
Policy Reforms and Sustainable Agricultural Intensification in Africa

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African farmers have traditionally pursued shifting cultivation in response to population growth and declining soil fertility. Rural population growth and displacement, due to urban expansion and the gazettement of parks and protected areas, have long encouraged the cultivation of new land by extending farming into forests, wetlands, hillsides, and pastures. However, in much of Africa the extensification path is rapidly becoming unsustainable or impractical as land grows more scarce in the face of population growth. That scarcity is increasing as the forest, rangeland, or wetland margin becomes exhausted, threatening biological diversity, and farmers are barred from using the remainder (for example, because of the gazettement of parks and protected areas), or soil degradation reduces crop yields and forage growth over time. Combined with increasing domestic demand for agricultural products fuelled by growth in population and incomes, there are strong pressures on farmers to intensify agriculture by using more labour and/or capital per hectare of land.

As African farmers are driven to intensify, however, the key issue to emerge is what *type* of intensification they pursue: sustainable or unsustainable. We contend in this article that many African farmers are intensifying in ways that are economically or ecologically unsustainable. Appropriate technologies for sustainable agricultural intensification are available. The crucial problems appear to revolve around thorny issues of institutions, markets, and policies that condition the incentives offered to farmers and their capacities to use those technologies. Policy researchers, therefore, have a crucial role to play in promoting sustainable agricultural intensification in Africa. Policy reforms to date have largely failed in this regard because few have paid serious attention to the inevitable necessity of sustainable intensification.

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The article focuses on two policy research questions: (i) what role have market-oriented policy reforms, commonly associated with structural adjustment programmes, played in pushing African farmers towards, or diverting them from, sustainable intensification? (ii) What policy actions are needed to address this gap? We explain how inappropriate policy reforms and weak markets can lead either to a failure to undertake necessary intensification — and therefore inevitably to extensification — or to an unsustainable form of intensification. Appropriate policies and reasonably functioning markets, on the other hand, can promote environmentally and economically sustainable intensification.

Definitions of sustainable and unsustainable intensification

We define ‘sustainable’ agricultural intensification (SAI) by two criteria: (i) an environmental criterion: the technology protects or enhances the farm resource base and thus maintains or improves land productivity; and (ii) an economic criterion: the technology meets the farmer’s production goals (his/her ‘reservation’ food and/or cash productivity levels) *and* is profitable.¹ In practice, satisfaction of these two criteria requires ‘capital-led intensification’ based on substantial use of non-labour variable inputs that enhance soil fertility (such as inorganic and organic fertiliser) and quasi-fixed capital, in particular land and water conservation infrastructure, that increases labour productivity (e.g., grass strips, anti-erosion ditches, hedgerows, bunds, and terraces) (Reardon et al., 1997; Clay et al., 1998).

By contrast, ‘capital-deficient’ intensification occurs when farmers depend inordinately on labour as a variable input to production. Characteristically, farmers following this path will merely add (unaugmented) labour to the production process on a given unit of land, allowing them to crop more densely, weed and harvest more intensively, and so on. We are not denying the importance of smallholder labour to African agricultural intensification, although too much labour without complementary inputs can mine the soil. Rather, we are emphasising that surplus labour must be channelled towards the creation of quasi-fixed capital that increases the labour productivity of subsequent periods, otherwise future surplus labour will go towards either extensification (e.g., deforestation) or unsustainable intensification. Where labour alone can successfully extensify (e.g., through slash-and-burn

1. We combine others’ criteria, in particular Lynam and Herdt’s (1989) definition of sustainability as the maintenance of total factor productivity, the combination of ecological sustainability and the meeting of human needs set out by the CGIAR Technical Advisory Committee (1988), and the profitability criteria for adopting and maintaining a technology presented by Feder et al. (1985).

deforestation or the burning of rangelands to clear areas for cultivation), it requires complementary inputs — equipment, cash, services — for successful investment in quasi-fixed capital in agriculture.

