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JANUARY 2006 • DIVISION FOR RURAL DEVELOPMENT

What can sub-Saharan Africa learn from Asian experiences in addressing its food crisis?

Addressing Food Crisis in Africa

Preface

This report is dedicated to our friend and colleague Rolf Larsson who tragically died in late 2004.

The report contains a summary of research made by Rolf Larsson and ourselves as part of a research project financed by the Bank of Sweden Tercentenary Foundation and Sida. For a more detailed report see Göran Djurfeldt, Hans Holmén, Magnus Jirström and Rolf Larsson (eds.) *The African Food Crisis: Lessons from the Asian Green Revolution*, London, CABI Publishing, 2005. We acknowledge the contribution by Mikael Hammarskjöld.

Lund and Linköping, February 2005

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Executive summary

Much writing on Africa presents a gloomy picture of the region's current situation and future prospects. The inability of Sub-Saharan Africa (SSA)to feed its growing population in particular, and tales of 'soft states' and corrupt governments, unwilling or incapable to deal with the situation, belong to the standard narrative about SSA.

This has not always been so. On independence most of SSA was self-sufficient in food. In less than 40 years, SSA has gone from being a net-exporter of basic food staples to relying on imports and food aid. During the same period output per capita in Asia has increased due to successful implementation of Green Revolutions and this once food-deficient region is now characterized by food-surpluses and even exports.

This booklet looks at the African food crisis against the background of the Asian experience. Our starting point is the fact that 30 to 40 years ago the Asian food situation was depicted in the same alarmist terms as is that of SSA today. Also, the concept of 'soft states' – lacking the social discipline to carry out policies – was originally reserved for Asian governments. The question we asked ourselves was: 'What are the prospects for a Green Revolution in Africa?'

Today the Green Revolution no longer seems to be *comme il faut*. It is commonly depicted as a narrow technological package (seed, fertilizer and irrigation), concentrating on wheat and rice. It is widely criticized for having negative social and ecological consequences and, in any case, due to different agro-ecological preconditions (e.g. limited irrigation potential), it is often deemed unsuitable for Africa. We found this critique to be largely exaggerated and beside the point. From a technological perspective, the green revolution has expanded and now includes crops (e.g. maize, sorghum, beans, cassava, bananas), which are important in SSA. As for its social consequences, the critique has often been based on assumptions and/or observations from the early days of the Asian Green Revolution. Most initial adversities have been overcome since then and there are reasons to be optimistic about the Green Revolution's poverty reducing potential.

Green Revolution goes far beyond technology. Based on the Asian experience, we interpret the Green Revolution as a *state-driven, market-mediated and small-farmer based strategy to increase national self-sufficiency in food grains*. In order to understand why so many Asian governments assumed a leading role in developing the food chain, we point to the crucial geo-political dimensions surrounding the Asian Green Revolutions.

Our investigation is based on an historical and comparative study of agricultural development in seven Asian countries and on secondary sources and interviews with key informants. For the African part of the study we have undertaken case studies in eight countries in SSA: macro studies based on secondary data and interviews with key individuals and, to complement this, village surveys and questionnaires involving more than 3,000 smallholders in 103 villages. In order to reflect the dynamism, we chose regions that are above average in terms of ecological and market (infrastructure) endowments but excluding the most extreme cases in this regard. Nevertheless, our areas of investigation can be said to be typical of the kind of environment in which a majority of SSA smallholders reside, yet sufficiently diverse to yield information about crucial conditions responsible for farmer performance.

Although the overall pattern of agricultural change is complex and varied, it is still possible to identify a sufficient set of common features to outline a particular development path for agriculture in Asia. Beginning in Japan during the Meiji-period (1868–1912) and subsequently followed in other countries in the 1960s and 1970s, Asian governments came to realize that agriculture and, especially, food production, had to be stimulated rather than squeezed if these countries were to maintain independence. Also, growth in agriculture was seen as the only realistic way to finance industrialization and modernization. Asian governments set out to stimulate food production by way of credit provision, subsidies and introducing remunerative price policies, investing in irrigation and transport infrastructure, and investing in research and extension services in order to develop and disseminate high-yield seed varieties (HYVs).

These governments assumed a leading role in agricultural development, with the result that administratively-regulated markets became the norm. However, markets were not nationalized nor were private traders eliminated. Often, Green Revolutions were initiated in high potential areas where returns on investments were high. This enabled further investment and expansion to other regions at later stages. For this reason – but also due to migration and interregional factor market adjustments – initial regional inequalities did not increase as much as the early critics had predicted.

Almost simultaneously, though apparently without any connection between them, governments in India, Indonesia and the Philippines made U-turns in agricultural policies with the introduction of Green Revolution policies in the 1960s. Generally, these and other similar steps represented a break not only with previous policies (which aimed at keeping food prices low for the urban population) but also with the prevailing orthodoxy in development thinking. How can we explain the recurrence of such dramatic policy shifts?

In several countries, population growth, limited availability of farmland and widespread poverty resulted in food-riots and social unrest. The fact that the regimes' survival was threatened by domestic opposition partly explains the policy shifts. In order to remain in power, existing governments (e.g. in Japan and India) changed policies to promote domestic food production and to improve the situation for the small farmers who generally became the back-bone of the new agricultural programs. In the Philippines, Ferdinand Marcos was elected president in 1966 on a platform aiming to encourage domestic rice production. In other cases (e.g. in Indonesia) military coups enabled the new leaders to break with previous policies and aim for the same goal. In some cases (e. g. in Japan, Taiwan and South Korea) land reforms benefiting smallhold-

ers were implemented. As a result governments commonly gained widespread support from the poor majority of the population.

External geopolitical factors were equally important. After Independence in 1947, India was unable to feed its population without importing wheat from Pakistan – which had been part of India before Partition. After the outbreak of hostilities over the control of Kashmir, the Indian food security situation worsened and it became increasingly important to opt for national food self sufficiency. Geopolitical conditions were crucial in South Korea and Taiwan. Under threat of invasion from North Korea and China respectively, the South Korean and Taiwanese political elites gained a wide autonomy permitting them to implement reforms that under other circumstances might have been successfully resisted by vested interests.

This was the time of the 'cold war' and the US government feared that 'overpopulation', poverty and food insecurity would fuel communist revolutions in Asia. From an earlier stress on food exports, nicely tailored to domestic concerns with overproduction of wheat (e.g. the PL 480 program), the US moved to stress export of technology rather than export of surplus grain. Both directly and indirectly (e.g. through the Ford and Rockefeller Foundations) the US government invested heavily in developing and disseminating new high-yielding crop varieties in order to enhance food availability. These technologies were freely available to Asian governments, a circumstance that contributed significantly to their high adoption rates.

Moreover, the world market price for cereals was high and imports expensive. This not only dramatically enhanced the importance of policies aiming at national self-sufficiency in food crop production, it also made it economically sound to pursue subsidies and price policies. Hence, a number of domestic and external (geopolitical) factors working simultaneously contributed to the policy U-turns undertaken and to the determination with which governments in Asia carried out their new green revolution policies.

It is frequently claimed that the currently dismal food security situation in Africa is due to the fact that 'the Green Revolution never reached Africa'. Partly, this is believed to be so because Green Revolution technologies have not been suitable for SSA, partly because African governments have neglected agriculture. However, the problem with African food production is neither technology (i.e. wrong crops) nor nature (i.e. poor soils and erratic rainfall). Nor yet is the problem that African governments have been reluctant to engage with the agricultural sector. On the contrary, there have been repeated attempts at state-led intensification. Nevertheless, during the last decades attempts to implement Green Revolutions in SSA have seen short-lived spurts of production rather than lasting improvements in productivity. Instead of asking 'Why have Green Revolutions been absent in Africa?', we need to ask 'Why have Green Revolutions not been sustained in Africa?'

One part of the answer is that few suitable crop varieties were available until the 1980s. But the main reasons are policy related. In order to grasp agrarian policies in SSA we need to take a closer look at the situations in which African policies have been pursued.

At the time when Asian Green Revolutions were initiated, the situation is Africa was quite different. Africa is often said to be under-populated and its often low population densities make infrastructure investments costlier and slower to realize than in, for example, Asia's more densely populated major Green Revolution regions. Until the mid-1970s

– in some cases until the 1980s – most countries studied were considered self-sufficient in food crop production and there seemed to be no great need to pay special attention to the food sector. With no permanent food problem and with virgin lands still available, the pressure to change established ways of production (and accompanying social institutions, etc.) was much lower than in Asia. To a large degree, African governments' priorities differed from those of their Asian counterparts.

The situation changed dramatically in the 1970s due to a series of internal and external shocks. Population growth and droughts increasingly strained food security. Most governments' budgets were affected negatively when oil prices quadrupled in 1973. A major drop in the price of copper in 1974 hit Zambia adversely. In various ways SSA governments committed themselves to developing food-crop agriculture and, hence, assumed a leading role in agricultural development. Public investment in the agricultural sector was generally high. As in Asia, the state provided credit and assumed responsibility for supplying inputs and handling produce through state-led cooperatives and marketing boards. Crop research programs were initiated and new high-yielding maize varieties were released.

In contrast to most Asian cases, private trader involvement was constrained or eliminated.

This enabled governments to:

- regulate prices;
- offer minimum price guarantees;
- offer pan-territorial pricing; and
- provide inputs such as seed and fertilizer at subsidized prices to a largely subsistence-oriented smallholder peasantry, which suddenly had access to external resources as well as 'markets'.

Nonetheless, in contrast to the Asian Green Revolution, farm-gate prices were suppressed and yield improvements were generally modest. Fixed prices squeezed the margin between cost of production and revenue from sale of produce for both smallholders and (public) traders, thereby reducing the incentive to produce a marketable surplus.

With governments' priorities increasingly emphasizing low (urban) consumer prices rather than improved (rural) producer prices, the result was maintaining the *status quo* rather than agricultural development. Surplus production under these circumstances was not always attractive and, where conditions deteriorated too far, smallholders were reported to have withdrawn into subsistence production. With parastatal organizations and marketing boards operating at a loss whilst subsidy costs mushroomed, this policy became economically unsustainable. Also, the whole endeavor turned out to be bad business for governments and the costs of upholding the system skyrocketed at the same time as governments' revenues deteriorated. From the mid-1980s to the mid-1990s Structural Adjustment Policies (SAP), aimed at reducing the role of the state and enhancing that of the private sector, were imposed upon most SSA governments. It was presumed that this would spur agricultural intensification and more general development.

But the results have not matched expectations. On the whole, farms in SSA remain small, both when measured totally and per crop. Fields are mainly worked by family members with women performing the bulk of farm labor using simple hand tools. Both average production and

yields of the major food staples (maize, rice, sorghum and cassava) are low although there are variations both regionally and within the same village. A small number of farmers (the top performing five percent) obtain yields substantially higher (double or triple) than the majority of farmers. These yield-gaps show that vast potential for agricultural growth exists in contemporary SSA – a potential that is insufficiently tapped.

Notwithstanding regional variations and recycling of hybrids, adoption rates for high-yield seed varieties are high, notably in the case of maize. In fact, adoption rates in SSA appear to be higher today than was the situation in South Asia in the 1970s. This suggests that technology is not as constraining as may be generally assumed. Conversely, after SAP most smallholders can no longer afford to purchase fertilizer. So the use of chemical fertilizer is extremely low: in the case of maize, more than half the farmers in the sample did not apply any chemical fertilizer during the 2002 season. For those who could afford fertilizer the average application rate was only 14 kilos per hectare. The amounts applied were even smaller for other crops. Potential yields of hybrid seeds cannot be realized without fertilizer.

Consequently, only about ten percent of the households surveyed produce a marketable surplus of food, whereas more than half the households interviewed fail to produce enough food to cover their consumption needs and are therefore net buyers of basic food items. Households may secure their food and income to buy food from sources other than staple crop production, e.g. sale of cash crops or working off-farm for cash. Such income is generally small and does not suffice to alter the persistent poverty and food insecurity situation affecting the majority of farm households interviewed.

A number of economic, political and institutional factors at regional, national and international levels hold back the performance of African smallholders. Under present conditions, only a small number of wealthy households have access to the resources and the financial security that make it possible to improve yields, raise production and market anything but a marginal surplus. The performance of these farmers and the gap between them and the majority clearly shows that the African food crisis is policy related.

It is a commonplace to 'explain' Africa's lack of development by stating that African political leaders have been (and perhaps still are) crooks and kleptocrats, who do not care about development and whose only ambition is to enrich themselves by appropriating public resources. Yet this is not a satisfactory (and definitely not a sufficient) explanation. After all, corruption and malpractice were also common in Asia. But that did not prevent the Green Revolution being implemented there.

African governments do not control their national territories to the same extent that Asian governments do – and did. The various African programs for agricultural development released in the 1970s had a double function. They were aimed partly at development and partly at nation building, i.e. the consolidation of state power. By providing agricultural inputs (and at the same time eliminating alternative suppliers) and by guaranteeing 'fair treatment' in the form of pan-seasonal and pan-territorial pricing for inputs and produce, a then-young African state could show its good intentions and, possibly, gain widespread legitimacy. The approach was often more benign than in Asia as indicated, for example, by the frequently accepted low loan-repayment ratios and cancellation of agricultural debts.

At the same time, the servants of the enlarged state apparatus became a substitute for the social base that the African State did not (yet) have. The state often turned a blind eye to malpractices and inefficiencies. Parallel to this, in order to reach out and extend the 'controlled' territory, local bosses, clan leaders and village headmen were co-opted into the clientelistic networks of the state, *viz*. indirect rule continued. The then-young governments had to buy their way into the countryside. Whereas in Asia governments expanded their room for maneuver by 'disciplining' factional interests, in SSA governments much less successfully tried to gain strength by allying with them. Hence, there were few efforts to transform prevailing structures.

While supposedly credit and inputs were distributed evenly and fairly among the peasantry, experience tells a different story. More often than not scarce resources were distributed to the politically well-connected, which often meant to large farmers, to loyalists and to the regimes' cronies, who often had nothing to do with farming. The result was a dual structure comprising, on the one hand a small group of 'modern' often well-connected and sometimes absent, commercial farmers and estate owners and, on the other hand, a vast majority of low-productivity, semi-subsistence oriented smallholders growing traditional varieties using only small amounts of fertilizers and improved seeds. In other words, agricultural modernization policies in SSA have not been smallholder based and, hence, have had no revolutionary impact.

Invariably, SAP was meant to result in a complete turnaround of the economy away from state-led development to a market economy. Government was to become the enabler rather than the manager. Implementing SAP, in many cases, meant a renewed priority for agriculture. However, in most cases, emphasis was not on staple food production but on export crops. Nevertheless, farmers initially responded favorably to the policy changes and production increases were sometimes substantial. Since deregulation came gradually, and since elimination of subsidies often followed other reforms with some delay, much of the initial positive impact of SAP appears to be related to the combination of deregulated markets and temporarily retained subsidization.

In the longer run, and almost without exception, it appears that SAP was no panacea for food self-sufficiency in SSA. Whereas large commercial farmers have found opportunities to diversify, smallholders remain 'stuck with maize' and have been progressively marginalized from, rather than integrated into, the liberalized market. Markets remain undeveloped, most smallholders can no longer afford chemical fertilizers and yields remain low, much below their potential. This has disrupted reform programs and played havoc with the legitimacy of governments meant to implement them. To varying degrees a growing number of African governments have turned away from market-based policies and are trying steadily to bring the state back in. We found several indications that governments in SSA today are moving towards taking on a role in agricultural development comparable to the one played by Asian governments carrying through the Green Revolution in the 1970s.

It can also be argued that the circumstances surrounding such a policy U-turn are more favorable today than they have been hitherto. Technologically, the Green Revolution is now much more Africa-friendly than was the case only two decades ago. The fact that development aid has declined since the end of the cold war, means that governments must make renewed efforts to develop their countries' internal resources. Population growth and increased food insecurity means there is pressure

from below calling for implementation of more smallholder-friendly policies, especially in the food-crop sector. Currently SSA is less 'under-populated' than it used to be. In large parts of SSA, the land frontier has been reached or is about to be reached. This means that the time is ripe for intensification rather than extensification. In many ways the present situation resembles that of Asia when Green Revolutions were launched there.

However, there are also a number of circumstances which seem to reduce opportunities for an African Green Revolution. Due to World Trade Organization (WTO) regulations, the scope for African governments to protect their agricultural sectors are much more restricted than they were in Asia in the 1960s and the 1970s. Governments' ability to engage in agricultural development is reduced because aid to agriculture has declined even more than development aid in general. Crop research results are no longer considered public goods today but are disseminated (by US and EU-based Trans national corporations) on a commercial basis, dramatically increasing the costs of an African Green Revolution. Moreover, world market prices for cereals are presently at the lowest level ever recorded. This makes it economically less rational for financially-squeezed governments in SSA to pursue costly subsidization policies. However, world-market prices for cereals are artificially low due to subsidized overproduction in the US and the EU which tend to dump their 'surpluses' in poor countries. This further reduces the prospects for SSA attaining food security by independently.

