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The Millennium Development Goals and the African Food Crisis

– Report from the Afrint II project

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Summary

The Millennium Development Goals and the African Food Crisis – Report from the Afrint II project[1]

This report summarises research carried out during three years (2007 – 2010) in the Sida-financed Afrint II project. The most salient, policy-relevant conclusions deal with maize, which is the biggest food crop in sub-Saharan Africa (SSA), and with seed-fertilizer technology, commercialisation and impacts of government policies. Findings are highlighted in Box 1 below.

In the following we first will describe the methodology making it possible to draw these and other conclusions. After the methodological discussion follows a deeper discussion of the above and other results of the research. The report ends with a more detailed consideration of policy relevance, especially as regards poverty alleviation, gender issues and sustainability. For a full discussion of these issues, see the book edited by the project leader Göran Djurfeldt, Aida Isinika and Ernest Aryeetey (Djurfeldt, Aryeetey et al. 2011).

1 The research reported upon here was funded by Sida-Sarec (contract no. 75000489), Sida-NATUR (contract no 750008839), the Swedish Research Council and Lund University.

The Millennium Development Goals and the African Food Crisis

BOX 1. POLICY RELEVANT AND SALIENT FINDINGS FROM AFRINT II

1) **Average** yields of four important staple food crops are low in international comparison.
2) **Yield gaps** are high. Ordinary farmers in the nine countries studied produce between 34 and 46 per cent less per hectare than the 5% best producing farmers in the same village. Assuming that only a part of these differences are due differing natural endowments (soil characteristics etc.), there is much potential to increase yields and production.
3) Farmers who are using **seed-fertilizer technology**, i.e. improved or hybrid seed and inorganic fertilizer produce 40 to 50% more per hectare than their peers. A wider spread of the technology would have substantial effects on yields and production.
4) **Market participation** had the most dramatic effect on changes in production between 2002 and 2008, with 80% higher increase in production for those who started or increased maize sales during this period. Other things equal, facilitating for smallholders to participate in markets for food crops through investments in infrastructure and market institutions is likely to have strong dynamic effects on production.
5) **Economic growth**, as experienced by many sub-Saharan African countries during the first decade of the new millennium, had strong effects on maize and other staple food production. Each one percent growth in GDP/capita, other things equal, and according to our data and modeling, resulted in around 2 per cent growth in maize production, during the period 2002 – 2008.
6) While **allocations to agriculture in state budgets** have gone up, this has not (so far) translated into field-level changes in maize production.
7) Changing **trade policies** after the collapse of the Doha Round of negotiations under the WTO, implying less dependence on imports of food crops, have had positive effects on domestic staple food production.
8) Production increase of maize from 2002 to 2008 had a **pro-poor profile** and was largely the result of smallholders cornering a larger share of the maize market.
9) Women farmers are not handicapped in terms of production or change in production, but primarily in access to land.
10) There is no evidence in our data that market led growth is anti-poor or anti-women

Background and methodology

Afrint stands for intensification of food crops agriculture in sub-Saharan Africa and has, so far, consisted of two phases, Afrint I, which lasted from 2001 to 2004, and Afrint II between 2007 and 2010. The Afrint project is headed by Professor Göran Djurfeldt, Department of Sociology, Lund University, Sweden and is a collaborating venture between researchers from Lund and Linköping universities in Sweden and some twenty researchers from universities and research centres, etc. in nine African countries. The Swedish team, the country teams and the advisors for Afrint II are presented in Box 2 below.

The Afrint project primarily dealt with four important staple food crops in sub-Saharan Africa, namely maize, sorghum, rice and cassava. In this paper, we concentrate primarily on features affecting maize production and productivity. Readers interested in performance of the other crops are referred to the more comprehensive CABI publication (Djurfeldt, Aryeetey et al. 2011). Likewise, some chapters are based

partly on econometric analysis. The technicalities concerning econometric equations have, likewise, been sketchily treated in the present report. Those readers interested in the mathematics and statistical theory behind our conclusions will need to consult the respective chapters in the abovementioned publication.

The Afrint project, while highlighting the importance also of other actors such as state and traders, pays special attention to the importance of smallholder farmers in agricultural developmetn. The Asian Green Revolution (analyzed during Afrint I, see Djurfeldt, Holmén et al. 2005) was a trinity in being *state-led, market-mediated and smallholder-based*. The overall conception of agricultural development captured in this trinity is also the starting point for the below analysis.