Insufficient use of quasi-fixed and variable capital, including inorganic fertiliser, combined with the intensity of land use that characterises most of the semi-arid and hillside tropics in Africa today, leads to soil mining and degradation. Weight and Kelly (1998) review soil science evidence that shows overwhelmingly that inorganic fertiliser is a necessary component for sustainable growth in productivity, even in fragile soils and low rainfall zones. In 1995, African farmers used 9 kgs per hectare (Weight and Kelly, 1998), down from 10 kgs in 1993, and as compared with 83 kgs per hectare in all developing areas in 1993 (Heisey and Mwangi, 1997). Rather than a cause for celebration, the low use of chemical fertiliser is a major *worry*, from both the environmental and food production perspectives: outside Africa, as much as 75 % of crop yield increases since the mid-1960s are directly or indirectly attributable to fertiliser use (Viyas, 1983). Even manure, a key component in most low-input systems, is in short supply in many countries such as Rwanda, Malawi, and Zimbabwe because of increasing population pressure and clearing of pasture lands for farming. When soils degrade, the traditional cycle of shifting cultivation accelerates, limiting the necessary regeneration of forest and range ecologies, thereby undermining the environmental objectives of sustainable intensification.

Capital-deficient intensification generally fails to meet the economic criteria for sustainability. Ruttan (1990) estimates that one prominent capital-deficient strategy, 'low-input sustainable agriculture (LISA), has the potential to increase food output by only about 1% a year in Africa, roughly the rate observed over the past twenty disappointing years, and well short of the expected 3.0–3.5% annual growth in African food demand. Failure to satisfy productivity goals will force a return to extensification on to fragile margins. In addition, capital-deficient intensification uses labour in a way and to an extent that may not be profitable. LISA techniques such as hand weeding, recycling organic matter, and alley cropping are labour-intensive. The evidence is mixed on the farm profitability of these practices (Low, 1993), because of the sometimes severe intraseasonal labour shortages common in African agriculture (Byerlee, 1980) — even in zones with high overall labour abundance (Hopkins and Berry 1994) — and as compared with alternative uses of labour off-farm (Reardon and Islam, 1989).

Where land constraints increasingly bind and labour/land ratios are rising, one might expect farmers to choose intensification technologies that are as labour-intensive as possible. Capital-led intensification might therefore appear to be a recipe for freeing labour for extensification. This conjecture depends crucially, however, on a 'one-sector' perspective, namely, that labour is used only in agriculture. In a multisectoral rural economy, if employment in the non-

farm sector pays more than farm labour and/or helps to reduce overall income risk, then farmers may eschew labour-intensive agricultural technologies even in the face of farm labour surpluses. Low (1986) shows this nicely in a case study of hybrid maize adoption in Botswana, where farmers deliberately chose labour-saving technologies in order to free labour for lucrative non-farm work. Similarly, labour liberated from the farm does not automatically go to bringing more land under the plough. Non-farm work often pays more per day than farm work and provides a means to stabilise incomes and smooth consumption through activity diversification (for example, in Rwanda, see Clay et al., 1998). Reardon (1997), in a review of 28 field survey studies in sub-Saharan Africa, found the average share of non-farm income in total income (in cash and in kind) to be 45%. Moreover, given weak rural financial systems, the presence of non-farm income could further reinforce capital-led intensification, as non-farm income enhances households' capacity to invest in quasi-fixed agricultural capital.

Conceptual framework: effects of policy on farmer behaviour on the environment

Farmers' choice of agricultural technologies and factor proportions — including the choice to extensify or intensify so as to increase output, and, if to intensify, what sort of intensification — turns fundamentally on the incentives and constraints they face. This section presents a conceptual framework in which policy changes induce changes in market conditions and prevailing price distributions, which in turn affect farmer choice, which then influences environmental outcomes.²

Figure 1 shows four sets of blocks. The first set comprises forces exogenous to the farm community that influence their incentives and capacity to respond. This first set consists of (i) policy reforms at the macro and sectoral level, (ii) structural changes (such as changes in global markets, in urbanisation, in infrastructure due to public investment), and (iii) projects which essentially comprise (i) and (ii) but apply to a specific area for a limited time.