We end on a positive note because, although the food situation in SSA is bleak and growing worse, our analysis shows that it is indeed possible, by means of policy measures on the part of African governments and the international community, to reverse the downhill slide. However, as the analysis implies, this requires policy interventions at several levels, including international trade regimes. This is a challenge to, among others, the Swedish government. Their stress on policy coherence gives grounds to work not only with aid, but also with trade and agriculture policies to further the goals of global sustainable development.

1. Food crisis in sub-Saharan Africa – the relevance of Asian models

Today much writing on Africa presents a gloomy picture of the region. Sub-Saharan Africa (SSA) seems haunted by the Malthusian ghost, and reports abound about the sub-continent's inability to feed its growing population. Tales of rapid population growth, alarming rates of land degradation, chronic food shortages and threats of famine, as well as of 'soft states' and corrupt governments, unwilling or incapable to deal with the situation, belong to the standard narrative about SSA.[1] Added to this we have the HV/AIDS epidemic, which has not only reversed positive development trends in health and education, undermining other development efforts, but also compounded problems of food security.

This has not always been so. At the time of independence, most of SSA was self-sufficient in food. In less than 40 years, the subcontinent has gone from being a net-exporter of basic food staples to reliance on imports and food aid. Since independence, agricultural output per capita has stagnated and, in many places, declined. SSA is the only major region on earth where cereal production per capita was lower in 2001 than in 1961. The stagnating or falling per capita cereal production in SSA over the last 40 years is in great contrast to the development in East, South-East and South Asia. Comparing the first and last five-year annual averages during the entire period, 1961–2001, per capita output in Asia grew 24% and decreased 13% in SSA. One question that presents itself is whether there are lessons to be learnt from the Asian experience that could benefit food security in SSA. We believe there are.

This booklet, summarizing the findings of a three-year research project,[2] looks at the African food crisis against the background of the Asian experience. The starting point for the study is the fact that 30–40 years ago the Asian food situation was depicted in much the same alarmist terms as is that of SSA today. The 'population bomb' was ticking in the 1960s, especially for Asia. The concept of 'soft states' – lacking the

[1] To facilitate reading we have excluded references from the text. For those interested, references for respective chapters are found at the end of each chapter.

[2] The research is carried by researchers from Lund and Linköping Universities in cooperation with the International Institute of Tropical Agriculture (IITA), Ibadan, Addis Ababa University, Nairobi University, the Centre for Basic Research (CBR), Kampala, Sokoine Agricultural University, Morogoro, Centre for Social Research (CSR), University of Malawi, Zomba, Institute of Economic and Social Research, University of Zambia, Lusaka, the Institute of Statistical Social and Economic Research (ISSER), Accra, the Nigerian Institute of Social and Economic Research (NISER), Ibadan. The project is funded by the Bank of Sweden Tercentenary Foundation and Swedish International Development Cooperation Agency (Sida). For more detailed results of the reseach project, see G. Djurfeldt, H. Holmén, M. Jirström and R. Larsson (eds.) The African Food Crisis: Lessons from the Asian Green Revolution, London, CABI Publishing, 2005.

social discipline to carry out policies – was originally reserved for Asian governments. Paradoxically, the expression was coined at the same time as these states broke their 'vicious circles' and launched the Green Revolution. Since then, Asia has been largely successful at famine prevention and a number of then food-deficient countries are now food exporters. It is commonly forgotten that the narrative that was standard in Asian studies then is now preserved for SSA. Thus the question is: If Asia could do it, why not Africa? Or to express it another way: What are the prospects for a Green Revolution in Africa?

The controversial Green Revolution

There are several reasons why the Green Revolution no longer seems *comme-il-faut*. The Green Revolution is criticized for having severely skewed socio-economic consequences. In the 1960s and 1970s, critics foresaw a forceful polarization of the agrarian structure. However, later research has shown that these apprehensions were not realized. Actually, smallholders appear to have benefited more than large farmers. So there are reasons to be optimistic about the Green Revolution's poverty reducing potentials.

A commonly spread 'truth' is that a Green Revolution unavoidably leads to a loss of biodiversity. However, in many places rice monoculture long pre-dated the Green Revolution. It is also questionable whether a Green Revolution actually does lead to loss of biodiversity. The Green Revolution's high yields have had a dramatic conservation effect by saving millions of acres of wild-lands all over the developing world from being cleared for more low-yield crops. Additionally, farmers in most Asian countries plant a wider variety of crops today than was the case in 1970, i.e. overall cropping diversity seems to have increased since the green revolution began.

Since its introduction in the 1960s, the Green Revolution has been moving in a more environmentally friendly direction than critics usually want to admit. It is now more adaptable to different local agro-ecologies than critics tend to assume. So, not only is today's Green Revolution more environment-friendly generally, but it is also more Africa-friendly than it used to be. In any case, an alternative, 'spontaneous', demand-driven, fully smallholder-owned intensification process from below is not necessarily ecologically sustainable.

Soil-mining agricultural practices are frequently reported in SSA at the same time as the subcontinent is said to have been bypassed by the green revolution. Most likely, such intensification will also be too slow a process to solve the problem. What SSA needs is agricultural growth substantially higher than population growth rate or at least four percent annually for the coming 10–20 years. Alternative methods such as Low External Input Agriculture (LEIA) have the potential to increase food output by only about one percent a year, or roughly the rate observed over the past 20 years. Hence, it is questionable whether the necessary productivity increases can be achieved without a green revolution.

Other critics argue that peasants in SSA should not opt for increased production of staple food-crops, i.e. a Green Revolution. Instead, they recommend a shift towards diversification, cash-crop exports, and extra-agricultural income generating activities. One may ask whether this reflects a concern for farmers' well-being in the north rather than in the south as experience from Asia (and Europe), indicates that enhanced productivity in food crop production is the key to successful development in other sectors.

A Green Revolution for Africa?

Critics argue that a Green Revolution would not be the solution to the African food-crisis. This, the argument goes, is so for several reasons. One line of critique points out that development 'packages' cannot be transplanted wholesale from one continent to another. Others critiques underline that no single strategy drawn from the Asian experiences should be considered optimal for most or perhaps any African country. We can only agree with this. But it does not mean that nothing could or should be learnt from the Asian experience(s). A part of the problem seems to be that both critics and protagonists of the green revolution often have a rather narrow vision of the phenomenon. The FAO, for example, defines the green revolution as 'the incorporation of scientific advances in plant breeding with technological packages that have allowed the yield potential of the crops to be realized more fully.'[3] While it is correct that technology was an important ingredient of the 'package', *the Green Revolution goes far beyond technology*.

The narrow focus on technology has made a large number of writers claim that the Green Revolution technology is not suitable for Africa (alternatively, that Africa is unsuitable for the

Green Revolution). This, they say, is so because it has focused too narrowly on the wrong crops – wheat, rice and maize – and/or because it depends too heavily on irrigation, for which SSA has a limited potential. That does not prove that the Green Revolution is inappropriate for SSA, it merely indicates that it has to differ, at least technologically. Contrary to what might be expected, National Agricultural Research Systems (NARS) in SSA as well as the total number of researchers have grown at an impressive rate during the last decades. Recent studies report improved effectiveness of agricultural research and show that investments in agricultural research in Africa may yield as high returns as such investments in Asia or Latin America. A review of past achievements shows an outstanding success of technological agricultural research in Sub-Saharan Africa.

Figure 1. Examples of successful technological agricultural research in Sub-Saharan Africa

- The generation and diffusion of improved, higher-yielding, maize Open Pollinating Varieties (OPVs) in Western Africa and hybrids in Eastern and Southern Africa
- Hybrid sorghum in Sudan and Zimbabwe.
- Semi-.dwarf rice for irrigated regions in West Africa
- Early maturing cowpeas in West Africa and disease-resistant sweet potatoes in Eastern and Central African highlands.
- New virus resistant banana varieties, and
- High-yielding, mosaic-resistant cassava varieties.

This shows that, nature is less of an obstacle than often claimed and that a range of improved technologies and crop varieties are now available making the Green Revolution more suitable for Africa than it previously was.

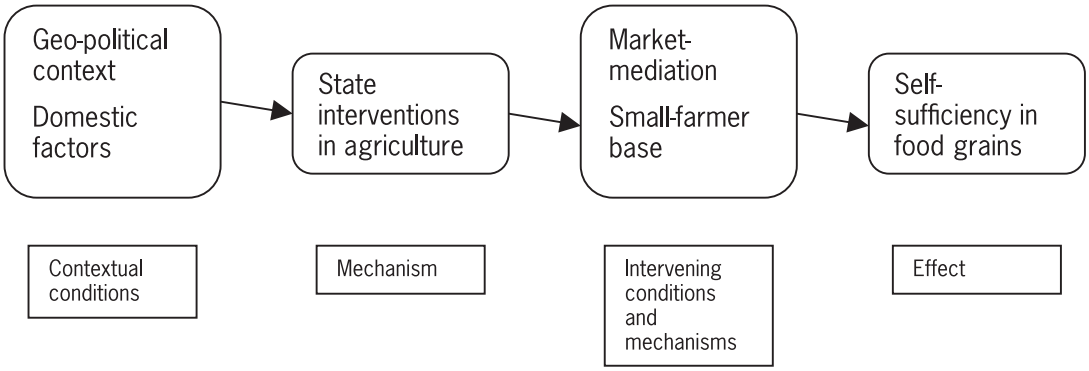
[3] FAO Lessons from the Green Revolution: towards a new green revolution, World Food Summit, Technical background document No. 6, Rome, FAO, 1996:1

A model of the Green Revolution

As mentioned above, the Green Revolution is too narrowly defined when seen as merely a 'package of technology'. History is full of examples where technologies have been known but not used. Adoption of technology depends not only upon its availability but also on prevailing circumstances. Furthermore there are actors involved, the options and strategies of which influence utilization and adoption rates. Our definition is much broader.

We see the Green Revolution in Asia as a *state-driven, market mediated and small-farmer based strategy to increase national self-sufficiency in food grains*. Technology was an important precondition for the results attained, and the development of agricultural technology was both an important part and a result of the process. Policies – and circumstances influencing choice of policies – explain why agricultural development was pursued the way it was. Our understanding of the Green Revolution is rendered graphically in the following way:

Figure 2. Asian model(s) of agricultural development, causal model]



The model stresses the following:

- The Green Revolution was state driven, *viz*. states or governments were driving the development of the food-grain commodity chains (see chapter 2).
- Green Revolutions were driven by states towards the goal of self-sufficiency in food grains, a goal that was motivated not only by the threat of famine, but also by the volatile world markets for grain, which made vulnerable those countries that depended on import.
- Asian Green Revolutions were market-mediated, *i.e.* markets played a fundamental role in different parts of the chain, both with regard to farm inputs and in the trade and processing grains. In other words, we are not talking about socialist models, like the one followed by China and Vietnam until the late 70s and 80s respectively and by North Korea even today.
- The Green Revolutions were small-farmer based, *i.e.* they were not based on large-scale mechanized farming. Asian rice farming was and remains dominated by small family farms.

– Finally, we point to the crucial geo-political as well as domestic political dimensions of the Asian Green Revolutions, which have to be kept in mind when discussing African agricultural development.

We want to stress that the model is used, not as a normative precept, but as a *causal and explanatory model*. We argue that this model is a useful tool in trying to *explain* the Asian Green Revolution. In chapter 2 we proceed to use the model in further understanding agricultural development in seven Asian countries, from Japan in the North, to India in the South. In chapters 3 and 4 we use the model as an heuristic method to try and understand what has happened or not happened in eight countries in SSA, from the 1960s onwards.

Methodology

The Asian part of the study (*see* chapter 2) is an historical and comparative study of agricultural development in seven Asian countries based on secondary sources and interviews with key informants. We start with Japan and continue with Taiwan and South Korea in East Asia. We conclude that there are important continuities between the agricultural policies pursued by these pioneers, and those followed in the more classical Green Revolution cases of Indonesia, Philippines, India and Bangladesh.[4] For the African part of the study, case studies were undertaken in eight countries: Ethiopia, Ghana, Kenya, Malawi, Nigeria, Tanzania, Uganda and Zambia. In all countries two types of study were conducted, on the one hand macro studies based on secondary data and interviews with key individuals. The purpose was to document agricultural development and, by means of the model, to explain what had and what had not happened in the respective countries. To complement this, village surveys and smallholder questionnaires were conducted in all eight countries (see Figure 3).

Figure 3. Countries, number of regions, villages and farm households

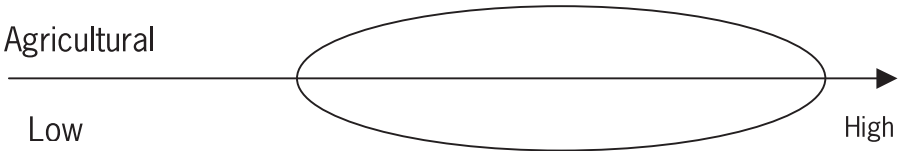
Country	Ethiopia	Ghana	Kenya	Malawi	Nigeria	Tanzania	Uganda	Zambia	Total
Regions	4	2	2	4	2	2	2	2	**20**
Villages	4	8	10	8	49	10	5	9	**103**
House-holds	322	416	298	400	495	403	320	443	**3 097**
% Female headed	5	17	43	40	12	20	14	24	**22**

Our intention has been to capture the dynamism in regions that are 'above average' in terms of ecological and market (infrastructure) endowments but excluding the most extreme cases in this regard. This is illustrated by the graph (below) showing 'agricultural dynamism' as a continuum, where 'low' depicts low productivity potential (aridity and/or poor soil quality and/or remoteness to markets) and 'high' shows high productivity potential (good agro-ecological conditions and good market access) (see Figure 2). While the households sampled are not representative of farmers in rural Africa as a whole, the sample area can be said to be typical of the kind of environment in which a majority of the small-

[4] In this summary of the research project, development in some of the countries is only described very briefly or in a couple of cases totally omitted. For a more detailed description and for more details on the methodology, see Djurfeldt et al, 2005.

holder population in SSA reside. This area is assumed to be sufficiently diverse to yield information about crucial conditions responsible for farmer performance.

Figure 4. Sampling frame



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2. Asian experiences of agricultural intensification

In the late 1970s Asia was given little hope of ever being able to meet its growing food demands and the old notion of an Asian dilemma of 'too little land and too many people' was still prevailing. However, things changed rapidly. Following the launch of the first high-yield rice variety, IR-8, by the International Rice Research Institute (IRRI) in the Philippines in 1966, production of rice – the main Asian staple crop – almost doubled in less than three decades. In the wheat growing regions, mainly in India and Pakistan, the introduction of high-yield wheat varieties resulted in quantum leaps in production. Per capita food crop production in Asia increased by more than 25% during the period and Asia moved from a situation broadly characterized as a food crisis to high levels of national food security in most countries.

For most Western observers this was an unexpected development but the Green Revolution in tropical Asia was not unique. Although less spectacular, dramatic increases in production had occurred in East Asia prior to the development in South-East and South Asia. Starting in Japan in the second half of the nineteenth century, and continuing in Japan's former colonies of Taiwan and Korea in the 1920s and 1930s, processes sharing several features with those of the Green Revolution in the tropics contributed to the transformation of these societies and their economies.

The state and Green Revolutions in East Asia

Although the overall pattern of agricultural change in East Asia is complex and varied, it is still possible to identify enough common features to outline a particular development path for agriculture in the region. This path has emerged as a consequence of a number of common environmental, economic and institutional characteristics conditioning agriculture and, partly, as a result of certain similarities in the agricultural development policies implemented in the three countries (Japan, South Korea, Taiwan). These policies were influenced by specific geopolitical conditions.

Although post-war development carried with it dramatic changes in all three countries, important foundations had already been laid for rapid agricultural growth based on the application of high-yield technologies prior to the miracle years. In terms of rapid agricultural growth all three countries experienced pre-war periods of historically very high growth rates.

The Japanese origin of the East Asian agricultural model

During the Meiji period, after intensive pressure from the USA, Japan opened up to the outside world. To maintain independence the national elite started on a rapid modernization process that converted the country from an isolated, backward feudal nation to a modern industrial country and an important regional power (1868–1912). For the Japanese leadership during this period, growth in the agricultural sector was the only realistic way to finance industrialization and modernization. At the same time, the new regime was forced to consolidate the nation and to improve the situation of the vast majority of the people – the farmers. With a very limited scope for expanding the cultivated area, the required growth had to come from a more intensive use of the land.