BOX 2. THE AFRINT II COUNTRY TEAMS

For Ethiopia, Dr. Wolday Amha, Ethiopian Economic Association, Dr. Teketel Abebe, Addis Ababa University, Dr.Mulat Demeke, Addis Ababa University; for Ghana, Professor Ernest Aryeetey, Institute of Statistical, Social and Economic Research (ISSER), Legon-Accra, Dr. Daniel Bruce Sarpong, Department of Agricultural Economics & Agribusiness, University of Ghana, Mr. Fred Danku, Institute of Statistical, Social and Economic Research (ISSER), Legon-Accra; for Kenya, Professor Willis Oluoch-Kosura, African Economic Research Consortium (AERC), Dr. Stephen K. Wambugu, Department of Geography, Kenyatta University, Dr. Joseph Karugia, the same department; for Malawi, Mr. John Kadzandira, Centre for Social Research, University of Malawi, Zomba and Dr. Wapulumuka O. Mulwafu, Faculty of Social Science, University of Malawi, Zomba; for Mozambique, Dr. Peter Coughlin, EconPolicy Research Group, Ltd., Maputo; for Nigeria, Professor Olatunji Akande, Nigerian Institute for Social and Economic Research (NISER), Ibadan and Dr. Olorunfemi Oladapo Ogundele, the same Institute; for Tanzania, Professor Aida Isinika, Institute of Continuing Education, Sokoine Agricultural University; for Uganda, Dr Bernard Bashaasha, Department of Agricultural Economics & Agribusiness, Makerere University, Kampala; and for Zambia, Mr. Mukata Wamulume, Institute of Economic and Social Research (INESOR) and Ms. Charlotte Wonani, Development Studies Department, University of Zambia.

Swedish team
From Lund University Professor Göran Djurfeldt, Department of Sociology, Professor Magnus Jirström, Dr. Agnes Andersson, Ms. Johanna Bergman Lodin, Ms. Cheryl Sjöström, Department of Human Geography, Professor Björn Holmquist, Ms. Sultana Nasrin, Department of Statistics. Member of the team was also Associate Professor Hans Holmén, Department for Thematic Studies, Linköping University.

Advisors
Professor Göran Hydén (now emeritus), University of Florida; Dr Monty Jones, Forum for Agricultural Research in Africa (FARA); Professor Richard Mkandawire, New Partnership for Africa's Development (NEPAD); and Professor Oliver Saasa, Institute of Economic and Social Research, University of Zambia.

Brief on methodology

Data collection for the first round of the Afrint project was made in 2002. The data collected as part of the second round are referred to as 2008 data, although in some cases collected in late 2007.

From the outset we selected five case study countries: Ghana, Kenya, Malawi, Nigeria and Tanzania. Outside francophone Africa, these five countries were ideally suited, in our view, to charting progress in intensification, induced from below by farmers themselves, or state induced, as in the Asian Green Revolution.

At the insistence of Sida, to the original five countries, four more were added: Ethiopia, Mozambique, Uganda and Zambia. Unlike the

original five, the three last mentioned countries were deemed[1] less constrained with respect to productive resources in agriculture. Ethiopia on the other hand is peculiar in an African context, with its long history of plough agriculture, and feudal-like social formation. In this project, our heterogeneous sample of countries has proved less cumbersome to work with than one might have expected.

Formally, the Afrint sample was drawn in four stages, of which the country selection described above was the first one. The next stage was regions within countries, followed by selection of villages within regions, and with selection of farm households as the last stage. All stages except the final one have been based on purposive sampling. Data collection was sought to be made at all four levels.

In-country teams were given fairly loose reigns to pursue the macro-level studies in a manner adapted to the local context. These studies were reported separately (see http://blog.sam.lu.se/afrint/?page_id=60) and included two books (Akande 2006; Coughlin 2006). The comparative analysis of these studies was reported in two papers by Hans Holmén (2005b; 2005a).

The households sampled within these countries were selected with respect to the agricultural potential of the areas in which they reside. The intention was to capture the dynamism in the areas that are 'above average' in terms of ecological and market (infrastructure) endowments but excluding the most extreme cases in this regard.