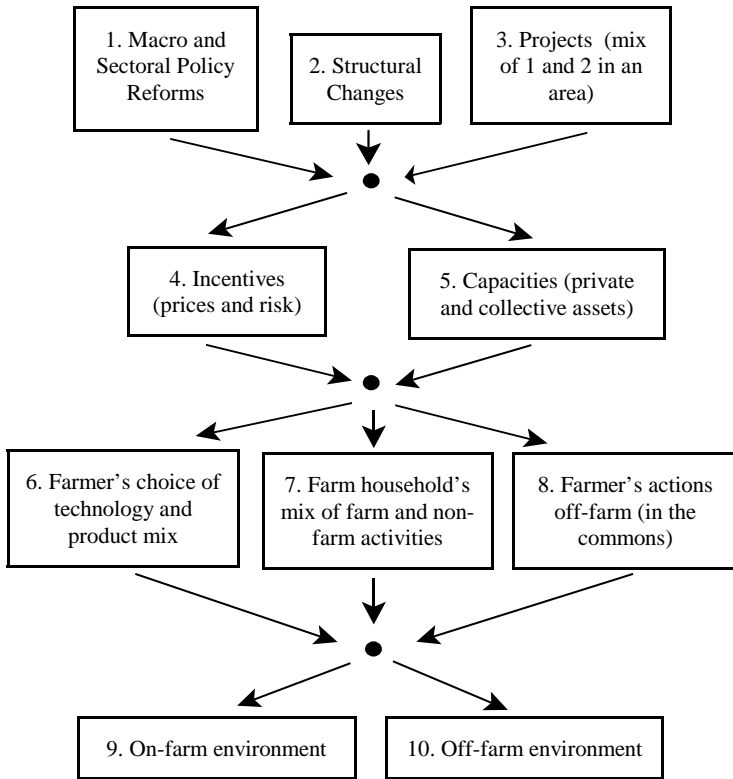
These three forces together influence the second set of two blocks: (i) incentives offered to farmers (market price distributions for both inputs and outputs, hence per unit profitability and risk of various crops and technologies), and (ii) the capacity that farm households and communities have to act on changing incentives (such as public capital (e.g., roads), private capital (e.g., animal traction equipment), or community capital (e.g., small-scale irrigation),

2. The model draws on Barrett and Carter (1999); Reardon and Vosti (1992); Reardon et al., (1995).

and their access to cash and information sources to purchase inputs and acquire knowledge for the application of new technologies (credit access, access to non-farm employment, and to extension).

Figure 1
Conceptual framework of effects of policy changes

The incentives and the farmers' capacity lead them to make choices as to resource allocation (of their labour, land, and capital) over various activities (on and off-farm, and on-farm over various products) and as to the technology they use to combine those resources for production (and thus whether they choose land- or labour- or capital-intensive technologies, which imply choices of extensive versus intensive production, and if the latter, the type of intensification, led by labour or led by capital). Note that there can be either induced technological innovation, where there is a shift in the basic technology



used, or simply a change in factor proportions, given a technology. These behavioural choices, in turn, have environmental consequences in land use on and off the farm.

Macro- and sectoral-level policies and incentives for SAI in Africa

The main policy changes common in Africa over the past fifteen years include the following macro and sectoral policy reforms: currency devaluation; liberalisation of marketing arrangements; removal of fertiliser and seed subsidies; removal of marketing subsidies for crop outputs; reduction of farm input financial services subsidies.

Too often in policy discussions concerning African agriculture there is a tendency to *assume* policy effects on output and input prices facing farmers, i.e. on the incentives for SAI. For example, 'liberalisation will raise farm profitability' is a claim commonly heard in policy debates. Lost amid the *ceteris paribus* assumptions are the complex means by which policies actually affect prevailing price distributions, transactions costs, and farmer behaviour. We argue that the effects of the major macro and sectoral policy changes associated with structural adjustment have been ambiguous and often disappointing, generating quite mixed farm-level impacts on intensification patterns.

Macro-level policy reforms

Macro reforms (such as devaluation or trade and domestic market liberalisation) tend to have analytically and empirically indeterminate effects on the incentives facing farmers, either enhancing or reducing net profitability and the relative risks of sustainable-intensification crops and technologies.

For example, exchange-rate devaluation could raise the output price of an 'intensification crop' such as rice or maize or cotton, more — or less — than the increase in input prices. This depends on the extent of tradeability of the outputs and inputs, on government 'pass-through policies' (how much of a trade gain do they tax away rather than pass on to the farmer), and on private commerce margins. Cases below illustrate both positive and negative effects. Alternatively, devaluation-induced increases in the prices of tradeables that are perceived to hurt consumers or farmers may be counterbalanced by governments which take 'accompanying measures' to reduce the price increases, such as reduction of tariffs on fertiliser in Mali and rice in Senegal following the 1994 devaluation of the CFA franc (Kante et al., 1995). Finally, devaluation can increase marketing costs and producer price risk, as in Madagascar (Barrett, 1999b).

The effects of market liberalisation can also be ambiguous. It could reduce commerce margins through competition, open up new output markets, and drive down farmgate input prices, thus improving profits (Kaufmann and O'Connell 1991). But market liberalisation can lead to increased *enclavement* of interior

markets, raising transport costs, prices of imported inputs, and price risk. The evidence in a variety of African rural areas points to concentration and market entry barriers that tend to produce greater price instability with liberalisation, and the ambiguous effects of devaluations on the profitability of input use for intensification (Barrett, 1997a, 1999b).