The Meiji government acted pragmatically and did not follow a master plan. The role of the state in agricultural development emerged gradually and the recognition that agriculture could not be squeezed unless simultaneously stimulated grew step by step. After failed attempts to introduce large-scale mechanized agriculture, the government quickly opted for the so-called 'fertilizer consuming rice culture', which proved compatible with the resource endowment situation at the time. The biochemical path of technological development in agriculture dominated Japanese agriculture up until the 1960s, when the overall level of mechanization increased rapidly.

The methods introduced in 1880–1920 bear striking similarities with the modern Green Revolution. Central to the package of technologies and inputs was the use of high-yield seed varieties (HYVs) of rice. These varieties had genetic characteristics allowing them to absorb large quantities of fertilizer, resulting in larger yields. Most important was the shorter, sturdier stem, which could resist lodging and carry the heavier panicles. The absorption of additional nutrients required a well-controlled supply of water, so the seed-and-fertilizer package first found success in areas with well-developed irrigation systems. In 1885, the Ministry of Agriculture and Commerce established an extension system, which contributed to the diffusion of both the best practical farming experience and new scientific knowledge.

Despite a certain polarization of the agricultural structure, the great majority of farmers gradually learned to utilize the labor-intensive technology to their advantage. As in the case of the modern Green Revolution, the smaller-scale farm households gradually overcame institutional obstacles. After the turn of the century it seems that they gradually became more efficient at utilizing the new commercial technology. In combination with the expansion of non-farm income opportunities, this contributed to a relatively low degree of inequality in incomes and lifestyles. As it turned out, it was the medium-scale farms (0.5–2.0 hectares), which came to form the backbone of Japanese agriculture after 1900.

The dependence on irrigation systems encouraged group solidarity and led to the gradual development of, for example, the water use associations operating at different hierarchical levels in the irrigation system. This greatly facilitated the spread and further development of agricultural technologies. In later years, when the development of new, more science-intensive technologies were to replace the old techniques, the strong links between farmers and their organizations on the one hand and government research institutions on the other, were of great importance.

The increasing role of the state

Although starting from a high level of land productivity, Japanese farmers successfully further intensified cultivation, thereby sustaining a steady average annual growth rate of the sector of approximately 1.8% during the entire period (1868–1912). The gradually evolving scientific capacity became increasingly important 1910–1920 when the exploitation and subsequent exhaustion of the traditional varieties' potential became evident. Despite the growth in fertilizer use, the rate of increase in rice yields started to decelerate and prices started to rise, resulting in riots in the major cities in 1918. The rice riots marked a new era, and Japan now moved from exploitation to subsidization of the agricultural sector. In 1921, the state started to buy and sell rice in the market and state intervention in the rice market gradually grew as a means to support the small-scale farmers' households.

While agriculture stagnated during the interwar years, it recovered rapidly after World War II. By 1950, the output of major crops had returned to pre-war levels. A radical land reform, implemented 1946–1950, established a class of small-scale rural landowners. This had a positive impact on income and asset distribution and strongly contributed to social stability in the rural sector.

The Japanese pattern repeated: Taiwan and Korea

As Japan's food problem became apparent during the 1918 rice riots, the government turned to its overseas territories for rice imports. Until then, rice exports to Japan had been discouraged in both Korea and Taiwan due to the fear of competition with the Japanese rice sector. As a result there was no surplus rice production to redirect and therefore short-run exploitation policies were followed initially. In 1920 the government launched a rice production program, which resembled an early version of the modern Green Revolution programs launched in the late 1960s and 1970s. Under the program, the Japanese government invested heavily in irrigation, water control and in research and extension. High-yield Japanese rice varieties, adapted to the ecological conditions of Taiwan and Korea, were developed and diffused and chemical fertilizer industries were founded in both countries. Furthermore, investments in the transport infrastructure as well as in education were substantial. The resulting rapid agricultural growth in the inter-war period raised the two colonies' share of Japanese rice imports from approximately half before the start of the program to more than 95% in the 1930s.

After World War II and liberation from Japanese rule, the two ex-colonies, both under *de facto* US occupation, experienced dramatic political and social changes. Chiang Kai-Shek's defeated army and the Kuomintang party fled the Chinese mainland and took control of Taiwan. The Korean peninsula was ravaged by war until 1952, when the truce between the UN and North Korea led to its division along the 38th latitude. These geopolitical conditions are crucial. Under the threat of an invasion from the North and from China respectively, the South Korean and Taiwanese political elites gained a wide autonomy permitting them to implement reforms that under other conditions might have been successfully resisted by vested interests.

As in Japan, land reform became an important starting point for both countries in strengthening an agricultural production system dominated by small-scale owner-cultivators. Land reform kept the peasantry politically quiescent. The regimes that were established in South Korea and Taiwan in the 1940s and 1950s were highly statist. Both set up a mecha-

nism for state intervention in agricultural production that resembles that in Japan in many respects.[5]

The early Green Revolution in South and South-East Asia

Almost simultaneously, but apparently without connection, India, Indonesia and the Philippines made U-turns in agricultural policies with the introduction of Green Revolutions in the mid- and late 1960s. The shift involved the famous package of technology containing new seeds, fertilizer and pesticides as well as other ingredients such as credit, improved extension and training, increased investments in infrastructure, irrigation and, what primarily concerns us here, a new price policy. The new policies introduced the idea of remunerative prices and built on the presumption that farmers can be stimulated to produce more if they get fair and reasonably stable prices. At the same time the new technology permitted increased margins brought about by the increases in productivity.

The Philippines

During the 1950s and early 1960s increases in area and yield did not keep pace with population growth. As prices started to rise, in both real and nominal terms, the administration started to increase imports. Central to the policies of controlling the price level through imports were the fundamental ideas of the strategy of industrialization through import substitution (ISI). Low food prices for urban workers formed part of this strategy.

For Filipino rice farmers, the slow growth in yields throughout the 1950s implied that the policy of low consumer prices was not compensated for by productivity growth on the farms. After independence, the idea of raising farmers' income through land reform legislation had been on the agenda but little was accomplished because of the opposition from politically influential large landowners. Unlike in East Asia, the US did not support land reform in the Philippines. Instead US policy clearly promoted agricultural development based on productivity growth as the solution to the food problem and low farmer incomes.

When Ferdinand Marcos was elected president in 1966 things changed rapidly. The first new HYV rice variety, IR-8 was officially released by the International Rice Research Institute (IRRI) in December 1966. In 1967, it was propagated in the Philippines and diffusion was very rapid. In the following year more than 35% of total rice production stemmed from high-yield varieties. The new varieties out-performed the old by over 75% and in three consecutive years, 1968–1970, imports ceased and rice was even exported.

The seeds by themselves do not explain the early success. The Marcos administration successfully coordinated government bodies and private actors in road and irrigation construction, extension services, credit provision and fertilizer supply. The program was concentrated to the provinces that ranked highest in terms of past productivity. Within each of these provinces high-potential villages were designated program villages and within these certain farmers termed 'co-operators' were selected for intensive assistance.

The Philippine case must be understood in a political context. From 1963 to 1967 food grain imports were huge, peaking at 18% of total consumption in 1965. In spite of high imports, Marcos' predecessor,

[5] For more details about agricultural development in Taiwan and South Korea see Jirström in Djurfeldt et al, 2005.

president Macapagal (1962–1965), was unable to prevent food scarcity. The food lines contributed to Macapagal's failure to be re-elected in 1965. During the campaign, Marcos vowed to ban massive rice imports to encourage national production.

In contrast to his predecessor, Marcos received the necessary support from Congress for massive investment in public works expenditure, especially for road building, irrigation and school construction. In order to encourage production, prices were permitted to increase. The government support price for rice was increased by 33% in 1966. In 1970, a pan-territorial support price was introduced. Marcos combined a sense of the symbolic significance of rice with a strategy combining investments in small-farmer production of rice, farm-to-market roads and rural schools. However, the success of the program contributed in 1970 to what proved to be a premature shift in government efforts towards sugar and coconuts and away from rice.

Self-sufficiency lost and regained

In 1970 rice production increases were limited partly due to radically rising fertilizer prices (50%). In combination with major pest infestation and extreme weather conditions in 1971 and 1972, the Philippines once again experienced poor harvests and needed large rice imports. Agricultural policy was again steered towards achieving food self-sufficiency. Implementation of a subsidized credit-fertilizer-extension program began in 1973/74 and lasted for 15 years. Again, it was areas with better-than-average production potential that were selected for program coverage.

During the early years of the program fertilizer subsidies were high, amounting to 40% of the commercial price in 1975. The program covered 40% of the Philippines' rice area in 1974–1975 – a period during which the world market price of rice peaked. After 1976 prices were reduced as the world market price of rice came down. The Philippines reached self-sufficiency in rice a few years after launching the strategy. Throughout the 1970s and early 1980s, national reserves of rice were always sufficient to meet any shortfall in domestic production. Rice scarcity did not occur again until in the 1990s.

During the initial years, the policy relied on a pre-existing set-up of government and private rural banks and credit co-operatives. A large number of the latter went bankrupt as a consequence of being forced to lend to default-prone farmers. In this respect, then, there was little market-mediation, but rather an attempt to socialize rural credit. The Marcos regime also continued a long-established policy of state rice procurement to be used for feeding the army and the urban population. In 1972 the construction of more than 500 buying stations started as the agency was equipped with more funds. However, government procurement neither eliminated nor replaced private rice trading, but only strove to regulate the prices.

External factors

While there is evidence for Marcos' strong interest for and commitment to the small-scale farm sector, it is more difficult to establish the background of these ideas. Particularly as they implied a break with previous policies, totally dominated by the interests of large landowners. One important factor was the flooding of the international banking system with petro-dollars from 1974. This made credit easily available for large-scale investments like irrigation systems and constructing feeder roads in rural areas. Furthermore, the ongoing war in Vietnam and the ever-

present threat of rural unrest made US aid almost freely available. The US also made its influence felt in the form of scholarships for higher studies in the US and through the Ford and Rockefeller Foundations. Since the 1950s, the latter two were driven increasingly by a neo-Malthusian and an anti-communist agenda, which, among other things, led to the establishment of IRRI in 1960 and to the development of the new rice technology.

Indonesia

There are many similarities between post-independence food policy in Indonesia and the Philippines. In both countries agriculture had developed according to the traditional vent-for surplus pattern characteristic of much of South-East Asia. As long as large, unused land areas were available, it was possible to increase staple food production through area expansion. To keep wages low in the labor-intensive plantation sector, colonial governments pursued a food policy emphasizing a low price of rice, the most important consumption item. The prime notion held by the Dutch, a notion retained by succeeding Indonesian governments, was that rice was too important to be left outside government hands.

Crisis and break with old politics

The food policies became ever more expensive as imports increased. Rice imports tripled in the second half of the 1950s, but in spite of the growing imports, prices doubled in 1957–1958. In 1959 President Sukarno launched a three-year self-sufficiency campaign including the innovative introduction of 'village padi centres' where seeds, fertilizer, training and credit were provided. The program failed due to the lack of incentives for the farmers.

As Indonesia's economic and political crisis was building up during the first half of the 1960s, the rice economy crumbled. With a rapidly increasing population, the per capita availability of rice was very low. In 1963/64 Java experienced a serious drought and a million people were starving in central Java. In 1965, production was only two percent greater than in 1954. Imports topped and runaway inflation drove rice prices to increase six-fold in 1965 and they continued to rise in 1966.

The military coup attempt late in 1965 and the transfer of leadership that followed marked the beginning of a new era – the Suharto era. During General Suharto's first two years in power, official attention was redirected to the agricultural sector. Having cut ties with China and the Soviet Union after banning the Communist party, Suharto had no choice but to turn to the West. At this point, the government decided to pay farmers an incentive price for their surplus rice. This was combined with a number of other measures aimed at accelerating production by promoting the adoption of HYV and fertilizer technology, strengthening the extension services and establishing village-level branches of Bank Rakyat Indonesia (BRI).

The most important institutional change resulting from the new agricultural policy under Suharto was the establishment in 1967 of Badan Urusan Logistic (BULOG), the new food logistics agency directly responsible to the President. Over the years BULOG developed into one of Asia's most powerful food agencies. To a large extent it was BULOG that implemented the rice price policy adopted in 1969. BULOG's task was to:

- support a floor price high enough to stimulate production;
- protect a ceiling price assuring a reasonable price for consumers;

– make sure that the range between the two prices was large enough to allow traders and millers a reasonable profit; and
– keep appropriate price relationships within Indonesia and internationally.

The 1972–1973 Rice Crisis

In 1970 and 1971, BULOG was successful in implementing the new policy. By mid-1972 the new rice program with its strengthened extension component and remunerative prices looked like a major success story. However, the South-East Asian drought in 1972 also hit Indonesia. As production suffered, retail prices soared. In some parts of Indonesia, rice prices doubled. Efforts to increase imports failed as adequate supplies simply could not be found at any price. The world market price rose five-fold in 1973 before the crisis ended. Jakarta's students hit the streets and in early 1974 the demonstrations erupted into violence.

The 1972–1973 rice crisis made the Indonesian government understand that a full-scale commitment to rice self-sufficiency was necessary. Suharto's background as a 'country boy' may have been one factor that brought him closer to the everyday realities of the Javan peasantry. In any case, the Suharto regime clearly realized the necessity of economic and social rehabilitation of rural Java in order to remove the main cause of the earlier growth of Communism.

Although the visions and plans pre-dated the sudden oil price hike in 1973, this incidence gave the oil-rich country economic possibilities to deal with the rice problem across a broad front. The creation and expansion of a national fertilizer industry formed part of the strategy to become self-sufficient in rice. Support to farmers during the 1970s and early 1980s was mainly indirect through subsidized inputs. By the first half of the 1980s Indonesia had reached food self-sufficiency, an achievement of historic proportions given the magnitude of food crises of the late 1960s and early 1970s.

India

While the green revolution in the Philippines and Indonesia largely revolved around rice agriculture, the early green revolution in India was a question of both wheat and rice production, and it was the early successes in the wheat sector that explained most of the growth, especially in the early phase from the late 1960s.

After Independence in 1947 India was unable to feed its population without importing wheat from Pakistan –part of India before partition. Western Punjab had for long been a net wheat producer for the rest of India and, after the outbreak of hostilities in 1947 over the control of Kashmir, the Indian food security situation worsened. The United States were the main supplier of grain to India. But in 1949 the US was reluctant to supply large supplies of grain, arguing that this would facilitate a food rationing system, which would work as a disincentive for producers and reduce India's chances of becoming self-sufficient in food grains. However, the rapid development of the cold war changed US policy and the flow of grains to India at reduced prices continued and increased.

During the first half of the 1950s, food grain production increased at a satisfactory speed (2.5% per annum), mainly due to area expansion and some investments in irrigation. However, during the latter part of the decade production stagnated and large imports were again needed. India

combined commercial imports with PL 480 grains from the US.[6] Consequently prices remained low for the domestic producers leaving no incentives for productivity increases. As food shortages grew and prices threatened to increase, the Indian prime minister, Nehru, decided to substantially increase the domestic grain procurement at low prices. Agricultural producers realized that further downward pressure on prices was to be expected and unrest was growing.

At this point, Nehru agreed to let the Ford Foundation prepare a study on the problems of Indian agriculture. The report called for a new approach to agricultural development. The central outcome of the recommendations of the report was the setting up of the Intensive Agricultural District Program (IADP) in 1961. The IADP was based on a 'package' approach to increase India's agricultural yields. It consisted of a combination of institutional, economic and technical innovations to be implemented at the district, block, village, farm, and field level, including a pilot district in each of the seven states.

The Shastri interregnum and the policy shift

Nehru died in 1964 and was succeeded by Lal Bahadur Shastri. During the Shastri interregnum, two years before the emergence to power of Indira Gandhi, important changes took place in India's development policies, including those in agriculture. The new Minister of Agriculture, C. Subramaniam, completely revamped India's price and procurement policies and emphasized that agriculture must be profitable. True to this spirit, Subramaniam took the initiative to form the Food Corporation of India, a major player in the rice and wheat markets. From the late 1960s the Food Corporation of India had a mandate to buy at the prices proposed by the Agricultural Prices Commission (APC). The Food Corporation procured between 10–20% of the marketed production.