For logistical reasons we could not aim for a sample which is representative in a statistical sense. Instead we aimed at a sample which is illustrative of conditions in the maize-cassava belt, excluding both low-potential dry and remote areas and extreme outliers at the other end of the scale, i.e. privileged high-potential areas. The questionnaires used can be found at: http://gem.sam.lu.se/soc/socgdjweb/Questionnaires/Questionnaires.htm.

Thus we used a four-stage sample design, with purposive sampling at all stages, except the last one, where households were sampled after having made up household lists. When we compare point estimates from the sample with those from other sources, for examples yields for the various crops with FAO statistics, no apparent sample bias has been detected.

In addition to household questionnaires we also used village questionnaires. Respondents to village interviews were key persons, like village leaders and extension agents. Investigators were also instructed to conduct focus group interviews with representatives for various segments of the village population, including women farmers.

When going for a second round and a panel in 2008, we went for a balanced panel design, i.e. constructing the 2008 sample so that in itself it would be representative of village populations in 2008. This also involved sampling descendants when a household had been partitioned since 2002. In case of sizeable in-migration to a village, we also provided for sampling from the newly arrived households.

The 2002–2008 panel thus is a subset of the two cross sectional samples. In itself this subset is not statistically representative of the village population in any of the two years. Since this is the case, one should be wary of making point estimates from the panel. Such estimates should instead be made from the two cross sections.

1 Not entirely correct, for example Nigeria is in fact much more abundant in land than than the other four original sample countries.

Establishing a panel implies that questions should be repeated and thus calls for small changes to the 2002 questionnaire. In principle then, the 2008 questionnaire is identical to that used in 2002, with only small modifications deletions and additions. The 2008 cross-section contains 3810 households.

What is called the attrition rate, i.e. the percentage of households interviewed in 2002 that were not reinterviewed in 2008 is 20.6 and varies considerably between countries, as Table 1.1 makes clear.

TABLE 1. ATTRITION RATES IN 2008 RESURVEY, PERCENT (SOURCE: OWN SURVEY DATA)

Country	Percent
Ethiopia	0,6
Ghana	14,1
Kenya	11,3
Malawi	24,0
Nigeria	12,9
Tanzania	34,7
Zambia	27,5
Mozambique	28,9
Total	**20,6**

Ethiopia is exceptionally low in terms of attrition. Besides good survey organisation, this stems from the fact that we drew our sample from the membership lists of the Peasant Associations. The moderate attrition rates in Ghana, Kenya and Nigeria are the reflections of excellent survey organisations set up by the country teams. The high rate in Mozambique is probably due to the high mobility among the rural population, which in turn was due to the post conflict situation that country was still caught in when the first survey was made (in 2005). Malawi, Tanzania and Zambia, finally, had problems with their survey organisation which unfortunately resulted in higher attrition rates. Between the 2002 and 2008 rounds a new Uganda team was brought into the project. The data from 2002 could not be used as a basis for a panel, why the Afrint II database contains only a cross-section for Uganda.

A quick analysis of the distribution of attrition shows that, first of all, the poor and those with smaller households are less likely to survive in farming. Secondly, women and widows are more prone to drop out, often because their security of tenure is lower, so that, if they do not remarry, they tend to return to their native villages. In both cases they disappear from the sample. It is no surprise that older farmers tend more often to drop out of the sample, especially if they have no descendants to take over the farm.

Comparing cross-sections 2002 and 2008

As described above, the Afrint II study is a panel study. Like all such studies it involves a panel bias, i.e. the panel is not representative of the population it is drawn from, since between the survey rounds households drop in and out of the population sampled. Point estimates should therefore not be made from the panel, but from the two cross sections. Thus we start by summarising some salient results from comparing 2002 and 2008 data.

TABLE 2. FARM AND HOUSEHOLD CHARACTERISTICS, CROSSSECTIONAL DATA FROM 2002 AND 2008 SURVEYS

Characteristic	2002	2008	Change, per cent
Mean farm size, hectares	2.42	2.16	11
Average yield of maize, per hectare	1.26	1.08	14
Participation in markets for staple crops, per cent	79	83	-4
Cash income from sale of:			
Staple crops		27	
Non-staple food crops		19	
Non-food cash crops		10	
Non-farm income		34	
Per cent of cash income from non-farm sources	54	47	-7

First we note an expected but nonetheless significant result: Farm sizes have decreased since 2002. The average in 2008 is 2.16 hectares, while it was 2.42 in 2002. This represents a decreased in area of 11 per cent over five years. Similar tendencies are noted also in the literature on Africa generally with land sizes shrinking due to increases in population. This again implies that if yields are constant, production per household would decrease and, other things being equal, worsen the food situation. Unfortunately, yields show little evidence of increasing.