The limited evidence available suggests that where state intervention lowered the mean and variance of agricultural product prices, liberalisation has increased not only the expected prices but also price variability (Krueger et al., 1988; Barrett, 1997a). This can undermine farm investment even where it raises average medium-term output prices, because price instability discourages investments in quasi-fixed capital (Barrett and Carter, 1999). Price instability also reduces the rates of technology adoption, lowering the speed of inter- and intra-farm diffusion of yield-increasing technologies (Kim et al., 1992).

Sectoral policies' impacts on farmers' incentives for SAI

Taken out of the macro policy reform context, the effects of most sectoral price policies (taxes, subsidies, price controls) on output or input prices are unambiguous. But placed in a stabilisation context, the effects are uncertain. Sectoral policies can counterbalance macroeconomic reforms, and may even be designed to do so. However, the past generation of policy reforms have tended to celebrate macroeconomic policy and to subordinate sectoral policy, ending sectoral interventions in the interest of achieving fiscal balance, border parity pricing, etc. Sectoral interventions may nonetheless have important, overlooked 'crowding-in' effects, encouraging private investment in sustainable technologies. We now consider several specific sets of sectoral policies.

Fertiliser/seed policy. African fertiliser use is the lowest in the world and has even decreased over the past decade and a half, i.e., over the same period in which fertiliser and seed subsidies and cheap input financial services programmes have been reduced or eliminated. The effective interest rate for input acquisition rose sharply throughout Africa, as did fertiliser and seed prices. Case study evidence points to a connection between the reduction in fertiliser use and these rising input and financial services prices (Kelly et al., 1996; Rusike et al., 1997; Maredia and Howard, 1997). Moreover, there is growing evidence that private fertiliser and seed merchants have responded much less than was expected to the liberalisation of input markets brought about by the elimination of fertiliser and seed parastatals (Rukuni, 1996; Dembele and Savadogo 1996; Rusike et al. 1997).

Fertiliser markets in Africa are plagued by a series of fundamental problems such as risk, seasonal demand, high transport costs, underdeveloped financial services markets, and cash-constrained farmers. Small markets add to the problems by limiting economies of scale and product differentiation to meet

diverse needs. Moreover, economies of scale in fertiliser production make domestic production inefficient in most African economies, so domestic fertiliser prices are sensitive to macro trade and exchange-rate policies, and to volatile international fertiliser prices. While fertiliser subsidies and domestic fertiliser production schemes have generally proved ineffective in Africa, it appears clear that private market conditions in rural Africa cannot currently support the necessary fertiliser deliveries, so some role for government is inevitable in the short to medium term. Given the considerable costs of delivering fertiliser to farmers on time and the restricted availability of fertiliser to most farmers, investment in improved private marketing infrastructure seems to be one of the most promising roles for the state (Ahmed et al., 1989; Rusike et al., 1997).

Profitability entails the existence of both an effective market and a favourable output/input price ratio (Dembele and Savadogo, 1996). Only profitable commercial agriculture (even if small-scale, and of food or non-food products) induces investment by African farmers in inorganic fertiliser use, animal traction, use of organic matter, and soil conservation. For example, in Burkina Faso, farmers use 13 times more manure on cotton and maize, both cash crops, than on sorghum and millet, the main subsistence foodgrains (Savadogo et al., 1998). In Zimbabwe, farmers mainly use improved tillage practices and fertilisers where there are profitable cash crops (Mudimu, 1996). In northern Ghana, fertiliser use is low on average and very variable over farms, but tends to be applied only to crops for sale (hybrid maize, cotton, rice), and not on subsistence crops such as sorghum, millet, and cowpea (al Hassan et al., 1996). In the highland tropics of Tanzania, farmers confine fertiliser and soil conservation practices to cash crops (Semgalawe, 1998), as they do in Rwanda (Clay et al., 1998), and Kenya (Tiffen et al., 1994). Policy reforms and project-level interventions that make sustainable crops and technologies profitable contribute to environmentally sustainable agricultural intensification.

Financial services policy. Delivery of rural financial services was commonly linked to the parastatal distribution of seed and fertiliser and parastatal collection of marketed crop output. Elimination of public input and output distribution systems thereby not only increased variable input costs for small farmers in many areas, but also often raised effective interest rates for rural borrowers or eliminated their access to seasonal credit altogether. Many private merchants have found market entry or expansion difficult in the absence of public rural finance schemes unless they are able to offer consumer credit themselves (Rusike et al., 1997).

