technologies and adapt them to local circumstances. Also various socio-economic constraints reduce the profitability of investments for farmers and confront them with high risks and imperfect labour and capital markets. Because of this combination of adverse factors, unless world market prices for agricultural products rise considerably, the transition towards integrated soil management technologies is unlikely to be achieved under a liberalized market regime. Consequently, in addition to restoring competitive conditions and remedying structural constraints, support of farm incomes may be needed to encourage farmer investments.

Once enough soil capital has been formed, the improved soil condition will make further investments more remunerative. Also, endogenous growth theory (Romer 1994) suggests that the ensuing development will induce a relaxation of some of the structural handicaps. In particular, an increase in agricultural production and trade can stimulate the knowledge base and infrastructural investments, and help mitigate imperfections in rural product, labour, and capital markets. Consequently, temporary support of farm incomes can be expected to achieve sustained agricultural development in many regions. In other regions, sustainable

[28] These elements are interrelated: improvements in transport and local market conditions will reduce transaction costs in the sale of farm output and the purchase of inputs, and thereby lead to more favourable price conditions at farm level.

intensification will remain dependent on support, even after adequate soil capital has been formed. Such continued support may be justified if the lack of agricultural development has serious external effects on the environment, food security, or socio-political stability (Breman 1997). Besides, in West-African countries, as in some West-European countries in the late 19th century, farm income support may contribute to a broad-based agricultural development which is desirable as a basis for overall economic growth. In any case, the legitimity of continued support will be enhanced if DCs also continue to support their agricultural sectors by direct allowances or by other means.

Bearing in mind the limited public resources available and the need for public investment for reducing structural difficulties, direct allowances to farmers are no real option in West-African countries. By the same token, fertilizer subsidies cannot easily be afforded. Besides, fertilizer subsidies will hardly increase (and may even deter)[29] the application of organic fertility measures and improved soil hydraulic measures, which depend to a large extent on labour investment. Hence, the synergetic effects of an integrated soil management approach will not be fully exploited. For these reasons, farm income support could best take the form of price support, e.g. by a West-African tariff union which could impose tariffs on agricultural imports. Such tariffs would also have the advantage of raising revenue, which could be used for public investments in infrastructure and institutional support. Negative effects on poor consumers could be alleviated, e.g. by large-scale food-for-work programmes. Such programmes could be used to carry out infrastructural works, and would give additional incentives to the production of food, so that different aims could be achieved simultaneously. DCs support for such programmes could be an effective form of development aid.

The use of protective instruments for promoting the development of domestic industries in LDCs has been heavily criticized in recent years. The four basic arguments are: (i) inefficiencies will arise because of resource misallocation; (ii) innovation, acquisition of technological capabilities, and cost-cutting will be discouraged by the lack of competition; (iii) vulnerability to external shocks will be higher; and (iv) wasteful rent-seeking activities will be encouraged (Rodrik 1995: section 4). However, these arguments are less valid when applied to the agricultural sector in West Africa, which is:

* far removed from the centre of political power;
* made up of a very large number of small-scale producers rather than a small number of 'infant industry' producers (cf. Olson 1985);
* characterized by a relatively competitive internal output market;
* at present confronted with severe forms of both overexploitation and underexploitation of resources such as land degradation and (seasonal) underutilization of labour;
* facing highly unstable world markets that serve as outlets for production surpluses dumped by DCs.

(Temporary) protection of farm incomes in West Africa can therefore not be expected to cause the type of inefficiencies that typically result from the promotion of new industries by means of import substitution policies.

How can farm income support be realized in West Africa? The conditions are in the first place political. The formation of regional tariff unions by LDCs should be tolerated by the powerful states (EU, US) and international institutions (World Bank, IMF), all of which can influence

[29] This is suggested by studies in other regions, e.g., that by Templeton (1994) on the hillsides of the Philippines.

trade policies of developing countries. Moreover, reducing the taxation of cash crops, supporting agricultural prices, and increasing the volume and efficiency of infrastructural investments require a change of policy in West-African countries themselves. This will not be realized simply by prescriptions by international agencies. Rather, it depends on a change of power relations within internal politics. The development of strong farmers' movements is necessary for counteracting the overexploitation of agriculture, and for enforcing positive measures that will encourage agricultural development. At a more general level, such movements can help create the popular countervailing power to bureaucratic and corporate power, which is a necessary condition for viable democracy.

In such a changed setting, important elements of the ecological-participationist view remain valid. A participatory approach is needed to mobilize local energies and indigenous knowledge, to implement expert knowledge and adapt it to the large variety in local circumstances, and to put an end to the impotence of many academic institutes whose reports have no effect in the field. Such a participatory approach should be coupled, not to a one-sided pursuit of farming systems which conform to a 'low external inputs' model, but to an integrated approach which, in varying proportions, combines elements of 'low external inputs' and 'high external inputs' models in a way adapted to local circumstances.[30] In this regard, the increasing support for integrated concepts of soil and pesticide management and a participatory approach by established agricultural research institutions is to be welcomed.[31]

[30] In fact, a really participatory approach can hardly do otherwise. In many places, farmers wish to use artificial fertilizers. Only if these wishes are ignored, or effaced by 'liberal' policies can proponents of participation adhere to a one-sided LEIA concept.

[31] See e.g. De Jager et al. 1998; Kauffman 1996.