Breaking down the farm size data further shows that the per capita access to land is very small in absolute numbers – 0.12ha per capita or less for the bottom 25% of the 2008 sample in all countries but Ethiopia and Nigeria. In Kenya the level is only a third of that figure – 0.04 ha per capita. Thus, and in line with the findings from other scholars, the bottom 25% of agricultural households in SSA are virtually landless. Considering that the production systems under study are predominantly rain-fed rather than irrigated, the land constraints facing an increasing share of smallholders are serious.

For the most important crop, i.e. maize, the average yield over the three-year period 2000 to 2002 was 1,26 tonnes per hectare. In the period 2006 to 2008, this figure had gone down to 1,08 tonnes. i.e. a decrease of 14 per cent. Adding area and yield increase, we conclude that overall the 2002 to 2008 period has meant a worsening situation for those depending on maize. The situation is even worse for sorghum, with a 45 per cent decrease.

The cultivation of highland or rainfed rice has recently experienced considerable dynamism, documented in a case study of Uganda by the

Swedish Afrint team member, Johanna Bergman Lodin, whose Ph.D. programme is within the project. While the Ugandan case can be described as close to a revolution (Bergman Lodin, Djurfeldt et al. 2010, forthcoming), this is not reflected in the Afrint II rice panel, which covers five countries, but for reasons stated above, not Uganda. The more general picture for rice is unchanging yields. For lowland rice on the other hand, we record a positive development with a nine percent increase in average yields (Jirström, Andersson et al. forthcoming 2011).

When it comes to crop patterns we see little change over the period discussed. It is remarkable though that 'high-value' crops, like potatoes, tomatoes and onions meant for local markets are grown by fewer households. This may be a result of comparatively better prices for staples during the period, giving rise to an increased concentration on these crops among some farmers.

Given the importance of seed-fertilizer technology, mentioned in the introduction to this paper, it is saddening that the usage of improved maize seed among our sample households has fallen by 7 percent, a decrease that is only partly compensated for by an increase in the use of hybrid maize (+5%). Since at the same time, fertilizer use has increased only marginally, the increased used of hybrid seed material is likely to have had less than optimum impact on production.

For sorghum we record a pronounced setback, involving a reversal to the use of low-yield 'traditional' seed material. For rice, adoption of seed technology has advanced, but is again associated with marginal increase in the use of inorganic fertilizer, which means suboptimal effects on yields and production.

Sorghum is, however, markedly subsistence profile, with lower volumes marketed than for the other crops (and especially compared to rice, which has a commercial profile). Otherwise about half of all households sell some of their output, but on the average not much. Similarly, the proportion of households not at all participating in markets for staple crops has increased somewhat, from 17 to 21 per cent. As we will argue, this is likely to have negative effects on their food security.

Stagnation and low market involvement notwithstanding, sale of staple crops is the most important cash earner, accounting for 27 per cent of total household cash income on the average. Non-staple food crops account for 19 per cent of cash earnings, while non-food cash crops (mainly tradition export crops like cocoa, coffee etc.) account for 10 per cent of earnings. As a already mentioned, there are few signs of dynamism in the production of such crops.

Against this background one might ask if dynamism occurs more outside the farm sector than inside. In other words, are non-farm sources of income compensating for the virtual stagnation of farm income during the period? Unfortunately not!

Non-farm cash income (including agricultural wage labour) on the average make up 34% of total household cash income. This average conceals considerable inequality, since approximately half the sample (51% in 2002 and 47% in 2008) lack any form of non-farm income.

So far the story is very close to the standard narrative on African agriculture, with stagnating yields and production and, by implication a deteriorating food situation. If we are interested in smallholder agriculture as a driver of poverty alleviation and a vehicle for fulfillment of

the Millennium Development Goals (MDGs), we are forced to draw very pessimistic conclusions.