The introduction of remunerative prices was combined with an emphasis on the agronomic component of the package concept earlier introduced. The new strategy involved concentrating on seeds, fertilizer, and extension in areas with high quality irrigation conditions. By concentrating on the potentially productive areas at the expense of others, the shift in 1966, thus, represented a turnaround from the egalitarianism under earlier programs. Shipments of semi-dwarf wheat seeds from Mexico and rice seeds from IRRI were rapidly supplied to the promoted areas. By 1967 two million hectares had already been planted under HYVs. The area increased rapidly. It has been estimated that HYVs supplied 62% of India's total cereal output in 1975, compared to six percent in 1967.

Gains in production continued during the 1970s and by the early 1980s a satisfactory situation with modest imports or even exports each year became the norm. Although it is possible to talk of an early success of the Green Revolution in the case of India, the benefits of new seed technology actually played a larger and more important role after 1975 than during the early years. From the late 1970s to 2000 – a period during which the Indian population doubled – food production more than doubled, much as a result of the spread of the Green Revolution.

Shift of power

The shift in policies in the mid-1960s to a large extent seems to have been a consequence of developments inside the ruling Congress Party.

[6] Public Law 480, which permitted export of grain as aid to friendly nations.

For the mobilization of voters, the party was dependent on the rural elite. The interests of this very elite, however, were hardly considered at central level under Nehru. He had the charisma to impose his moderate socialism onto a party whose rank and file were (was?) conservative rather than socialist in their inclinations. The rural elite was more influential at national level, which explains a great deal of the dilemma in Nehruvian policies – the plans remained paper products as implementation at national level was actively or passively sabotaged.

After Nehru's death, Shastri was the choice of the party bosses, a group of leaders with the majority of their backing in their respective states and among the rural elites. Higher prices for agricultural produce were in the economic interests of the rural elite. Moreover, remunerative prices were beneficial to all agricultural producers who sold at least part of their crops, i.e. to the vast majority of Indian farmers.

Particular Indian features

Compared to the cases previously discussed, the Indian Green Revolution has two specific features, which must be mentioned. The first concerns the slower growth rates, at least initially. The second concerns the limited (direct) impact on poverty.

The Indian Green Revolution is symbolized by the early breakthroughs in the Punjab and Haryana – the heartland of the Indian Green Revolution. For a long time these two states stood for a disproportionate share of the food grains (both wheat and rice) procured and used in the public distribution system. The slower impact in the rest of the country was due to poor suitability of the IRRI varieties, among other reasons. Advances could not be made in the traditional rice growing areas in East and South India until the national breeders had developed their own high-yielding crossbreeds. This accounts for the much higher growth rates in the late 1970s and in the 1980s.

Finally, the persistent poverty in India would seem to contradict our argument and it deserves a comment. It was not until the late 1970s that the Indian Green Revolution had any impact on poverty rates; and much of the progress on this front can be attributed to overall development in agriculture. Still today, large sections of the Indian population are food insecure and the country finds itself in the paradoxical situation of surplus stocks co-existing with food shortages for vulnerable groups. It is wrong, however, to attribute this distribution problem to the Green Revolution.

Global dimensions and the role of the US

The Green Revolution was a global process *institutionalizing* a global diffusion of gene-mass as old as agriculture itself. The Mexican dwarf wheat, for example, which was used for the Indian wheat revolution in the Punjab, was the result of crossing Mexican varieties with Japanese plant material, made available to the breeders employed in Rockefeller Foundation's Mexican Agricultural Program. Similarly, the new rice varieties were crossings of plant material from different lines that had developed and been bred separately. The breeding program was carried out at the International Rice Research Institute (IRRI) in the Philippines and was funded largely by the Rockefeller and Ford Foundations.

Geo-politically there are also important global dimensions to the Green Revolution. As was earlier the case in Japan, Taiwan and South Korea, the US input to the modernization of agriculture was very much shaped by the cold war and the anti-communist agenda. To these con-

cerns, from the 1960s and onwards, a new element was added, viz. concern with the growing population. Neo-Malthusianism gained increasing influence, starting in the late 1940s, but becoming politically influential during the Kennedy administration.

One reason for the apocalyptic visions was the fear that overpopulation and resulting problems of food security would fuel the communist movement. The urgency of these concerns increased with the war in Vietnam and led to a change in American policy. The US moved from an earlier stress on food exports, nicely tailored to domestic concerns with overproduction of wheat, to stress export of technology, rather than export of surplus grain. This again led to the two big Foundations investing considerable resources in developing new technologies for rice farming.

What is interesting, especially compared to the current situation, is that US policies stressed the export of technology and the need to make countries technologically capable of attaining self-sufficiency in food grains. This in strong contrast to the current situation where the international agricultural research system is starved of resources and where crucial technologies in plant breeding are controlled by private companies rather than by institutions in the public domain. Increasingly today, technology exports are based on commercial principles, whilst US and European policies have reverted to dumping surplus grain on the world market. This again creates difficulties for latecomers to the Green Revolution while, fortunately, countries like India (and China) have gained the necessary competence largely to pursue their own development of agricultural technologies.

The global and geo-political dimensions of the Green Revolution do not invalidate the explanations stressing domestic factors. On the contrary, in India the two explanations complement each other. Something similar can be said both about Indonesia and the Philippines. When Marcos was elected it was on a platform confronting the sugar barons and other landlord interests while flirting with the poor rice farming electorate with the slogan 'Rice, Roads and Schools'. Similarly, although Suharto came to power in the aftermath of a coup attempt rather than via elections, his overriding concern in establishing the legitimacy of the military regime was to win the Javanese population consisting mainly of small rice farmers. The new agricultural strategy was part of the effort to undermine agrarian radicalism and to build up rural political support.

One of the most persistent myths about the Green Revolution was that it mainly benefited large farmers and that it contributed to a concentration of landownership, massive increase of landlessness and of poverty. As is increasingly realized, this is far from what happened. Since the distributional effects of the new technology were not as foreseen by contemporary critics, the strategies formulated in the late 1960s bore fruit. With large sections of the agrarian and rural population gaining from the new policies, the new regimes won widespread legitimacy.

Asian Model – Conclusions

It is clear that we can speak of an Asian model of agricultural development, since some factors recur in all the cases that we have discussed. Forgetting the specificities for a moment then, the common features are:

– State intervention was strategic for the expansion and improvement of large-scale irrigation schemes and rural infrastructure, for expanding capacity in the fertilizer industry, and for the national agricultural research and extension systems, which played a prominent role in the process.

- We use the terminology of being *state-driven* and *market-mediation* to represent the fact that a state-directed process of development does not necessarily imply that market mechanisms have no influence. Administratively regulated markets are an outstanding characteristic of the Asian model of agricultural development, but within the framework of these markets, private commercial activities were significant.
- A third characteristic of these state-driven, market-mediated processes of development is that they were small or family farmer based, and that the uni-modal character of agrarian structures grew even more pronounced in the process.
- A price policy assuring profitability to smallholder agriculture seems to be a common feature. The U-turn in agricultural price and trade policies, which occurred at about the same in the mid-1960s in India, Indonesia, the Philippines and South Korea, and (less dramatically) a decade earlier in Japan and Taiwan, was an essential, although often neglected part of the Green Revolution policy package, and a precondition for the spurts in production. It was also a means of assuring that the new technologies became farmer-based.
- These cases share a political goal – self-sufficiency in food grains – which became important due to political factors stemming, *inter alia*, from the rivalry between states in the international system of states. Achieving self-sufficiency became important for regime survival, but it was also a goal promoted by the donors, especially by the US.
- In all the cases, except perhaps Taiwan, nationalism had an obvious role in motivating and legitimating agricultural development policies. In the case of Taiwan, the cold war and anticommunism played a similar role as ideological driving force.
- Foreign aid played an important role, motivated not only by strategic considerations during the cold war, but informed by the 'false' 'Population and National Security Theory', with its neo-Malthusian and anticommunist tilt, which motivated an export of technology crucial for making the Asian economies independent of food aid and import.

On the other hand, the specificities have to do among other things with timing:

- In East Asia, Japan and Taiwan are largely pre-Green Revolution cases, while in the rest of Asia there is a time lag of about 20 years before the Green Revolution as such is launched. There is a common background to the later start in the rest of Asia having to do, not only with the breakthrough in seed technology, but also with the food crisis in the beginning of the 1970s, adding to the shock of the oil crisis.
- There is also a shift in the financial policies at about the same time. In the 1950s and 1960s most countries had followed a 'squeeze agriculture' policy, trying by all means to keep down farm gate and food prices in order to mop up a surplus for industrial growth. After unlinking the dollar from the gold price in the early 1970s, a fundamental structural change in the Bretton Woods system, many countries turned to deficit financing as a means of driving agricultural development. In a number of countries this meant subsidies for farm inputs, remunerative farm gate prices and subsidized food prices – policies obviously fuelling at least moderate inflation.

– Equally important, the U-turn of price policies in South and South-East Asia signifies a first partial break with the import substitution industrialization strategies followed since decolonization.

Conventional accounts view export-led industrialization as the break with ISI occurring only in the 1970s (except in Taiwan and South Korea where it came earlier), but here we see that this break is antedated by the revamped agricultural development strategies. The specificities notwithstanding, the model of the Asian Green Revolution that emerges is one of a market-mediated, farmer-based, state-driven process. It is conditioned by geopolitical and institutional factors. However, it has no direct causal links to demographic factors. Finally, technology is not a driving force, but a necessary –although insufficient –factor.

Returning finally to the causal model outlined in the Introduction, we hope that the above analysis substantiates our contention that this model explains the green revolutions in Asia. We regard the question of *transferability of the Green Revolution* as less interesting and fruitful and we want to use our model differently. In the following chapters the overarching question is: Can the causal model developed on the basis of the Asian cases *explain* what *is* happening and what *is not* happening in sub-Saharan Africa? Can these explanations in turn be used for formulating strategies for agricultural development in Africa?

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3. History of agricultural intensification in sub-Saharan Africa

With about one-fifth of the earth's land surface and only 12% of world population, Africa is often said to be under populated. However, its frequently leached and depleted soils, and often adverse climatic conditions pose comparatively difficult constraints for agriculture. Moreover, the size of SSA, in combination with its low population densities, makes infrastructure investments costlier and slower to realize than in, for example, Asia's more densely populated major Green Revolution regions.

The population of Sub-Saharan Africa (SSA) has quadrupled since 1950 and it is projected to more than double between 2000 and 2050. In aggregate, in 2000 some 410 million people, or almost two-thirds of the population, were classified as rural. Expansion of arable land has stagnated in recent years, indicating that land frontiers may have been reached. The result is rapidly mounting population pressure and declining ratios of arable land to agricultural population. Farm-sizes are generally shrinking and land distribution in the small-farm sectors appears to be becoming comparable to those of many Asian countries at the time of their Green Revolutions.

Poverty is widespread. On average, 48% of the population in SSA in 1987–2000 had an income under the national poverty lines. With declining per-capita food production and little with which to pay for imports, food-aid to SSA has been a persistent phenomenon during the last decades. For example, seven of the eight countries included in the study, have received food-aid (cereals) every year since 1970. In 2003, 25 countries in SSA faced food emergencies because of drought and floods, for example. Six of these countries are included in this study.

It can be argued that, in such a situation, intensification of (food) agriculture 'ought' to take place. Apparently, it does not – despite assertions by, for example, Eicher that SSA has 'vast agricultural potential'. Is it true that intensification is absent or insignificant under these circumstances? And, if it is, how can this be explained – and changed? A possible, or at least partial, answer could be the low population densities. Following the logic of Boserup and many others, intensification is not likely to occur until possibilities to expand extensive farming are exhausted. The pressure to change established ways of production (and accompanying social institutions, etc.) has been low compared to more densely settled regions such as those where the Green Revolution first took off in Asia.

Intensive farming, however, is not a new phenomenon in SSA. Nor is the agricultural history of the subcontinent without successes. Also today 'islands' of intensive agriculture are found in more densely populated areas with access to markets and infrastructure.

The problem with the African food production is neither technology (e.g. the wrong crops) nor nature (e.g. poor soils and erratic rainfall). Nor is the problem that African governments have been reluctant to engage in the agricultural sector. On the contrary, there have been repeated attempts at state-led intensification. However, during the last decades, experiences of attempted Green Revolutions in SSA (e.g. maize revolutions in Kenya in the 1970s and Zimbabwe in the 1980s, and Nigeria's Green Revolution program in the 1970s and 1980s) have been short-lived spurts of production rather than lasting productivity improvements. Rather than asking: 'Why have Green Revolutions been absent in SSA?' we need to ask: 'Why have they not been sustained?' One part of the answer is, the fact that few suitable varieties of seeds were available until the 1980s, a situation that has since been remedied. Yet, as will be outlined below, the main reason for lack of intensification and/or failures to make the Green Revolution sustainable in SSA are policy related.

Post-independence food crop performance in sub-Saharan Africa

The following analysis is based on statistics concerning population, land use, production (tonnes) and productivity (yields per hectare) of major food crops, and adoption rates for various inputs (seed, fertilizer) in eight countries in SSA. It is based on secondary sources, FAO statistcs, on the case studies that were commissioned as part of the *Afrint* project, and on information from official sources in the countries concerned.

The analysis is further divided into pre-SAP, SAP and post-SAP periods, i.e. before, during and after implementation of Structural Adjustment Programs in the countries studied. As a matter of convenience, the period during which Structural Adjustment Policies were implemented in SSA is usually defined as circa 1985 to 1995.[7]

Indicators of intensification

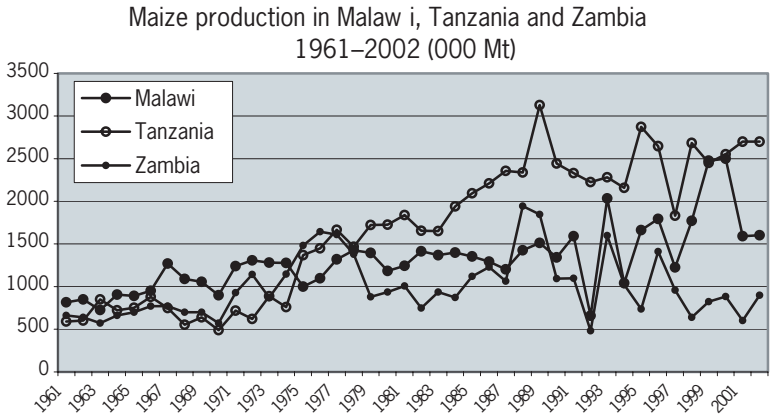
In contrast with widespread views of stagnant food production in SSA, a look at the FAO's index of food production reveals a slow but steady increase in aggregate food production between 1961 and 1985 and a faster growth from 1985 to 2002. With few exceptions, the Afrint country studies, however, present a less optimistic picture of recent trends, indicating that the FAO might paint too rosy a picture.

From 1971 to 1996–97, aggregate production increased at more than two percent per year for all the major food crops in Africa. The problem is not so much a lack of increased production but rather that population growth has outstripped food production. Enhanced production levels have various causes, but for SSA as a whole, most of the increment in production has resulted from an increased area under cultivation with only minor contributions from yield improvements. Additionally, the aggregate FAO production statistics show that, although growth rates appear to have increased for most countries in recent years, present patterns are unstable and display greater year-to-year fluctuations than those observed for earlier periods. This observation is not only confirmed

[7] There are some deviances from this assumption, e.g. in Ethiopia SAP only began in 1993. For more details see Holmén, H. in Djurfeldt et al. (2005) respondence of drought years and low maize harvests, it seems as if both peasants' vulnerability and national food insecurity has increased during SAP and post-SAP.8

but also strengthened when looking at trends in maize production in the individual countries under study (Figure 5).

Figure 5. Maize production in Malawi, Tanzania and Zambia



Source: FAOSTAT

This indicates that general improvement in aggregate food production post-SAP appears to be accompanied by a greater insecurity in national food self-sufficiency. Unstable, and possibly worsening, weather conditions may play a role here but as Olouch-Kosura puts it, 'the major culprit may be policy related, particularly market reforms'. There is only a weak correspondence of drought years and low maize harvests, it seems as if both peasants' vulnerability and national food insecurity has increased during SAP and post-SAP.[8]

Maize production

Maize is the prime staple crop and it has been the crop favored by governments trying to increase food production in all the countries studied.[9] The countries investigated show a general upward trend in maize production. Although trends have been fluctuating and uneven, present levels of production are on average 400–500% higher today than 40 years ago in Ghana, Nigeria, Tanzania and Uganda. Total annual maize production in Kenya and Malawi is about double that of the early 1960s. The real laggard, according to FAO statistics, is Zambia where present levels of production are only some 12% over those in the mid-1960s.