While the government parastatals were able to establish a functioning credit scheme by interlinking input and output markets, such a scheme is not necessarily available to private operators under present institutional and legal arrangements. In particular, the adverse partial equilibrium effects of state

monopoly or monopsony appear in hindsight to have been at least partly mitigated by the favourable general equilibrium effects of loosened rural liquidity constraints, only made possible by government market power that made interlinked credit-marketing contracts feasible.

In the wake of reduced rural credit volumes, smallholders rely increasingly on cash crop and non-farm earnings — through labour markets or small or medium-scale enterprises — to finance capital accumulation and to smooth consumption. However, these income sources usually exhibit high Gini coefficients and are distributed regressively — the biggest farmers also earn the most off-farm and from cash crops. So with the removal of the public input and equipment financing, access to alternative (usually self-) financing is often quite concentrated. The effect is concentration of the capacity to follow SAI among larger operators and commercialised smallholders only, leaving the mass of semi-subsistence smallholders to extensify, intensify unsustainably, or exit from agriculture (Reardon et al., 1994; Reardon, 1997; and Clay and Reardon, 1997).

While there is scant empirical evidence on the link between the demise of public financial services and the use of seed and fertiliser, even less is known about how the changes in the market for financial services have affected physical capital formation, such as of small-scale irrigation or animal traction equipment or post-harvest machinery. One hypothesis would be that the effective interest-rate increase undermines such farm investment (Lipton, 1991), but there have been few, if any, studies of this effect. Prices of physical capital items that are mainly imported in much of Africa (such as animal traction equipment, irrigation pumps, spare parts for vehicles, tractors, ploughs) are driven up by currency devaluation. This translates into higher costs for irrigation schemes, transport, and land conservation investments. We do not know of any studies of the price elasticity of African farm investment, but it is highly likely that the combination of financial sector retrenchment, contractionary monetary policy, and currency devaluation has discouraged investment in agrarian quasi-fixed capital. Of course, where such investments had already been made, the capital remained available and seems to have contributed in some places to the maintenance of sustainable intensification practices, as the case studies of Burkina Faso and Mali in the following section illustrate.

Stimulating rural finance is central to the promotion of capital-led, sustainable agricultural intensification. While some quasi-fixed capital investment involves considerable commitment of labour — e.g., bunding, terracing — there is usually a complementary commitment of purchased inputs. Moreover, inorganic fertiliser and tools must almost always be purchased. Given the considerable seasonality of agricultural incomes, capital-led intensification depends on non-farm earnings, cash-crop earnings, or the capacity to engage in intertemporal savings and borrowing. While state-directed rural credit schemes were often fiscally unsustainable and ineffective in serving

Africa's most credit-constrained smallholders, there is nonetheless a strong case to be made for state subsidisation of the initial start-up and training costs for self-sustaining rural financial institutions that can mobilise local savings and recirculate them within and across communities as loans (Zeller et al., 1997). **Land policy.** In the past decade land policy has mainly involved titling schemes, the gazetting of public areas, and some very limited land redistribution. The former would tend to drive up land prices, spurring intensification and long-term land improvement investments (Place and Hazell, 1993), and the latter would tend to increase the marginal value product of land use through a higher labour/land ratio, as smaller farmers would supplant larger farmers (van Zyl et al., 1995; Barrett, 1996; Byiringiro and Reardon, 1996). However, the impact of land tenure on technology adoption and investment is ambiguous in sub-Saharan Africa. Migot-Adholla et al. (1991) show that the impact of land tenure systems is blurred by many other structural factors (such as rural health, education, and infrastructure).

The burst of activity during the past decade in gazetting lands for protected areas increases tenurial insecurity for those living in environmentally sensitive areas. If farmers are less certain than before that the state will not appropriate their land for parks, reserves, etc., then they have less incentive to invest in the conservation measures required for sustainable agricultural intensification. The bitter irony is thus that pressures for environmental conservation may induce environmental degradation by threatening current operators' control over the land.