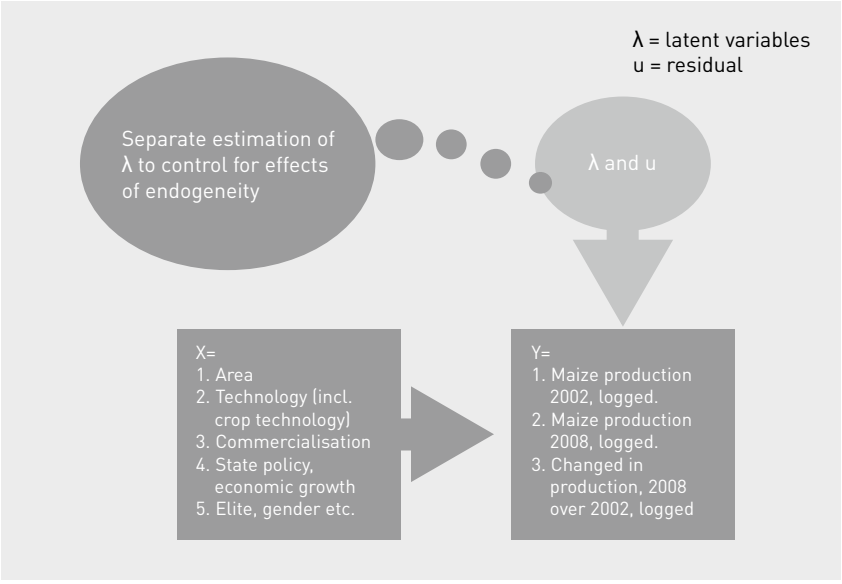
However, the great advantage with panel data, is that is permits the researcher to penetrate beneath the seemingly stagnating surface. Net changes, with the few exceptions noted above, imply stagnation and even retrogression, but when changes are netted out we lose sight of the individual household trajectories which contribute to the net zero sum. Individual households are moving upwards and downwards in terms of production, yields, usage of seed-fertilizer technology, commercialization etc. By using the panel data to study these individual trajectories we are able to draw conclusions on the potential drivers of agricultural change. These conclusions were summarized in the introduction. In the following section, we substantiate these findings.

Drivers of agricultural change – the case of maize

Panel data have the advantage, first of all, that they facilitate causal attribution. Cross-sectional data, like those discussed above, have the distinct disadvantage that conclusions on causality can be problematic, because a correlation between two factors may be spurious. If a correlation at all mirrors a causal relation, the direction of causality, from x to y, or the other way round, is not always straightforward. By using time-lagged values for independent variables, causal attribution from panel data is much less tricky. We profit from this advantage when we try statistically to model change in maize production and its drivers.

In a simplified form, the maize model can be portrayed as in Figure 1 below.

Figure 1. The maize model



The model we are referring to is estimated by regression techniques, or by what economists usually refer to as an econometric model. Such a model seeks to derive, by means of statistical techniques, a description of a dataset by means of a vector of coefficients (regression coefficients, usually denoted as ß), which most efficiently describes the relation between a matrix of independent (X) and dependent variables (Y).

As is illustrated in Figure 1, our matrix of independent variables (X) contains what we theoretically conceive of as drivers (or independent

variables): technology (most importantly seed-fertilizer technology), commercialisation, state policies (budget priorities, aspects of trade policies) and economic growth. Social factors (elite and gender) are also controlled for. Finally, we control for area under crop, which means that we model not only production, but also yields, or change in yields. By statistically controlling for factors that may influence production, we can isolate the effect of each factor independent of the other factors.

We use three dependent variables (Y) with each one matrix of independent variables: y_1 = production of maize in 2002, logged;[2] y_2 = production of maize in 2008 and y_3 = change in production 2008 over 2002, logged. By modelling production of maize in 2002 and in 2008, we get two independent estimates of a simple production function for maize. Since data were collected in two rounds, this makes it possible to check the robustness of the estimates (which should be roughly similar in both equations), as well as to gauge possible changes in the production function between 2002 and 2008.

Note that the independent variables for the production function for 2002 refer, either to the situation when the farm was newly established (usually when a young couple set up as a separate household). We call this the reference year, which is a variable with a mean of 22 years. In other words, farms surveyed in 2002 were on the average established around 1980. Similarly the independent variables for the 2008 production function refer either to 2002 or to the period 2002–08.