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# Appendix

## The West-African resource base

Key parameters considered in this Appendix are based on the length of growing period concept according to FAO (1978), the soil geographic distribution of the Soil Map of the World (FAO-Unesco 1977), the soil classification terminology of the revised legend of this map (FAO 1988) and the land degradation types of the Global Assessment of the Status of Human Induced Soil Degradation Map of the World (Oldeman *et al.* 1991).

*Sahara desert*
The climatic constraint in this zone is too severe to allow agro-pastoral land use. However, the presence of rock phosphate deposits in Mauritania, Mali and Senegal is of interest for agriculture in West Africa.

*Sahel steppe*
The Sahel steppe has a (semi-)arid climate, with a precipitation between 250 and 550 mm $yr^{-1}$, and a growing period between 60 and 90 days. The land is mostly flat to slightly undulating, with a natural vegetation of short grasses and sparse low shrubs. Most soils are sandy and derived from eolian deposits (*Arenosols, Regosols*) with a (very) low organic matter content, low to moderate soil fertility, and low water retention capacity. Of minor extent, but important for irrigated agriculture, are the more fertile loam and clay soils which have developed in river and lake deposits (*Fluvisols, Gleysols, Vertisols*). The land use is semi-nomadic transhumance (the dominant cattle raising system) and, to the south, extensive rain-fed cultivation of drought resistant millets. Irrigation has been introduced in the Niger, Senegal and Volta river basins. Rain-fed production is constrained both by the short growing season and the shortage of moisture during this season. Nevertheless, agro-ecological research indicates that productivity could be improved, e.g. by applying (rock) phosphate and organic matter (Breman and Uithol 1984; Teme *et al.* 1996). The Sahel steppe is affected by various forms of land degradation. Overgrazing induces wind erosion on the sandy soils. Many soils are sensitive to sealing and crusting, resulting in a lower infiltration of rain water and a higher run-off. Without appropriate drainage facilities, irrigated land is liable to salinization and alkalinization.

*Sudan and Guinea savannas*
The semi-arid Sudan savanna has a precipitation between 550 and 900 mm $yr^{-1}$ per year and a growing period of 90 to 165 days. In the sub-humid Guinea savanna, this increases to 900 - 1500 mm $yr^{-1}$ and approximately 165 - 270 days (Windmeijer *et al.* 1993). However, even in the rainy season in the Guinea savanna, rainfall is uncertain and highly variable from year to year. Most land is nearly flat, or constituted by slightly undulating low hills with very long slopes. Natural vegetation consists of tall grasses with widely spaced fire-resistant trees. In the Guinea savanna, trees naturally are more numerous, but in more densely populated areas many trees have been felled, those remaining being mostly species of economic importance. The Guinea savanna is dominated by lowly fertile acid soils (*Acrisols*), the Sudan savanna by lowly to moderately fertile soils (*Lixisols*). Shortage of soil moisture during the growing season is aggravated by soil shallowness, caused by rock or a continuous ironstone layer near the soil surface (*Leptosols*), a hard pan or compactness in the subsoil (*Planosols*), or a high content of

ironstone gravel (*Plinthosols*). More fertile soils have developed in alluvial deposits (*Fluvisols, Gleysols, Vertisols*). Soils in valleys and flat depressions, especially in the sub-humid savanna, are often saturated with water for prolonged periods (*Gleysols and Plinthosols*). Most traditional land use systems are based on long fallow, which enables the restoration of soil fertility, but at present, many regions are experiencing a transition to permanent agriculture. Major crops in the Sudan savanna are millet, bambara nut, sorghum and maize, while cash crops include ground-nuts and cotton. The Guinea savanna zone has more maize and less sorghum, and in the moister parts also root crops such as yam. Rice is cultivated in irrigated areas and moist valley bottoms in both zones. Human-induced land degradation consists in 'soil mining' (i.e., decreasing soil fertility by agriculture exploitation, see Van der Pol 1992) and water erosion. Soil fertility management is hampered by the low or moderate nutrient-rentention capacity of the prevailing soil types, which enhances leaching. Both soil mining and water erosion are aggravated because, for various purposes, vast areas of grassland and crop residues are annually burned by farmers (Korem 1985).

*Equatorial rain forest*

The Equatorial rain forest zone has a precipitation from 1500 to over 3000 mm $yr^{-1}$, while the length of the growing period ranges from 270 to 365 days. The prevailing soil types are acid soils with a very low fertility (*Acrisols, Ferralsols*). Ferralsols are deep permeable soils resistant to erosion. Acrisols have less structure stability and are liable to water erosion. The rain forest does not rely on nutrients in the soil, but on nutrients locked up in the biomass itself. If the forest is cleared, as has been done in many regions, the organic matter mineralizes rapidly and yields drops to a very low level after a few years of croppings. All the same, a long forest fallow will restore soil fertility. Major crops in the rain forest zone are root crops like yam, taro and cassave, and perennial crops such as oil-palm, bananas, cocoa, coffee and rubber. Annual crops give moderate yields because of high nutrient leaching. Deep rooting perennials give better yields. This zone is suitable for agroforestry.

The production capacity of tropical rain forest and humid savannas is still a controversial issue. Some authors consider these as potentially high-yielding food production areas (e.g. Higgens *et al.* 1982). Current computer production models also show a much higher productivity than common agricultural practice. However, these models only include a limited number of conditions which are relevant for production. This optimistic view is contradicted by Weischet *et al.* (1993), who point to the fact that no technology is available for high-yielding agriculture at a large scale, given that *Ferralsols* and *Acrisols* must be extensively treated with various supplements, including trace elements, and lime to reduce acidity. Also, the development of livestock production in woody areas is hampered by trypanosomiasis.