Back to the future: projects in lieu of policy? While public involvement in agriculture is *de-organising* with the dismantling of financial services and input parastatals, it is *re-organising* as public or NGO projects which are, essentially, mini-packages of policies that affect smaller groups on a temporary basis. These packages basically reproduce at least a subset of the pre-structural adjustment policies — extension services, subsidised 'microfinancial' services, subsidised equipment and inputs and marketing services, etc. These are often presented as 'demonstration projects' in areas where diffusion might eventually have a chance. Good examples include the Sasakawa Global 2000 projects in Ethiopia, Ghana, Tanzania, Mozambique (see Putterman, 1995; DE/MAP and DNER/MAP, Mozambique, 1998) and a variety of contract farming schemes (Little and Watts, 1994).

Many of these have succeeded in sharply increasing yields on participating farms, but only by circumventing the structural obstacles that often impede adoption of SAI methods. In other words, projects have delivered appropriate inputs directly to farmers on a timely basis, often with financial services, thus obviating potential bottlenecks in commercial distribution systems, and have ensured a market for the output. However, the results then often prove non-transferable outside the scheme, unsustainable once the scheme ends, or both.

And the schemes themselves may not prove fiscally sustainable on any significant scale.

Such projects demonstrate that African smallholders can achieve higher yielding, environmentally sustainable agricultural production. They also implicitly demonstrate how the weak state of rural factor and product markets mutes both incentives to intensify sustainably and the ability of governments and donors to alter those incentives effectively through macro or sector-level policy. While macro- and sectoral reforms may have been necessary to establish a stable macroeconomic environment, they have generally proved insufficient to remedy the underlying structural problems that induce unsustainable intensification and extensification.

Case-study illustrations

Sustainable intensification

In the cases in this section, the successes were demand-driven, in that profitable agriculture and relatively low-risk markets were linked to growing demand for the product. Buoyant global export markets combined with measures to make inputs and credit available (cotton in the Sahel), regional export markets combined with irrigation investment and devaluation to increase competitiveness (rice and onions in Mali), and urban markets combined with local value-added processing (bananas and banana wine in Rwanda).

Onions and rice in the Office du Niger in Mali (Mendez del Villar and Diakité, 1995; Coulibaly et al., 1995). In the 1980s–90s, the Malian government was investing in upgrading the irrigation infrastructure to create the capacity for a supply response to new incentives for rice and onion production in the Office du Niger.³ At the same time, it was moving out of the control of irrigation infrastructure maintenance, farmer production planning, and output and input marketing, paving the way for the development of the capacity of private merchants to react flexibly to new incentives. These came in the form of the 1994 devaluation of the CFA franc, whereby both rice and onions produced by Office du Niger farmers became much more competitive within Mali and the West African region, and net returns to production were increased.

The new incentives plus the improved infrastructure allowed double cropping (rice followed by onions), which significantly increased total farm income, and

3. Much of the infrastructure improvement was financed by loans to the government, the repayment of which is costly. The World Bank, among others, views this as a subsidy to the farmers, and there is a movement under way to recover the costs from farmers, which would reduce but not eliminate the new profits.

thus increased the productivity of government investment in infrastructure and the motivation and capacity of farmers to maintain it, and improved cash flow so that farmers are better able to purchase fertiliser and farm equipment, permitting significant intensification. The increased volume of production plus the market liberalisation attracted private merchant investment as well.

Bananas in Rwanda (Byiringiro and Reardon, 1996; Kangasniemi, 1998; Clay et al., 1998). The development of rural towns and higher incomes increases the demand for processed products, which provide profits for local farmers supplying the inputs and for rural households undertaking the processing in their homes. The case of bananas and banana wine in Rwanda is one where structural change (rural town development and increased pressure on land), not policy reform, has been important for sustainable intensification.

The profitability of banana production is substantially greater than alternative land uses (except coffee), and this creates an incentive for intensification, which is magnified by the decreasing availability of land in the Rwanda countryside, where population pressure is high. Although there is a gestation period for the bananas to become established, food crops can be grown around young bananas, so that even the poor can tolerate the gestation period, which is not true of some other cash crop perennials. Over the past two decades, therefore, there has been a rapid rise in banana cropping in Rwanda. As they are grown on the small hillside plots, bananas provide much more protection than other crops against erosion, which has become a major concern of Rwandan peasants. Moreover, banana wine is an important source of non-farm income for rural households, with low participation requirements for the poor, thus enhancing overall food security.

Cotton/maize zones in Burkina Faso and Mali (Dioné, 1989; Savadogo et al., 1995, 1998). Enhanced profitability and reduced risk (relative to traditional millet/sorghum production options) were assured via fertiliser and seed subsidies and credit, and guaranteed output markets for cotton farmers in the Guinean agroclimatic zones of these two countries. These were/are administered via vertically co-ordinated, mixed public/private firms linked into a global market for cotton — a system which led to rapid expansion of the area planted to cotton in Mali and Burkina Faso in the 1970s–80s. At the same time, public programmes were set up to help cotton farmers acquire the capital to increase their capacity to respond to the incentives (via animal traction equipment programmes with financial services to facilitate purchases).