Yields

Maize yields have improved throughout the period under study but yield levels remain low, on average 1.5 tonnes per hectare in the early 2000s (see figure 6). Variances within countries are great. Of greater interest here are differences as to when improvements occurred (see figure 6). For Tanzania and Malawi, there appears to be no big influence of SAP on

[8] Time series for maize production in Malawi, Tanzania and Zambia were compared to national precipitation data obtained from http://www.cru.uea.ac.uk/~timm/cty/obs/TYN_CY_1_1.html.

[9] This condensed report is confined to maize performance. For those interested, a more detailed overview of the evolution of food crop agriculture in SSA can be found in Djurfeldt et al, 2005.

yields. There is a slow and steady increase since the 1960s. In Ghana and Uganda, to the contrary, yields have made rather big improvements during SAP and post-SAP.[10] As for the remaining countries (Ethiopia, Kenya, Nigeria and Zambia), they all experienced yield improvements pre-SAP but these trends were broken during SAP. In Ethiopia, Kenya and Nigeria yields stagnated whereas Zambia has faced declining yields post-SAP.

Figure 6. Maize yields (tonnes per hectare) 1965–2001 (three years average)

	1965	pre-SAP*	post-SAP**
Ethiopia	1	1.5 (1991)	1.6
Ghana	1	0.8	1.4
Kenya	1.1	1.6	1.6
Malawi	1	1.2	1.3
Nigeria	0.8	1.1	1.1
Tanzania	0.8	1.3	1.6
Uganda	1	1.2	1.8
Zambia	0.9	1.8	1.5

* Average yield in the three years immediately preceding SAP.

** 2000/02 Source: FAOSTAT.

Area harvested

Whereas yield improvements have been small and fairly similar since the 1960s, trends in maize areas are more diverse. According to FAO figures, half the countries studied (Ghana, Kenya, Malawi, Tanzania) have seen a slow but steady growth in maize areas throughout the period. In Ethiopia, Kenya and Tanzania a leveling off occurred during SAP and post-SAP.

Uganda had a very unstable pattern of production of maize until the mid-1980s, after which maize area more than doubled in 15 years time. In Zambia, area expansion came to a halt in the mid-1970s when it dropped about 50% and has thence remained at the same low level. The opposite trend is found in Nigeria where maize area declined slowly between 1961 and 1982 and then expanded dramatically (about 450%) through SAP and then dropped somewhat post-SAP.

An effort was made to measure the importance of yield versus acreage behind growth in maize production. We compared growth rates in these two factors during different periods, i.e. on the one hand the whole period since the early 1960s and, on the other hand, from the introduction of SAP until present. With the exception of Zambia, over the whole period under study – from independence to date – area expansion has been more, sometimes far more, important than yield improvements. In, for example, Ghana, Nigeria and Uganda area expansion has been 5–12 times as important for production increases. The same holds for Ethiopia and Malawi but at lower (*i.e.* about double) levels.

[10] In Uganda, the introduction of SAP coincided with the (almost) ending of civil war.

Figure 7. Growth in maize area and yield since SAP (3-year average)

	Growth%	
Country	**Area**	**Yield**
Ethiopia*	47	17
Ghana	105	80
Kenya	33	-10
Malawi	34	11
Nigeria	132	-9
Tanzania	16	21
Uganda	111	58
Zambia	7	18

* from 1993–95 FAOSTAT

Also in the period since introduction of SAP area expansion has been more, sometimes much more, important than yield improvements for increases in maize production in six out of eight countries investigated. Broadly speaking, SAP did not significantly alter the relative importance of area versus yield growth seen in the pre-SAP period, although differences have been reduced in most cases.

In all countries (except Zambia), area expansion is the main source of growth in gross maize production. In some cases – e.g. Ghana – post-SAP area expansion is seen as a response to market liberalization. Others point out that, area expansion proves that now there are (finally) seed varieties available adapted to the savannas. Generally, however, this is interpreted as a sign of declining use of improved technologies after SAP was introduced (*Afrint* macro studies). Large tracts still attain low yields whereas well-endowed areas may have double that amount. Hence, many smallholders only reach maize yields of about or below one tonne per hectare whereas in ' isolated cases' large, commercial farmers may reach maize yields of five tonnes in Ghana or even nine to ten tonnes in Zambia.

Summary of food crop performance 1961–2002

For the other major food crops (rice, sorghum, cassava), the importance of area expansion has been accentuated since the introduction of SAP and yields remain low, much below their potential. Yet it is too early to talk of a Sub-Saharan Green Revolution. So far SAP cannot be said generally to have correlated with increased food productivity.

Cassava as the exception, with productivity that has increased, sometimes dramatically, in recent years (post-SAP). On the whole, from the information available, there appears to have been very little structural change and no major changes in cropping patterns seem to have occurred in the smallholder sector. The use of modern technologies and improved seeds appears to have either stagnated or declined in recent years and in several countries agriculture is pushed into the margins, resulting in increased fluctuations in yields and vulnerability for the smallholders.

Intensification?

So far extensification has been a more 'practical' option in large parts of SSA. At the same time, 'high level' intensification (e.g. HYVs, mixed farming, fertilizer, specialization on high-value crops) is practiced primarily by a small group of large farmers and also, to a lesser extent, by smallholders in heavily populated areas and/or near market centers and

communication networks. In other areas, a 'lower level' of intensification takes place, as shifting cultivation and the bush fallow system are fading out because of population pressure, and when land pressures are forcing smallholder farmers to practice continuous cropping, often in cereal monoculture. Often such soil-mining practices go hand in hand with encroachment into marginal or unsuitable lands with, sometimes, serious effects on the quality of land.

However, focusing solely on aggregate level statistics draws attention away from all the interesting differences. Average yield levels were found to be low for all crops studied. But for them all we found reports of yields substantially above average – for maize 10 tonnes per hectare, for rice 3.5 tonnes per hectare for sorghum 2 tonnes per hectare, and for cassava 16 and even 28 tonnes per hectare. Yield levels differed both between countries and within countries. These figures tell us that intensification of food staple production definitely has taken place in SSA – in some regions and among certain categories of farmers. Although slow, intensification takes place also among staple food producers.

The issue of intensification versus extensification, is rather complicated, and even more so when looking for the driving forces behind such processes. Both population pressure and market forces are at play – in different combinations in time and space. But also other factors – enabling as well as constraining – are involved. What we can document in contemporary Africa south of the Sahara, therefore, is neither clear-cut trends of intensification *nor* of extensification. Rather, simultaneous processes of intensification, diversification and development occur parallel to processes of extensification, de-agrarianization and involution.[11] So far, and in sharp contrast with the Asian experience, attempts to launch Green Revolutions and/or to improve the productivity of African food agriculture – especially small-scale agriculture – have been quite exclusive, involving only limited sections of the farming populations. In other words, they have hardly been smallholder-based, as the Asian model would require.

State, market and food crop performance

From independence until the mid-1970s food was not generally a big problem in SSA, even though fluctuating harvests caused local and/or temporary difficulties. Most countries studied were considered food self-sufficient at least until the 1970s and in some cases until the 1980s. With agriculture still capable of providing the necessary foreign exchange to pay for imports and virgin land still available in most cases, there seemed to be no great need to pay special attention to the food sector in those days. According to Akande and Kormawa 'the idea of green revolution … was unknown in Africa' in the 1960s and 1970s. In the 1970s, the situation changed dramatically due to a series of internal and external shocks. Population growth and droughts (e.g. in the Sahel and the Horn of Africa) increasingly strained food security at the same time as a major drop in copper price in 1974 adversely hit Zambia and a quadrupling of the oil-price in 1973 negatively affected most governments' budgets.

SSA governments committed themselves in various ways to develop food-crop agriculture and, hence, assumed a leading role in agricultural development and public investments in the agricultural sector were generally high. A number of strategies and combinations of strategies were implemented, state-farms in Ghana, Nigeria, Ethiopia and Zambia,

[11] For a discussion of de-agrarianization and involution, see Chapter 2, Djurfeldt et al (2005).

collectivization in Nigeria, Ethiopia and Tanzania, in combination with attempts to reach out to smallholders with campaigns, extension and inputs. In some countries (e.g. Ghana, Nigeria, Kenya), ambitious, large-scale irrigation programs were launched. As had been done in Asia, the State provided credit and assumed responsibility for supplying inputs and handling of produce through state-led peasant associations, cooperatives and marketing boards. Efforts were made to strengthen agricultural research and to expand extension services. For example, crop research programs were initiated in a number of countries and new high-yielding maize varieties were released. In contrast to most Asian cases, private trader involvement was constrained or eliminated. State monopolies in the handling of agricultural input and products became the rule. This enabled governments to regulate prices, to offer minimum price guarantees and pan-territorial pricing, and to provide inputs like seed and fertilizers at subsidized prices to a largely subsistence-oriented smallholder peasantry. In many places, the smallholders found that they suddenly had access to external resources as well as 'markets'.

Missed opportunities?

Moreover, the governments' approaches to raise food production among the smallholders were relatively benign, which is indicated, for example, by the frequently accepted low loan repayment ratios and debt-cancellations for agricultural debts. In some cases, however, coercive measures were resorted to, for example the forced movements of people into new settlements in Tanzania and Ethiopia. In the latter case, with Teketel's expression, the peasantry literally became 'tenants of the State'.

More often than not, smallholders were perceived as tradition-bound and lacking 'achievement orientation' and states and 'developers' lacked faith in the smallholder peasants' abilities to enhance productivity or to develop their production for the market. Thus a preference emerged for 'modern' and 'scientific' models of agricultural development. Top-down management practices and negative attitudes towards the peasantry resulted in very simplified messages being transmitted to the smallholders. At the same time, the benefits that smallholders could gain from modernization were quite limited even though food agriculture was often subsidized.

Through the monopolization of 'markets', farm-gate prices were suppressed and yield improvements, generally, were modest. In contrast to the Asian green revolutions, fixed prices squeezed the margins between costs of production and revenues from sale of produce for both smallholders and traders and, hence, reduced the incentive to produce a marketable surplus. With governments' priorities increasingly emphasizing low (urban) consumer prices rather than improved (rural) producer prices, the result was maintaining the *status quo* rather than agricultural development. Surplus production under these circumstances was not always attractive and where conditions deteriorated too much, and where the option existed, smallholders were reported to withdraw into subsistence production. Moreover, with parastatal organizations and marketing boards operating at a loss and the costs of subsidies mushrooming, this policy became economically unsustainable. Also for the governments, the whole endeavor turned out to be bad business and the costs of upholding the system skyrocketed at the same time as governments' revenues deteriorated.

It is commonplace today to 'explain' this lack of development by stating that African political leaders have been (and perhaps still are)

crooks and kleptocrats, who do not care about development and who's only ambition is to enrich themselves by appropriating public resources. While such malpractices no doubt occur(ed), sometimes even on a grand scale, this is not a satisfactory (and definitely not a sufficient) explanation.

Poverty, i.e. a general lack of resources, contributes to explain the dismal record pre-SAP. In contrast to Asia, it could be argued that the task that African governments set for themselves in the 1970s was just too large. For example, at independence Tanzania had only 16 university graduates. This, of course, was quite insufficient as a base for any broad development program, let alone as foundation for the public sector. Lack of resources and insufficient administrative and managerial capacity could explain the top-down approaches and the simplified messages resorted to. It could also, at least in part, explain the frequent policy shifts and administrative reshufflings that took place. The circumstance that policies were poorly coordinated, that policies often were not implemented, and that they were often changed before results could be evaluated, could also be explained on similar grounds. But this is also not a sufficient explanation and it does not clarify why these efforts failed in SSA while they succeeded in Asia. After all, policy shifts, bureaucratic awkwardness, top-down approaches, coercion and 'one-message-only' policies were not uncommon in Asia either. Additional explanations are needed.

A contradictory agenda

The various African programs for agricultural development released in the 1970s had a

double function. Partly they were aimed at development and partly a nation-building, i.e. the consolidation of power. By providing agricultural inputs (and at the same time eliminating alternative suppliers) and by guaranteeing 'fair treatment' in the form of pan-seasonal and pan-territorial pricing for inputs and produce, the State could show its good intentions and, possibly, gain widespread legitimacy. At the same time, the servants of the enlarged state apparatus became a substitute for a social base that the State did not (yet) have and the state tended to turn a blind eye at malpractices and inefficiencies. Parallel to this, in order to reach out and extend the 'controlled' territory, local bosses, clan leaders and village headmen were co-opted into the clientelistic networks of the state, viz. indirect rule continued. Also in these cases, malpractices, nepotism and diversion of resources from their intended use were often tolerated.

Also, while credit and inputs were supposedly distributed evenly and fairly among the peasantry, experience tells a different story. More often than not, scarce resources were distributed to the politically well-connected which often meant large farmers, loyalists and the regimes' cronies or even absentee farmers, retired civil servants, and soldiers who often had nothing to do with farming.

Polarization, external shocks and economic collapse

The result was the establishing of a dual structure comprising, on the one hand a small group of 'modern', often well-connected, and sometimes absent, commercial farmers and estate owners and, on the other hand, a vast majority of low-productivity, semi-subsistence oriented smallholders growing traditional varieties and using only small amounts of fertilizers and improved seeds. Whereas the Green Revolution technologies as such have been found to be scale-neutral and, in Asia, they have benefited

smallholders as well as larger farmers, in SSA the beneficial effects of the technology have been much more restricted.

For the governments, the situation worsened in the mid 1970s due, among other things, to oil price shocks in 1973 and plummeting copper prices in 1974/75, and drought in the 1970s and early 1980s. Most countries were forced to turn to the IMF and the World Bank for financial assistance. For various reasons, external as well as internal, governments in SSA had to implement Structural Adjustment Policies (SAP) in order to access continued development aid and to be able to renegotiate their debt repayment schedules.

Structural Adjustment (SAP) and food crop intensification

Invariably, SAP was meant to result in a complete turnaround of the economy away from state-led development to a market-based economy. The new role of the government was to become an enabler rather than a manager. This meant, on the one hand, that macro-economic stability was imperative (balanced budget and devaluation of overvalued exchange rates to facilitate exports and curb imports, thereby creating incentives for producers for the home market). It also meant deregulation of markets and the liquidation or transfer of parastatal organizations to the private sector. Moreover, subsidies and price guarantees were to be abolished, since these gave the wrong signals to traders and producers and would lead to misallocation of (scarce) resources. In short, the state should step out of agriculture and limit itself to strengthening the infrastructure and institutional framework within which markets operate.

Implementation of SAP, in many cases, meant a renewed priority for agriculture. However, in most cases, emphasis was not on staple food production. Nevertheless, farmers initially responded favorably to the policy changes and production increases were sometimes substantial. To begin with, reforms emphasized currency devaluations and macro-economic reform, liberalization of grain markets and removal of price controls on agricultural commodities. Subsidy elimination usually followed with some delay.

That agriculture initially responded positively, most likely, is a consequence of:

- Growth in cash crops exports; and
- Expanding market opportunities for staple crops, especially maize, when markets were deregulated and more traders appeared.

However, in the food crop sector, this positive response appears to have been a temporary improvement.

Though Ghana is an outstanding exception, it appears that SAP was no panacea for food self-sufficiency in SSA. This has disrupted the reform programs and played havoc with the legitimacy of governments meant to implement them. Moreover, the abovementioned pre- SAP tendency towards polarization appears to have been accentuated during SAP. In, for example, Kenya and Zambia, intensification tended to be a privilege for the wealthy. Hence, small-farm production increased mainly through area expansion, while large-farm output expanded mainly through increased yields.

A number of countries, notably Kenya, Malawi, Nigeria and Zambia, have had 'stop-and-go' implementation of SAPs, in no small degree due to the political dangers (e.g. food riots) involved. Agricultural input subsidies were either abolished but reintroduced – as in Malawi and

Tanzania – or subsidies have been retained – as in Nigeria and Zambia – although the levels of subsidization have been repeatedly raised and reduced – as in Nigeria.

These circumstances seem to imply a number of conclusion .Firstly, although unstable climate is a problem for agriculture in most countries, ups and downs in food production appear to be closer related to ups and downs in levels of input subsidies than to changing weather conditions. Secondly, the initial positive impact of SAP may equally well be related to the fact that it was only partially implemented than to SAP per se. More exactly, it can have been the combination of retained subsidization and deregulated markets that produced the positive effect. Thirdly, due to the on-and-off patterns of state involvement in agricultural markets, it is not always so easy to make a clear distinction between SAP and post-SAP periods. By the mid-1990s, however, agricultural subsidies had been withdrawn in all countries concerned and this could be regarded as a convenient start of post-SAP (but see below).