The most important equation, however, is the third one which links the logged difference in production, 2008 over 2002, to a similar set of independent variables, referring either to the situation in 2002 or to the period 2002–08. It is this equation which allows us to chart the drivers of agricultural change, i.e. the variables which together explain the dynamic that has been there, under the surface as it were, since 2002.

Regression models contain a *residual*, which contains the variance in the dependent variable, which cannot be attributed to the matrix of independent variables. It follows that the smaller the residual, the greater the explanatory power of the model, but this is not the most significant aspect. A requirement of a "good" regression model is that the residual should be normally distributed, which implies that the matrix of independent variables and the associated regression coefficients give an unbiased estimate, in this case, of the determinants and drivers of production and change in production.

However, strict applications of regression techniques do not allow the off-hand assumption of a normally distributed residual. Preferably, one should show that there are no latent variables (denoted λ in Figure 1) that bias the model. Some latent variables[3] which should be active are easy to conceive of, like agro-ecological potential of the farm land, farmer's capabilities and farmer's entrepreneurial capacity. We have no estimates of these variables and especially the latter ones are generally regarded as difficult if not impossible to estimate by survey methods.

To get a robust model we need estimates of the latent variables involved, not necessarily of each latent variable as such, but of *their aggregate effect*. In the maize model we achieve this by separately modelling two more dependent variables, viz. adoption of seed-fertilizer tech-

2 Taking the natural logarithm of the dependent variables has several advantages, making for a better fit and for easy interpretation of the regression coefficients.

3 Variables are referred to as latent if the researcher has no empirical estimates of them.

nology (ξ_1) and market entry (ξ_2)[4] by a matrix of independent variables (Z). Since the same latent variables are likely to be involved in the determination of ξ_1 and ξ_2 as in the determination of (Y), we can take the residuals from the models of technology adoption and market entry and introduce them into the maize model in order to check if they bias the results of the model. The result of this check is that the maize model turns out to be robust and likely to be non-biased. It should therefore be what in econometric parlance is called BLUE, i.e. the *Best Possible Linear Estimate*. Thus we feel quite confident in reporting the results below.

This is not the place to report in detail on the results of the modelling exercise (Andersson, Djurfeldt et al. 2011). The overall thrust of the results can be summarised more or less as in the introduction:

1) *Average yields* of four major food crops are low in international comparison. It is essential that productivity in agriculture generally and food production specifically is enhanced, both for overall development and for reaching the Millennium Development Goals.
2) Farmers who are using *seed-fertilizer technology*, i.e. improved or hybrid seed and inorganic fertilizer produce 40 to 50 per cent more per hectare than their peers. Since we have controlled for other influences on production (such as land size, gender, etc), these results indicate that a wider spread of technology would have substantial effects on yields and production.
3) *Market participation* has the most dramatic effect on changes in production between 2002 and 2008, with 80% higher increase for those who started or increased maize sales during this period. Other things equal, facilitating for smallholders to participate in markets for food crops through investments in infrastructure and market institutions, *other things equal*[5], would have strong dynamic effects on production.
4) *Economic growth*, as experienced by many sub-Saharan African countries during the last few years, had strong effects on maize and other staple food production. Each one percent annual growth in GDP capita, other things equal, and according to our data and modeling, resulted in annually around 2 per cent growth in maize production, during the period 2002 – 2008. Adding a 95% confidence interval to this, we can say with 95% probability, *ceteris paribus*, that the effect of a one unit increase in GDP per capita corresponds to between 1.15 and 2.85% increased growth in maize production.

4 Note that these variables also occur as two of several independent variables (X) in the maize model.

5 This clause, which is also called the ceteris paribus clause, refers to regression as a quasi-experimental technique. Like in an experiment, all other variables can be kept constant by statistical techniques in order to simulate what happens when a given variable is manipulated, e.g. when use of seed fertilizer technology increases or decreases.