Farmers reacted to this public/private promotion of their incentives and capacity by both cotton planting (extensification via expansion of the planted area) and intensification of production on areas of adequate soils, with relatively large amounts of fertiliser, organic matter, and animal traction used on both cotton and the rotation crop, maize. Moreover, there were ripple effects from

cotton (cash generation and equipment acquisition) on to the input acquisition and productivity of maize farming.

Unsustainable intensification or extensification

In most of the cases that follow, policy reforms did not create the adverse conditions that sparked unsustainable intensification or extensification. Liberalisation simply exposed long-standing structural impediments. Low population densities and high import costs made infrastructure expensive, climate variability increased output and input market risk, scant cash savings and limited marketed volumes begat thin rural financial markets, etc. But at great expense (to the state and to donors) widespread efforts were made to overcome these obstacles through subsidies (to output marketing, inputs, financial services, storage, and transport). By the mid 1980s, however, these had proved fiscally unsustainable. Schemes tied to profitable export or domestic markets (e.g., cotton in the Sahel, as discussed above, or horticulture in Kenya and Zimbabwe) or to politically powerful producer strata, such as large farmers in Zambia and Zimbabwe (Rusike et al., 1997), were often left undisturbed, or even enjoyed expansion because previous investments in capacity enabled a robust response to the new incentives created by macro policy reforms.

The story was very different, however, for the broader swathe of producers: smallholders producing grains, roots, and tubers under rainfed conditions for domestic markets. Whereas the cases of SAI among this stratum of producers before the market-oriented policy reforms basically occurred in public imitations of private/public cash crop schemes, when the subsidised element of these schemes was withdrawn there were cuts in input and output market coverage and increases in input and financial services prices and in risk exposure. The result was a return to extensification, a shift toward capital-deficient intensification, or both.

Rice in Madagascar (Barrett, 1995, 1997a,b, 1998, 1999a). Until the economic reforms of the 1980s, the state controlled rice prices, keeping them low and stable, as in most low-income countries (Krueger et al. 1988). With the reforms, decontrolled output prices rose and became more volatile, due in part to sharp exchange-rate devaluation and in part to the deteriorating state of the private marketing infrastructure and financial markets. Fiscal cutbacks effectively ended rural roads maintenance, and reduction in public credit further increased price volatility and reduced the access of smallholders to cash for inputs.

The increased mean and variance of rice prices induced Malagasy rice producers — most of whom are net rice purchasers — to stimulate output by expanding the area under cultivation through further shortening of fallow periods and extensification into fragile forest margins. Moreover, cash constraints and the effects of devaluation on imported inputs reduced even

further the traditionally low fertiliser use, further disintensifying production and forcing extensification.

Maize in Zambia and Zimbabwe (Howard and Mungoma, 1997; Eicher, 1995; Rusike et al., 1997). Before the structural adjustment programmes of the second half of the 1980s and the first half of the 1990s, the governments in these countries had undertaken massive investment in rural feeder roads and depots to provide reliable market access, subsidised farm credit programmes, subsidised fertiliser and seed inputs, and expanded extension services to smallholders — conditions that in the early 1980s provided the incentive and capacity for smallholders to adopt long-available hybrid maize varieties. This technology was essential to SAI among smallholders in the most environmentally fragile areas, and there was a boom, a local Green Revolution. However, neither could afford the public expenditures demanded by the depot provision and the subsidies to seed and fertiliser and financial services, and under pressure from international financial institutions concerned about fiscal deficits, the system was dismantled in the second half of the 1980s and early 1990s.

Following the reforms smallholders in both countries have shifted away from fertiliser use on maize and towards 'labour-led' intensification which threatens soil fertility. Private smallholder output and input markets are slowly emerging, but it is too early to tell how widespread and successful this will be and whether it will render sustainable intensification economically profitable again for the smallholder majority.