Post-SAP food crop performance

The generally positive effects on staple food production that followed immediately after SAP have not been sustained post-SAP. In most cases yield growth of major cereals has been marginal or stagnating, often less than one percent per annum post-SAP. This is commonly because diversification has occurred among large, commercial farmers, who abandoned maize during SAP, whereas smallholders remain 'stuck with maize' and have been progressively marginalized from, rather than being pulled closer into, the liberalized market.

Use of modern inputs

The decline or stagnation in staple food production is directly related to reduced use of modern inputs post-SAP. This is despite the fact that a range of new technologies (improved varieties) has been released and made available to farmers in many countries and despite observations that Green Revolution technologies have been found to adapt favorably to local environmental conditions and show remarkable resistance to disease. However, except seed, modern inputs are not being used.

In most countries investigated, smallholders have faced major problems accessing modern inputs during the 1990s and de-adoption of hybrids and fertilizers have occurred in recent years. Nevertheless, in some cases, *e.g.* Zambia, the use of HYVs is high, reaching 57% of farmers in the mid-1990s. Likewise, in Ghana about 60% of farmers use improved varieties of maize, rice and cassava. The recent dramatic growth in cassava yields in Malawi must also be a consequence of widespread adoption of new, high-yield varieties. These seem to be exceptional cases, however, and generally the use of modern inputs is much lower.

This is particularly the case with fertilizer. In large parts of the subcontinent, agriculture is constrained by leeched and nutrition-poor soils. Moreover, cattle diseases and shrinking farm size have limited access to manure in many cases, which enhances the need for chemical fertilizers. However, average fertilizer use for SSA in absolute terms (less than 10 kg/ha) remains far below mean levels in all other parts of the developing world.

Declining fertilizer use on food crops appears to be the most dramatic effect of the SAP reforms. In aggregate terms (not confined to food crops), fertilizer consumption generally increased prior to the introduction of SAP. Only in Kenya and Uganda has growth been sustained

through SAP, although in Kenya the trend has become more erratic post-SAP. In the other countries, fertilizer consumption has either stagnated (Ethiopia) or declined (Malawi, Nigeria, Tanzania, Zambia).

Moreover, most of the increase in fertilizer use has been on cash crops, with minor increases maize. Fertilizer prices have increased post-SAP while grain prices have declined. Sometimes price increases on fertilizer have been extremely high, reaching several hundred percent. Smallholders in SSA presently pay the highest prices in the world for chemical fertilizer. And we are talking about no small differences. Fertilizer prices are presently reported to be 4.5 times as high in western Kenya than in Europe. Hence, with few exceptions, only a small proportion of small-scale farmers in SSA presently use inorganic fertilizer.

Subsidies and agricultural credit

With the dismantling of parastatal organizations during SAP, most governments have ceased providing agricultural credits to smallholders. Instead, commercial banks are relied upon to extend loans. But, generally, smallholders do not have the necessary collateral. And even if they do, interest-rates – 46% in Ghana and 48% in Malawi – are prohibitively high. Hence, small-scale peasants in SSA today only exceptionally have access to agricultural credit.

Infrastructure

While transport and storage infrastructure generally expanded pre-SAP, with few exceptions (Ghana, Tanzania) infrastructure investments have deteriorated in recent years, in Kenya according to Olouch-Kosura, 'to the extent that it has become a hindrance to growth'. Even where infrastructure has improved, the costs of transport have increased when governments have withdrawn (subsidized) transportation of produce. Hence, transport costs are everywhere high, posing disincentives for peasants to commercialize and for private traders to extend their activities beyond more densely populated and easily accessible areas.

Extension

A similar effect of SAP can be seen on extension services in most countries. Whereas there appears to be no consistent trend post-SAP in terms of increasing or decreasing government budget allocations to extension, these are in most cases being transformed into market-oriented undertakings, viz. at the same time as the concept of 'progressive' farmer is revived, extension is now to be demand-driven.[12] Commonly, the stated objective is to transform agriculture from subsistence orientation to a commercial enterprise via a step-wise development from 'subsistence-peasant' through 'emerging (progressive) farmer' to 'commercial farmer'.[13]

Extension in SSA has often been criticized for being top-down and insensitive to smallholders needs and priorities. Top-down extension was not uncommon in Asia during its green revolutions. Arguably, this did not hinder their successes. Hence, the circumstance that African extension has been less effective than its Asian counterparts ought to be

[12] The exception being Ethiopia which is presently focusing on food crops and, mustering more than 15,000 extension agents, aggressively promotes an 'intensified package approach' which, however, is characterized by top-down blanket recommendations and leaves little room to articulate peasants' interests or active participation.

[13] This reorientation towards participation and being demand driven seems, however, to contain a fair amount of lip-service. The Malawi Ministry of Agriculture's suggestion that 'not many people take farming seriously' and that smallholders 'should look at farming as a business and not just a hobby' is a case in point. As this study shows, structural and institutional factors explain more about low adoption-rates than do peasants' alleged 'improper attitudes'.

explained by other factors. Most likely, profitability explains the different outcome. Even if Asian smallholders have been taxed as well – actually at a higher rate than in Africa – their margins between input and output prices have been much greater. In Asia, price policies made it worthwhile for smallholders to invest and adopt new technology, while in SSA they do not. Without similar incentives, it is, with Bazaara's and Muhereza's words, 'questionable whether [African] subsistence farmers want to become commercial producers'.

Entrepreneurs and agricultural markets

Since the implementation of SAP, state monopolies on input provision and trade in agricultural produce have been eliminated and private traders and entrepreneurs have found some new room for maneuver. Some recent studies argue, like Woodhouse, that 'there seems little doubt that increased agricultural output has been largely driven by producers' response to market opportunities' and that 'the market is generally competitive, particularly at the retail level'. These quotations may, however, give too rosy a picture of market development post-SAP. Other studies present a quite opposite picture of the current state of affairs. Generally, they found markets to be undeveloped with a limited number of traders, mostly engaged in produce trade rather than input supply, the latter circumstance reflecting that whereas output markets may have been fully liberalized, input markets sometimes remain controlled. Liberalization has been half-hearted and patronage policies have been found to be compatible with processes of political and economic liberalization. In Ethiopia, *all* private fertilizer traders withdrew in 2001/02 due to unfair bureaucratic treatment. Instead has been created monopolistic holding companies with 'strong ties' to regional governments. In other cases, privatized parastatal organizations have been sold to top politicians' kin and proxies, sometimes at extremely low prices, resulting in private monopolies replacing state monopolies.

This is not to say that governments are indifferent to market development, only that opportunities to enter are artificially skewed. Moreover, it should be remembered that most potential customers of inputs and producers of output are small-scale and liquidity constrained. Hence, even when they respond positively to market signals, the supplies and effective demands of smallholders are limited. Taken together with frequently dispersed settlement patterns and inadequate road infrastructure, this renders trade rather costly. Also, most traders are small-scale with limited working capital and limited capacities both to store and to transport agricultural commodities. They are hardly ever capable of extending credit, especially not for food crops. They face difficulties in reaching economies of scale and most traders operate at very small margins.

Agricultural markets tend to be non-competitive and trust appears not (yet) to characterize these newly emerging markets. Not surprisingly, individuals as well as firms prefer to deal with people they already know. Hence, African smallholders are facing serious marketing and price uncertainties, which have contributed to diminishing producer confidence in newly liberalized markets. Increasingly this, in turn, has encouraged governments to intervene in order to correct 'market failures'.

Jayne et al make the point that the common notions of 'market failures' in SSA often miss the point. True, subsidies and monopolies distort markets but rather than malfunctioning, the question is instead often one of missing markets, i.e. markets that are not only thin and

volatile, but often 'do not arise at all'. Thus, governments' lack of confidence in the capacity of the private sector tends, as Saasa puts it, to become 'a self-fulfilling prophecy in the sense that its continuing involvement in the market despite market liberalization has fuelled the private sector's loss of confidence in this activity and, hence, a good justification for further government entry.'

There can be good grounds to doubt the motives for government's market interventions. But the 'one-message-only' policies imposed by the IMF and the World Bank to substitute market for government, as the 'trigger' of development, has been preoccupied with hypothetical gains in ideal situations far removed from real world possibilities and constraints. Proponents of SAP have had the ill-founded expectation that market reform would be quick and that around the corner there were willing and able entrepreneurs just waiting for the 'go-ahead'. This turned out to be wishful thinking.

Post-SAP?

Since the introduction of SAP, the World Bank and the donor community have been pushing hard for African governments (and peasants) to abandon food self-reliance and instead opt for food security by means of diversification, prioritizing export crops and investment in non-farm sources of livelihood. To some extent such reorientations have surfaced in all countries studied. On the other hand, national food self-sufficiency is still a declared objective in Ethiopia, Kenya, Malawi and Nigeria.

Governments in SSA implemented SAP more or less reluctantly. Since then, a growing number of countries have all turned away from market-based policies to varying degrees, and are steadily 'bringing the state back in'. At the time of writing, the state maintains a trade monopoly on grain in Ethiopia and it has resumed the role of 'buyer of last resort' of food staples in Kenya, Nigeria and Zambia, for example. The Zambian government signaled disappointment with SAP and a progressive return to direct government intervention in agricultural markets. In 2002 it resumed supplying subsidized maize seed and fertilizer. It has further 'announced that it plans to implement a floor price policy on maize for the whole country. Kenya is further protecting domestic staple food production by means of a flexible customs policy. For similar reasons, Nigeria has placed a number of domestically produced food crops on the Import Prohibition List. In 2003, the Tanzanian government resumed subsidizing fertilizer in order to ensure national food security.

In Malawi, the government and the World Bank have recently collided over the state's ambition to distribute permanently subsidized starter packs (small amounts of maize, legume seeds and fertilizer) to smallholders and positions appear to become ever more polarized on this issue. The government emphasizes the need to enhance food availability by means of growing more food. The World Bank advocates export of cash crops and food imports. Whether the above observations are indications of 'failures to adjust' or a 'failure of adjustment' remains an open question.

There are several indications that currently several governments in SSA are moving towards taking on a role in agricultural development comparable to the one played by Asian governments carrying through the Green Revolution in the 1970s.

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4. Micro-level findings

This chapter discusses cross-sectional data based on a survey carried out among some 3,000 farm households in eight countries in Sub-Saharan Africa. The sampled households are typical of African family farms and located in what were considered high-potential areas.[14] They generally have a small area under cultivation, both when measured totally and per crop (Figure 8). Production is partly for subsistence, partly for sale. Fields are mainly worked by family members, with women performing the bulk of farm labor using simple hand tools. Locally, fields are prepared by ox-drawn plows.

Figure 8: Land under cultivation (total and per crop in ha) and proportion o households cultivating by type of crop.

	Total	Maize	Cassava	Sorghum	Rice	Other food crops	Non-food crops
Mean farm sizw	2.6	1.0	0.6	1.0	0.8	0.7	1.0
Median farm size	1.8	0.7	0.4	0.8	0.6	0.5	0.5
Pct. hh cultivating	100	85	40	23	25	81	37

Farming performance – indicators of intensification

Maize

Both average production and yields of maize over the period 2000–2002 were generally low with an overall mean yield of 1.3 ton/ha and year (Table 2). Regional average maize yields range from 0.7 tonnes per hectare Bwanje Valley in Malawi to 2.5 tonnes per hectare in Kaduna State, Nigeria. Village averages range from 0.4 in Kiambii village, Kenya to 5.3 tonnes per hectare in Galma village in Nigeria. There is variation not only in country means but also between farmers within the same region and village. Although the yields obtained by the majority of farmers are generally low, a small number of farmers (the best-performing) five percent have yields that are substantially higher than the majority of farmers. These large differences show a) a considerable diversity in the conditions of production facing farmers in different parts of SSA, and b) an ongoing process of polarization among the African smallholders.

[14] For more details on the survey methods and sampling, see Larsson in Djurfeldt et al, 2005.

Cassava, sorghum and paddy/rice

A similar pattern as for maize emerges for the other staple crops covered in the study, i.e. cassava, sorghum and rice. There is considerable variation between farmers, as well as between regions, villages and countries. The three year average yield of cassava at 5.4 tonnes per hectare is far below the corresponding FAO estimate for SSA as a whole (8.9 tonnes per hectare). A major difficulty here has been the problem of accurately estimating what is the seasonal or annual cassava production.[15] What we did find in terms of cassava was that higher yields in general were reported from countries and farmers, which had been exposed to new high yielding and virus resistant varieties. The highest yields were reported from Nigeria, indicating a possibly ongoing cassava revolution there.

Figure 9. Maize production (tonnes/farm) and yields (tonnes per hectare) seasons 2000–2002*

Country	Proportion sampled farmers growing maize (%)	3-seasons mean production (t/farm)	3-seasons mean yield (t/ha)	3-seasons median yield (t/ha)	5% best performing farmers yield (t/ha)**
Ehiopia	52	1.2	1.2	1.0	4.0
Ghana	49	0.8	1.2	1.0	5.2
Kenya	100	0.9	1.6	1.1	4.7
Malawi	99	0.6	0.9	0.8	2.2
Nigeria	98	3.7	1.8	1.4	3.4
Tanzania	89	0.9	1.0	0.8	2.2
Uganda	91	1.1	1.5	1.2	4.4
Zambia	100	1.5	1.1	0.9	2.8
Total	85	1.5	1.3	1.0	3.4

* Yields above 10 tonnes per hectare at farm level have been excluded.

**Based on village gigures

For sorghum, average yields based on the survey stand at 0.8 tonnes per hectare, which is also the FAO estimate for SSA as a whole for the period 2000–2002. Also in this case, there is a pronounced variation between countries, regions, villages and farm households.

Overall average yield of paddy stands at 1.4 tonnes per hectare, which is somewhat less than the FAO estimate for SSA as a whole (1. Tons or metric tonnes per hectare?) for the 2000–2002 period. Rice is grown by nearly half the sampled farmers in Ghana, Tanzania and Uganda. Average yields lag behind those obtained elsewhere in the world. Some individual farmers, however, experience yields at levels with those recorded in Asia. At farm level, the highest yields were produced by farmers in Nigeria and Tanzania (7.4 and 7.7 tonnes per hectare, respectively). A quarter of the rice farmers have all or part of their land under irrigation and have higher yields.

[15] There are several problems regarding yield estimation. As described in a recent report from FAO, cassava is planted throughout the year and a single plot will contain plants of different ages, new plants replacing old ones as they are consumed. Furthermore, during its life span of up to two years, cassava may be harvested at any time

Farm level yield gaps

The above description shows that in potentially dynamic areas of SSA, the majority of farmers get yields far below those possible to obtain under existing agro-ecological conditions. Yield potential was defined as the mean yield of the five percent best performing farmers per crop and village. Figure 10 gives the summary yield gaps for all four staple crops, which point at a general gap of about 60% between the majority and the best performing farmers the same village.

Figure 10: Summary of yield gaps, all crops.

	Mean yield (t/ha)	Potential yield (t/ha)	Yield gap (%)
Maize	1.3	3.4	-60.3
(Cassava)	(5.4)	(14.0)	(-57.6)
Sorghum	0.9	1.8	-53.5
Rice	1.4	3.6	-58.9

Partly, the large yield gaps can be explained by intra-village differences in agro-ecological conditions (soils, slope etc.) favoring some farmers while handicapping others. The main reasons for the yield gap, however, are economic and political conditions leaving the majority of smallholders with no other choice than to produce largely for subsistence with no or little use of purchased yield improving inputs.

Technology adoption, land use and labor

Hoe cultivation is the dominant kind of land preparation amongst the farm households interviewed. Due to labor constraints this set definite limits to farm size and total output. In tsetse free areas where it has been possible to raise cattle, the use of oxen for plowing and chart transportation has increased the productivity of labor and hence the area that can be cultivated, provided land is available. However, only a minor percentage of the farmers, mainly the wealthiest strata, have access to or can afford to hire tractors for plowing and other tasks. The use of oxen and tractors in the preparation of maize and rice fields is positively associated not only with higher production and marketing of crops, but also with considerably higher yields. This bears evidence of the larger resources, including yield raising inputs that can be afforded by those farmers who have access to oxen and particularly tractors.

Irrigation

Although land under irrigation may be more common in SSA than is officially recognized, it still only constitutes a fraction of all land cultivated. Of the land cultivated by the sampled farmers, only about seven percent is under some kind of irrigation. Virtually all irrigation systems recorded are small-scale and managed by individual farmers or groups of households. Irrigation systems mostly concern the cultivation of vegetables and to some extent rice.