Peanuts in the Senegalese Peanut Basin (Kelly et al., 1996; Gaye and Sène, 1994; Diagona et al. 1995, 1996). Seed, fertiliser, and credit subsidies and animal traction equipment programmes greatly reduced the input and equipment costs of peanut farmers in the Senegalese Peanut Basin in the 1970s and early 1980s. This fostered sustainable intensification as input use per hectare climbed sharply in the production of peanuts sold as a cash crop in a guaranteed export market. Liberalisation brought the removal of these government subsidies and guarantees. This led to a relative dis-intensification of peanut production and a precipitous decline in the use of inorganic fertiliser, in part in response to decreases in the expected profitability of improved input use due to changes in subsidy and financial services policies in the 1980s. It also reflects a risky and deteriorating physical environment, as a result of low and variable rainfall, plus decades of continuous peanut/millet cultivation with limited use of fallow, organic matter, and chemical fertilisers.

Following the sharp drop in fertiliser consumption during the 1980s, farmers began increasing peanut seeding densities to improve yields and incomes, at least in the short run, and to compensate for the declining soil quality which they believed was slowing down the growth of peanut ground cover and

therefore causing weed problems. Survey data show that many farmers are using more than twice the recommended quantity of seed per hectare. Although raising seed density appears to be a logical short-run solution, agronomic research suggests that it is not a sustainable practice. Without supplementary fertiliser and organic matter, increased seeding densities not only lead to further soil mining but also undermine seed quality over time.

The 50% devaluation of the CFA franc in January 1994 failed to break this vicious circle in the Peanut Basin, mainly because producer prices did not rise sufficiently to offset the increased costs of imported inputs. Nor has it reversed the pre-devaluation problem of low fertiliser use and movement towards higher peanut seeding densities. Constraints on access to peanut seed, fertiliser, equipment, and financial services have limited the post-devaluation supply response in the peanut subsector in Senegal.

Summary and conclusions

The central claim of this article is that policy reforms have had ambiguous effects on sustainable agricultural intensification in Africa, broadly defined as adequate use of inorganic fertiliser, organic matter, and agrarian capital such as soil conservation structures and equipment and irrigation. In an exceedingly capital-constrained continent, SAI is clearly a challenge, and at present most African smallholders appear not to be choosing sustainable paths, hence the interlinked crises of rural poverty, declining per capita agricultural productivity, and environmental degradation. Nonetheless, the vicious circle can be reversed by means of appropriate ancillary investments. Most needed technologies are available already. The key lies in giving African smallholders the capacity and incentives to choose sustainable expansion paths. To date, however, the policy community has focused excessively on macro-level reforms that have, at best, simply laid bare underlying structural weaknesses in rural markets and, on occasion, have reversed policies that induced sustainable intensification. A generation of policy reforms have generally proved blind, not neutral, to their likely net effects on smallholder production practices.

Evidence has been presented of a mixed record of recent policy reforms on African farmers' incentives and capacity to undertake investments prerequisite to SAI. This mixed record of effects on incentives and response capacity has translated into a mixed record of sustainable intensification. The success stories of continued or induced SAI occur where necessary investments were previously made, or continue to be made, through projects in farm-level capital investment, and where market proximity and satisfactory infrastructure enable markets to function reasonably well. Where state or NGO interventions have resolved structural weaknesses in factor or product markets or established an agrarian capital base, farmers enjoy incentives and have the capacity to pursue

SAI as demonstrated by case studies from Burkina Faso, Mali, and Rwanda.

Unfortunately, many of Africa's poorest smallholders live in relatively remote areas, poorly served by infrastructure, financial institutions, or public services, and faced with poor and volatile terms of trade. In their daily struggle against food insecurity and poverty, the capital-led path to SAI remains inaccessible, often leading to a vicious circle of immiseration and environmental degradation. In such settings, liberalisation too often exposed the fundamental structural weaknesses of the rural economy and induced a return to environmentally dangerous extensification, in Madagascar, or to unsustainable, capital-deficient intensification, in Senegal, Zambia, and Zimbabwe.

The issue, then, is how to reverse the decline in conditions for the broad mass of smallholders producing cereals, tubers, and roots under rainfed conditions for local markets. To a large degree this will involve policies that encourage private investments, supported by public infrastructure, institutions, and goods, to improve the state of rural factor and product markets. Heavy-handed government interventions in marketing systems proved to be fiscally unsustainable failures in most of Africa. But the necessary state support services for private marketing have too often been thrown out with the parastatal bathwater in the course of economic reform programmes. We argue that the state needs to steer a middle course between relying solely on liberalisation, which has not delivered the goods, and heavy interventionism. The selection of the needed public investments in physical infrastructure and institutional change will need to be made in a country-specific fashion, supported by cost-benefit analysis which has only rarely been undertaken since macrocentric reforms began almost twenty years ago.

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