Improved seeds

We found adoption rates of high yielding seed varieties to be quite high, notably in the case of maize. In fact, adoption rates of high yielding varieties are higher in Africa today than was the situation in South Asia in the 1970s. This suggests that technology is not as constraining as may be generally assumed. It should be noted, however, that although farmers

may report use of hybrid seeds, such statements sometimes refer to *re-circulated* hybrid seeds with a poorer production potential than hybrid proper. In this sense, the figures may give a somewhat brighter view of seed adoption than is actually the case. Also, there is considerable variation between countries and regions when it comes to the adoption of improved seeds. The highest adoption rates of maize HYV were recorded for Kenya, Zambia and Nigeria with 75–80% of the sampled farmers using either hybrids or composite varieties. In Tanzania, the situation was the opposite with 80% of the farmers using traditional varieties as their main type of seed.

For cassava, the vast majority of farmers (60%) use traditional varieties. The exception is Nigeria, which accounts for most records of improved cassava in the sample. In Nigeria, 82% of the cassava growers use improved planting material. Adoption rates of improved virus resistant varieties are relatively high also in Uganda, Ghana and Malawi.

Also in the case of sorghum and rice, improved varieties seem to have partly replaced traditional ones. For sorghum, adoption rate is highest in Kenya, where a third of the sampled farmers (33%) use improved seed. For rice, about 60% of the farmers in Nigeria and 30% in Ghana and Uganda use improved varieties. Generally, lowland rain-fed rice dominates and is grown by more than three quarters of the sampled rice farmers.

Agro-chemicals

In contrast to the relatively high adoption rate of HYVs, the use of pesticides is modest and the use of chemical fertilizer is extremely low. With due consideration taken to the fact that fertilizer recommendations differ with crop type, agro-ecological characteristics, type of fertilizer used etc., our data point at a generally very low fertilizer application on staple food crops. This finding is in line with macro level observations.

In the case of maize, more than half of the sampled farmers (53%) did not apply any chemical fertilizer at all during the 2002 season. The average application rate was 14 kg/ha. There is, however, considerable variation in the national and regional average application rates on maize, as well as in the amounts reported by individual farmers. For example, Kenyan and Zambian average rates on maize reach 31 and 37 kg/ha while in Uganda and Ghana rates are negligible. For the other crops, the amounts applied are even smaller. On rice, one third of the farmers applied some fertilizer. On sorghum, 45% of the farmers used fertilizers, albeit in very small quantities. Chemical fertilizer use is nearly non-existent for cassava.

Non-industrial or organic inputs

The limited use of chemical fertilizer is to some extent compensated for by fallowing, crop rotation, intercropping and by the incorporation of organic matter in cultivated fields. In the case of maize, crop rotation and intercropping (most often with legumes) are practiced by almost half of the farmers and another third use fallowing for restoring soil nutrients. About as many apply compost material, most often in the form of crop residues that remain on the fields after harvesting. A quarter of the farmers use animal manure on maize, but three quarters of the households do not have cattle and more than half of the farm household do not have goats or sheep. About a third of the sampled farmers have taken on additional conservation and investment measures on their maize farms

in the form of planting trees and grass strips, constructing leveling bunds and, in some cases, building terraces on sloping land.

The picture is similar for the other staple crops. Most of the measures mentioned are well established practices for maintaining soil fertility in situations of permanent cultivation. The thorough land preparation required in such circumstances, including the collection and spreading animal manure and other organic matter, as well as the need for repeated weeding, conservation measures etc. are all labor-intensive tasks.

Returns to labor

Not only is the overall production of staple crops per farm unit small, returns per labor or consumption unit within the farm households also bear evidence of an agricultural crisis in SSA. We have assumed that 220 kg of grain equivalents per person (consumption unit) per year is roughly what is required to be food secure from a farm household's own production. Below this amount, households are net buyers of staples, above this amount they are surplus producers. Figure 11 outlines the distribution of grain equivalents per consumption or labor unit. Due to large measuring errors in estimating cassava production, figures are presented both including and excluding cassava. It is not only evident that there is remarkably low production per capita, but also that distribution is highly variable and skewed. Production for the lowest ten per cent of the households interviewed is negligible while the highest ten per cent of the households interviewed produce a surplus exceeding two to three times their own consumption needs.

More than half the households (55%) fail to a produce above 220 kg of grain equivalents per consumption unit and year and consequently are net buyers of basic food items. When cassava is excluded, this figure is 62%.

Figure 11. Production of grain equivalents (kg) per year and consumption unit per household.

	Mean	Median	10%	90%	SD	220 kr pcu	Total no. of cases
Kg grain eq. pcu	270	156	34	542	566	55%	2707
Kg grain eq. incl. cassava pcu	332	196	39	677	607	62%	2728

Households may secure their food and incomes to buy food from other sources than staple crop production, including other food crops (e.g. vegetables) and sale of cash crops (e.g. cotton, coffee, tea, cocoa, etc.), or they may work off-farm for cash. Such incomes, however, are generally small and insecure and do no suffice to alter the persistent poverty and food insecurity affecting the majority of farm households interviewed (see below).

Commercialization and market integration

In the case of maize, cassava and sorghum, only about half the growers had anything to sell after their last harvest in 2002 and the amounts marketed were modest (Figure 12). In the case of maize, the average amount sold per household was 0.6 tonnes, all growers considered. Looking at sellers only, the average amount sold was 1.2 tonnes per household, although there was a large variation between households.

For maize, as well as for the other staple crops, the bulk of marketed production comes from a commercially oriented minority of the farmer population. The skewed distribution of marketed production is evident

when average and median sales are compared. As far as staple crops are concerned, marketed production is marginal for the vast majority of farmers. Although most of them (87%) did sell at least something of at least one crop in the year preceding the survey, the amounts sold and the incomes generated were small.

The highest marketing rates are for rice and other food crops (e.g. vegetables, beans and potatoes), both of which may reflect the economic liberalization that swept across the continent in the 1990s. Production of both rice and vegetables are market driven and, in the case of the latter, is an important and immediate source of cash income that can be regularly tapped throughout the year by households in need of cash.

Figure 12: Proportion farmers selling and amount marketed

	Maize	Cassava	Sorghum	Rice	Other food crops	Nonfood crops	Any type of crop
Proportion of growers who sell the crop (%)	48	57	49	74	70	100	87
Average (and median) amount sold, all farmers (ton)	0.6(0.0)	1.4(0.3)	0.3(0.0)	0.5 (0.2)	–	–	–
Average proportion of total production sold, all farmers (%)	24	31	18	33	–	–	–

Off-farm activities

The most common types of off-farm activities are various micro businesses and employment. Our definition of 'employment' is crude but most often refers to low-income jobs of a casual labor type found in both the farm and non-farm sector. Micro-business includes various self-employed activities such as e.g. brewing, petty trade and retailing and crafts. In most cases incomes earned in micro business can be assumed to be higher than from employment activities. Finally, large-scale business refers to self-employment activities (transportation, construction, manufacturing and trade) that in terms of scale, investments and returns surpass those of micro-business. Only a few households are involved in this kind of wealth generating activities.

About half the households (53%) have at least one adult member who regularly earns income from activities outside the farm. And, on average, nearly one third of all adult members (28%) are regularly involved in some kind of income earning activity outside farming. This pattern is fairly uniform in all countries except for Ethiopia and Nigeria. In the former both the proportion of households (21%) and the proportion of members (11%) involved in off-farm activities is remarkably low, a circumstance that reflects the low level of urbanization and diversification of the rural economy. In Nigeria, on the other hand, more than three quarters of the households (77%) obtain incomes from outside their farms.

Despite the Nigerian exception, the general picture is one of a problematic livelihood situation for the majority of farming households. Although income was not measured directly in the Afrint survey, the proxy indicators we have been discussing, as well as yields and marketing of food crops, all bear evidence of an agricultural crisis that manifests itself in persistent poverty and food insecurity for the rural population.

For most farmers, non-farm and off-farm work generate only small incomes, which although important, are inadequate to alter the poverty condition they are experiencing. Similarly, incomes from sale of other food crops may provide important supplements to their household budgets but, with few exceptions, take place on a limited scale, involve high labour and transport costs and are prone to large price fluctuations. Also for what could be termed traditional export crops or non-food cash crops is the situation problematic. About one third of the households produce non-food cash crops, but under conditions that often have deteriorated due to increased competition by new actors on the world market (cocoa, coffee etc.) or due to price dumping by Western producers and governments (e.g. cotton).

Context and conditions of intensification

At village level, factors referring to the various agro-ecological settings of the villages surveyed include rainfall pattern, soil quality, slope, and proportion of irrigated land, as well as distance to towns and permanent crop outlets, access to road infrastructure, electricity, etc. Not surprisingly, a crude classification of the surveyed villages into low/good potential with respect to agro-ecology and market factors (agricultural dynamism) shows that yields, production and marketing are higher in villages with both good agro-ecological and market conditions than where such preconditions are missing (see Figure 13).

Figure 13. Yield (tonnes per hectare) by village type of agricultural dynamism.

	Maize	Cassava	Sorghum	Rice
Low agri/market potential	1.2	4.9	0.7	1.0
Mixed agri/market potential	1.2	3.9	0.9	1.5
Good agri/market potential	1.7	9.6	1.0	1.5

While it can be concluded that both markets and agro-ecology matter, it is also evident that average yields and production remain low also in areas where relatively favourable conditions are present. This circumstance points at the existence of a number of general and macro based mechanisms that constrain small farmer activity in Sub-Saharan Africa.

As a general observation, state intervention and farmer organization are not very prominent features in the post-SAP situation. In the areas surveyed neither state support nor farmers organizations have any significant impact on yields when it comes to maize. However, there is a weak but positive relationship between marketing of produce and the presence of state/NGO support. In rice cultivation, higher yields tend to be associated with the simultaneous presence of farmer organizations (irrigation groups). For sorghum higher yields are associated with state or NGO projects. In the present SSA situation the support to farmers by the state is generally weak and viable farmer organizations are rare or missing altogether. The crude character of these independent variables makes it tricky to analyse their precise impact and to identify what aspect of state intervention is responsible for higher yields. A cautious interpretation is to say that the results do not contradict the Asian model that external (state) intervention or the presence of local farmer organizations, may have a positive impact on yields and hence on farmers' ability to produce for the market.

The impact of 'modern' technology on crop yields is the perhaps most apparent finding. Chemical fertilizer, improved seeds and pesticides, as well as mechanical means of land preparation (tractor and

oxen plowing) are for virtually all crops associated with higher yields. In the case of maize each factor adds about 500–700 kg per hectare. It is worth noting that we observe this effect on the basis of a rather crude division of households into users/non-users of industrial inputs that takes little consideration to the variation in actual application rates. In respect of the generally low quantities of fertilizers applied, for example, the findings point to a large potential for obtaining higher yields in SSA, should farmers' adoption and use of industrial inputs increase.

Applying animal and green manure both have a significant impact on maize and sorghum yields, each increasing maize yields by about 250 kg per hectare, for example. These are typical measures for intensifying production where farmers find industrial inputs too costly. They do have some apparent drawbacks. Access to animal manure is a problem for the majority of households lacking livestock. More important, both are labor demanding and set definite limits to the farm area that can be supplied by these inputs given the farm labor available.

Generally, farmers who score high on the use of chemical fertilizer also seem to use manure to a greater extent. However, when the scale of farm operations and labor concerns are taken into account, the limited potential of using animal manure for raising productivity becomes obvious. Manure increases yields where farm size is small and land can be operated manually. When oxen or tractors permit the cultivation of a larger area, the effect of manure disappears while that of fertilizer remains. The highest yields and returns to labor are found among farmers who combine oxen/tractor plowing with industrial inputs, notably fertilizer.

The effect of green manure (e.g. crop residues left on the land after harvest or compost material applied to small areas) seems independent of industrial inputs or type of land use, at least in the case of maize where it contributes positively to higher yields. Crop rotation, on the other hand, seems to have no significant impact on yields. This possibly reflects an interaction effect where farmers combine fertilizer use with crop rotation.

Finally, the positive impact on rice yields of irrigation technology is noteworthy. Irrigation is not commonly adopted but where it occurs, almost exclusively for rice and vegetables, it has a positive impact on yields.

In summarizing, we want to underline the positive impact of industrialized inputs on yields, notably chemical fertilizer, and at the same time, the strikingly low adoption and application rates of these inputs by farmers in SSA. The findings indicate that markets can generate higher yields and production in places where agro-ecological conditions are favorable. However, the low average yields obtained by the majority of farmers in such settings indicate that essential elements for realizing a surplus production (i.e. market incentives) are lacking.

Gender and wealth

In the preceding chapters we have indicated that yield, production and marketing of food crops contain dimensions related to poverty/wealth. We have argued that certain groups are disadvantaged in terms of risk management and access to the assets and inputs required to increase their production for the market. Apart from poor farmers one such (and overlapping) disadvantaged group is women farmers – particularly in female headed households.

The wealth and gender distribution of the household survey sample is given in Figure 14. The sex of the farm manager is in the vast majority of cases equivalent to that of the household head.

Figure 14: Wealth and gender (of farm manager) of sampled households.

Wealth group	No. of cases	Per cent	Cumulative per cent
Very poor (1)	749	26.0	26.0
Below average (2)	1 005	34.9	60.9
Average (3)	837	29.1	89.9
Above average (4)	223	7.7	97.7
Very wealthy (5)	67	2.3	100.0
Total	2 881	100.0	
Missing	216		
Grand total	3 097		

Sex of farm manager	No. of cases	Per cent
Male	2 421	78.5
Female	664	21.5
Total	3 085	100.0
Missing	12	
Grand total	3 097	

Almost 90% of the households are found in the first three wealth groups for which average maize yield do not exceed 1.4 ton per ha and average production is not higher than 1.8 tonnes per year. In terms of production per capita (consumption unit), it is only the two wealthiest that are net surplus producers. The wealthiest group have, on average, yields more than twice as high as the poorest group, and in terms of total production and production per capita, score seven to ten times higher (see Figure 15). The higher production for the wealthy groups is not only a result of their higher yields but also of their larger farm size and the labor saving assets they have access to in the form of oxen and tractors to work the land.

Figure 15. Maize yield and production (total and per consumption unit) by wealth group.

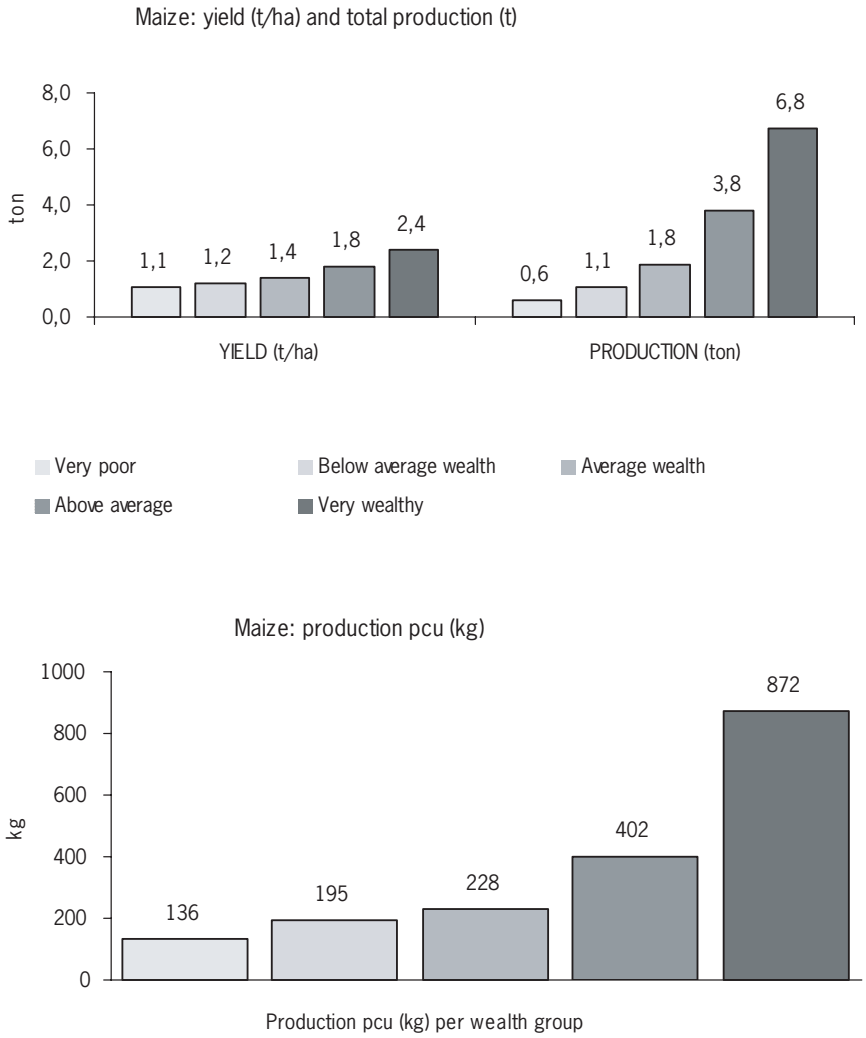
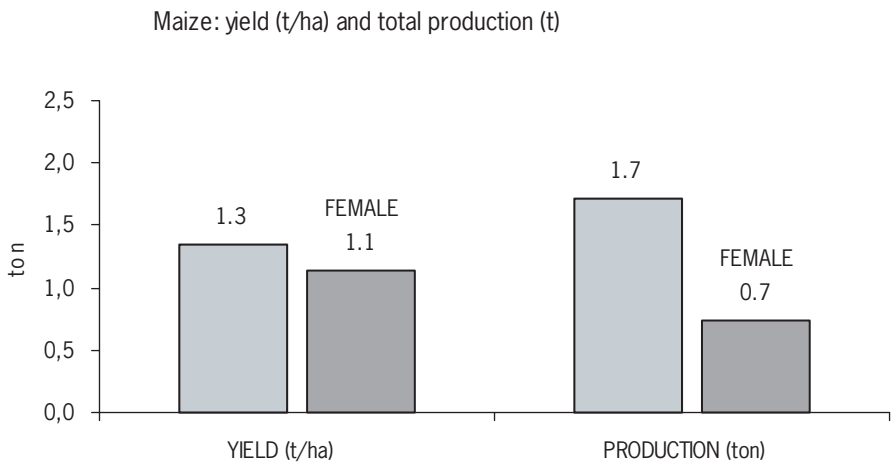


Figure 16 shows the gender dimension of farm performance in maize. The difference in yield is to the advantage of male-headed households but is not very large, and at country level is statistically significant only in the cases of Malawi, Kenya and Tanzania. The difference in production per capita is significant but not exceptional (females: 183 kg, males: 223 kg). Total production, on the other hand, differs substantially and male-headed households on average produce more than twice as much as female-headed households on a yearly basis. This suggests that gender differences in farming primarily refer to the scale of farm operations, rather than to the level of intensification. Female households more often tend to lack the resources necessary (e.g. land, labor etc.) for producing a surplus. Compared to male households, their farming is to a greater extent subsistence rather than market oriented.

Figure 16. Maize yield and production by gender; male and female headed households.



The differences described for maize pertain to cassava, sorghum and rice as well. For all crops, there seems to be a marked leap in both level of production and yield between the households of the two or three lowest wealth groups and the rest. The two lowest groups encompass about 60% of the households, this indicates the approximate proportion of households trapped in a situation of low production, low yields and low income.

Moreover, there are differences in the pattern for maize on the one hand, and cassava, sorghum and rice on the other. For cassava and rice, both average production and yield are lower for the wealthiest group than for the groups in the middle. For sorghum, total production is highest for the wealthiest group while yield for this group is considerably lower. This suggests that the wealthiest strata concentrate on maize as a cash crop, where they are able to take advantage of their larger farm size and better access to labor saving technology. Apart from commercial maize production, the wealth of this group probably derives from a number of other sources, i.e. various kinds of profitable off-farm enterprises.

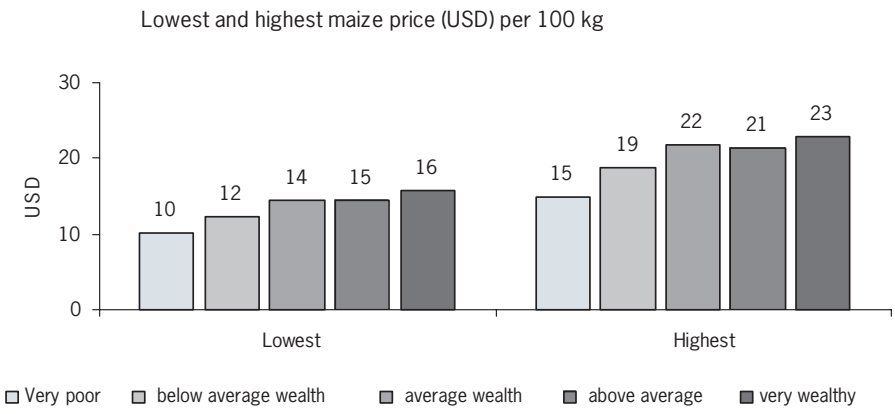
Market integration

When it comes to marketing, gender and wealth differences are as striking as for production. The significance of maize as a market crop is accentuated in that commercial maize production, to a greater extent than is the case for the other staples, involves the wealthiest group. For cassava, sorghum and rice, the share of farmers producing for the market and the proportion of harvest sold is highest for the middle groups. Overall, however, most marketing is done by the middle groups, while the poorest groups show a considerably lower level of market integration. As demonstrated earlier, the quantities sold are in most cases very modest.

Not only do poorer groups market their crops less often and in smaller quantities, the price they obtain is generally lower than for the wealthier groups. Crop sale by poorer groups often takes place as a distress sale at a time when prices are at their lowest. Wealthier farmers, on the other hand, can afford to store part of their harvest until demand and prices

rise. They are also generally in a better position to negotiate sale prices, transport costs etc. (Figure 17). Male and female farm managers, however, obtain about the same farm gate price for maize. In terms of gender, the major differences pertain to the scale of farm operations and to the level of market orientation and income rather than to productivity and unit price for sales.

Figure 17. Lowest (post harvest) and highest farm gate price for maize by wealth group.



Links between off-farm income and farm production

A significant part of a household's market integration is its involvement in off-farm activities. What then are the links between off-farm activities/incomes and farm performance?

For all crops there is a distinct pattern suggesting a U-shaped relationship between off-farm incomes on the one hand, and farm performance (yields) and commercialization of farm production on the other. This means that above a certain critical level, incomes earned from off-farm activities are positively associated with both yields and the propensity to produce for the market.

Regardless of crop, households relying on employment as their sole source of off-farm income have lower yields and are less likely to market their produce. The negative association between this group and yields/commercialization suggests that the income generated from employment is too small to be reinvested in agriculture. For this category of households, farm production appears to be predominantly subsistence oriented. In contrast, income from micro-business implies a higher degree of commercialization measured as the share of households producing for the market and the share of production sold. The most pronounced difference is found between households with large-scale business and other categories of households. This finding indicates that this group of households produces at a larger scale and can afford labor saving and yield improving inputs.

Moreover, looking at producer price level, a similarly distinct pattern is revealed. Higher incomes from certain kinds of off-farm activities seem to imply a higher farm gate price. This suggests that access to sufficiently large off-farm incomes makes the households better equipped to obtain a better price, for instance by storing a part of the harvest until demand is higher. This capacity is obtained when incomes derive from micro business and large-scale business activities. Off-farm income in the form

of employment, however, has the opposite effect. Employment in the form of low-income jobs underlines the poverty condition of affected households and indicates that crop sales for this group are distress sales at a time when prices are most unfavorable. This is a condition they share with households without access to off-farm incomes.

Based on the surveys, we have found substantial differences between households in terms of production (total and per capita), productivity and crop sales. The majority of the rural farm population, including a disproportionate number of female headed households, is economically marginalized in that their level of production is too low to permit more than irregular sales of very small quantities. Off-farm activities provide an important complementary income source. When such incomes are high, they accrue to larger/wealthier households and seem to come along with higher yields and better farm-gate prices.

Summary conclusion

It should be remembered that the Afrint survey was carried out in what were considered to be high-potential areas in SSA, i.e. with comparatively favorable climatic and agro-ecological conditions as well as above average access to transport infrastructure, labor markets and markets for inputs and sale of produce. Nevertheless, our data supports the view that smallholder farming in SSA – even after the SAP reforms of the 1980s and 1990s – face a prolonged and multi-dimensional crisis:

- a high degree of subsistence farming;
- low productivity;
- low and uncertain incomes;
- a high risk exposure to market failures and climatic adversaries; and
- an increasing resort to multiple but meager sources of off-farm income.

While the adoption rates of high yielding seeds are relatively high, the use of chemical fertilizer is marginal for most farmers and for most crops. For all crops and in all analyses chemical fertilizer is the input with the strongest and most consistent effect on yield and level of production (both total and per capita). Yet few farmers see it worthwhile or can afford to use fertilizer.

The performance of African smallholders is held back by a number of economic, political and institutional factors at regional, national and international level. Under present conditions, only a small number of wealthy households have access to the resources and the financial security that make it possible to improve yields, raise production and market anything but a marginal surplus. The performance of these farmers and the gap between them and the majority clearly shows that the African food crisis is policy related. Where market and agro-ecological conditions are favorable, households respond with higher production and higher yields. On the whole, however, the majority of the farm population, including most female-headed households, is trapped in a situation of low and uncertain incomes, financial and institutional insecurity, inadequate on-farm resources, and low labor and area productivity. Many such subsistence-oriented small farmer households are not food secure throughout the year. In the present situation, few households can afford or see it worthwhile to invest in productivity-raising and labor-saving technologies in order to produce a marketable surplus of staple food crops. As a result their market integration into is small.

5. Conclusions:
What can sub-Saharan Africa learn from Asia?

A fundamental argument made in this booklet is that the Green Revolution was not merely a 'package of technology'. We have used a holistic model stressing that Asian Green Revolutions were state-driven, but that they provided for important roles for the private sector and, most importantly, included the smallholders in the process (Djurfeldt, in Djurfeldt et al, 2005).

Furthermore, we stress the geopolitical situation facing Asian governments from the mid-1960s and onwards. The threat of famines loomed, as did the fear that food scarcity could lead to uprisings or communist revolutions. Ruling elites felt that, at the very least, they had to make sure that their constituencies had enough food to stay calm. These circumstances translated into far-reaching modernization programs, often propagated under a nationalistic rhetoric. All had in common Green Revolution policies deliberately aimed at including the smallholders, if not, one could hardly have talked about revolutions.

The Asian Green Revolutions were concentrated to the major staple crops and were firstly initiated in high-potential areas, where returns on investment were higher and, hence, made possible further investments elsewhere. From these core areas they spread spatially into other areas (and crops). Had the Asian governments at the time instead diverted investments, extension, etc. to the most remote regions and the most place-specific crops, the Asian Green Revolutions would never have come about.

As a result of the Green Revolutions Asia has avoided major famines. Countries that were food scarce then no longer are, and several have turned into net exporters. It is difficult to see how this could have been achieved without a Green Revolution.

It is a widespread myth about the Asian Green Revolution that it worsened ecological crises, increased poverty and inequality. Although this issue has not been dealt with in this study, there is sufficient evidence that this myth does not stand the test of empirical evidence. A large body of literature exists today which shows that, on the whole, the Asian Green Revolution has been scale neutral and, in fact, smallholders have tended to benefit rather than lose out. Moreover, initial regional income inequalities due to uneven implementation were overcome by migration and interregional factor market adjustments.[16] A growing number of

[16] As demonstrated by Otsuka and Yamano (in Djurfeldt et al, 2005).

researchers are finding that the Green Revolution can be an effective pro-poor development strategy.

Adversities notwithstanding, the Asian Green Revolution has also had major positive ecological effects. As pointed out by Borlaugh – the 'father of the green revolution' –'the high yields of the Green Revolution … had a dramatic conservation effect: saving millions of acres of wildlands all over the Third World from being cleared for more low-yield crops'.

Often arid and always diverse, African agro-ecologies are commonly seen as hindrances to agricultural intensification, but should rather be viewed as limitations. This is evidenced by the recorded yield-gaps, for example, which indicate a vast potential in African smallholder agriculture (Larsson in Djurfeldt et al, 2005). Appropriate technology is largely available 'on the shelf' and technologies are now more Africa-friendly than they used to be (Haggblade in Djurfeldt et al, 2005).

Although irrigation cannot be developed on a massive scale (as in parts of Asia), it can still make significant contributions to food security and agricultural development in Sub-Saharan Africa. There is plenty of evidence that small-scale systems, built and managed by farmers, continue to expand, driven by commercial opportunities (Larsson in Djurfeldt et al, 2005).

Adoption rates for high-yield varieties, drought tolerant and pest resistant seeds are often high, not infrequently at par with or even exceeding those in Asia in the early years of Asia's Green Revolution. A serious problem, however, is the price of fertilizer. African smallholders presently pay the highest prices in the world for inorganic fertilizers with serious consequences for the performance of other Green Revolution technologies, let alone food security (Holmén, Larsson in Djurfeldt et al, 2005).

State efforts to drive the intensification of agriculture in Sub-Saharan Africa have periodically met with substantial success, giving another indication of the potential (Holmén in Djurfeldt et al, 2005). These efforts have, however, only occasionally included the smallholders.

Food security, for smallholders as well as for the population at large, requires deeper integration of farmers into the markets, especially for staple foods. For markets to evolve, it is essential that governments – as they did in Asia a few decades ago – not only oversee the operation of markets but also to be active in the markets and benefit from market opportunities. It is not the samll scale of African peasant farming, which constrains them, but the deep economic and political crisis afflicting African agriculture and discouraging smallholders from realizing their potentials.

The Afrint studies have also shown that where market opportunities exist for farmers to realize reasonable returns from their labor and capital investments, and the necessary inputs are accessible, they are likely to respond not only by intensifying food crop production in order to meet their own subsistence needs as well as market demand, but also to invest in maintaining or improving land fertility. Where such opportunities are weak or non-existent – i.e. without market integration – much smallholder agriculture is unsustainable, both socially and ecologically. With few incentives and no money to invest, no livestock to produce manure, and with fertilizer prices prohibitively high, these peasants are forced into depleting the soil of nutrients. Hence, instead of being hurt by being integrated in the market, smallholders suffer when excluded from it.

Another myth, especially popular among Western academia, politicians and aid agencies, is that African governments are incapable of driving development, let alone maintain law and order in their territories. Here it is good to remember that exactly the same arguments were made about Asian governments, especially loudly at the very same time that they were initiating their Green Revolution (Djurfeldt and Jirström in Djurfeldt et al, 2005).

In the first decades after independence, food was not a great problem and extensification was still an option for smallholders. Thus there was room for other priorities on the part of the state, as well as of the peasants. The situation is different today. In large parts of sub-Saharan Africa the land frontier has been reached or is about to be reached. Intensification thus has to substitute for extensification. To an increasing degree African governments, if they want to remain in power, have to make serious efforts to develop the internal resources of their countries. With smallholders making up an overwhelmingly large part of the population, implementation of Green Revolution policies seems a natural option. It is therefore no surprise that we have documented signs that governments in some Sub-Saharan countries 'obstruct' donors' demands of a reduced role for governments and instead resume a more active role in promoting food crop agriculture.

The stance of donors in general, and the IMF and the World Bank in particular, following the implementation of Structural Adjustments in many African countries, is to emphasize food security rather than food self-sufficiency. Food security implies that resources should be directed at developing those sectors where countries have a comparative advantage and obtain their food supplies from the global market. The implication is that sub-Saharan Africa should refrain from developing national or regional self-sufficiency in staples, unlike the Asian route, and unlike the path industrialized countries are currently following, if not preaching.

Under present conditions, it seems highly unlikely that a 'food-security' policy would actually lead to African food security. Whereas many constraints to African agricultural exports remain internal to the continent, the answer to the question 'Can Africa export itself out of its agricultural crisis?' to a large extent depends, not on the African actors or leadership, but upon measures taken by political institutions outside Africa. Are they willing to create markets for African exporters?

In the meantime, African governments have reasons to overhaul their import policies and look more closely at the room that the WTO gives them for protecting their own domestic production of staples.

Too many attempts have been made in Africa to copy the Asian Green Revolution. It cannot be done. As is often pointed out, conditions are entirely different, both in terms of agro-ecology and in terms of economic, political and global circumstances. The African Green Revolution is and must be different, as the 'limping' development in Africa amply shows (Holmén in Djurfeldt et al, 2005).

That it cannot be copied does not mean that the Asian Green Revolution is irrelevant. We have tried to show that prevalent definitions of the Asian Green Revolution are too narrow and focus too specifically on technology. This narrow focus prevents one from discovering the true relevance of the Asian experience.

The research reported upon here corroborates the relevance of the Asian Green Revolution. As there was in Asia, there is scope in Africa for a state-driven, market mediated and small farmer based Green Revolution. For it to progress from a one-legged limp to a two-legged

stride requires African governments to get up walking. Currently, too many governments do not own their agricultural policies. To be effective governments have to invest in building the infrastructure and the institutions needed to better integrate smallholders into markets. They further have to invest in 'farmer friendly' technologies. Although present geopolitical conditions are perhaps more constraining than those facing an earlier generation of Asian leaders, there is still room for action. It can be made bigger by creative interventions on the part of the donors.

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