5) While *allocations to agriculture in state budgets* have gone up, as a result of the Maputo Declaration in 2003 and under the CAADP, this has not (so far?) translated into field-level changes in maize production.[6]
6) Changing trade policies after the collapse of the Doha Round of negotiations under WTO, implying less dependence on imports of food crops, have had positive effects on domestic staple food production. Thus, the effects of trade policies seems to have shifted over the period. The relationship between maize imports during the latter half of the 1990s and domestic production is statistically significant and negative during the first period (between the reference year and 2002), suggesting that cheap imports may have undermined domestic production. During the second period, from 2002 to 2008, these disincentive effects disappear. In turn this may be connected to the effects of new global trade regimes associated with the World Trade Organization and the protective tariffs introduced following the collapse of the Doha Round, as well as with rising world market prices for staples and improving commercial incentives for domestic producers from 2007 onwards.
7) Production increase of maize from 2002 to 2008 had a *pro-poor profile* and was largely the result of smallholders cornering a larger share of the maize market. Interesting results emerge for the elite. In the period up to 2002, elite status[7] is related to higher production, as earlier claimed by Larsson (2005), but this does not hold for the period from the reference year to 2008, where the regression coefficient is not significant. This may signal a change, which is also brought out by the coefficient in the model for change in production, in which the coefficient is negative, although only significant at the 5% level. This may suggest that recent dynamism in maize markets can have brought new groups of smallholders into commercial production. Such a conclusion is reinforced by the strong effects we have already quoted for market entry. Thus there is some, but admittedly not very strong evidence of smallholder driven development. This development is not state driven, as suggested by the Asian model, but driven by the market.
8) Women farmers are not handicapped in terms of production volume, yield or change in production. Like reported in an earlier paper (Djurfeldt, Larsson et al. 2008) women farmers, who often are

6 Under the New Partnership for Africa's Development (NEPAD), which is an economic development programme of the African Union (AU), adopted by African heads of state in 2001. NEPAD includes the Comprehensive Africa Agriculture Development Program (CAADP), which was adopted two years later Comprehensive Africa Agriculture Development Programme (CAADP). (no year). Retrieved March 1, 2010, from http://www.nepad-caadp.net/about-caadp.php. This programme has an ambitious, well structured and informed agenda for African agriculture. Yet more substance was added at the Second Summit of the heads of states and governments of the AU in Maputo in 2003, when in a document at a concurrent meeting with the ministers of agriculture, it was stated that: 'To this end, we agree to adopt sound policies for agricultural and rural development, and commit ourselves to allocating at least 10% of national budgetary resources for their implementation within five years' (Conference of Ministers of Agriculture of the African Union. (2004). "Report of the Ministers of Agriculture." Retrieved March 1, 2010.)
A 10% budget allocation to agriculture is high by recent historical standards; on the average it was only a fraction of that in sub-Saharan Africa from the 1980s to the early years of the new millenium. According to Fan et al. (2008), investments in agriculture in Asia today constitute eight to 4% of total government budgets. During the Asian Green Revolution, from the late 1960s, according to the same source, investments were from 15% and upwards. All accounts made up, total investments were at least 50% higher than the goal set by NEPAD.

7 Elite is here defined as the 5% largest landowners in each village.

widows, achieve the same yields as their male colleagues, but lower production because they tend to cultivate less area. This again has to do with property systems, where land tends to revert to the man's lineage when a woman becomes a widow.

9) There is no evidence in our data that market led growth is anti-poor or anti-women

We included descendant households, i.e. households that was partitioned since 2002 and where one of the descendants has been sampled to replace the head of the household of the undivided household. The positive effect of a generational transfer on production is evidenced by a regression coefficient indicating that descendants currently have significantly higher production than others.[8] This too is an expected and well known phenomenon in studies of farm economics and rural sociology, as the ambitions of a younger generation in the process of an intergenerational shift are generally higher than those of their parents. The extent to which such ambitions translate into investments that enhance the productivity of the farm units depends on the smallholder business climate, however. The positive sign of the regression coefficient for descendants can thus be taken to indicate that the business climate in maize production has been somewhat positive during the period from2002 to 2008. This conclusion is supported by other results to be reported below. However, the business climate differs considerably between countries, which we will come back to below.

Another very significant result is that the change in maize production recorded between 2002 and 2008 has been largely *extensive*, i.e. building on expansion in cultivated areas rather than in yields. This again indicates that yield enhancing trends are still very weak in the villages studied. This finding is reinforced by the result that, when comparing the two cross-sections, increasing production between the two rounds of data collection was hardly at all associated with increased use of seed-fertilizer technology, as mentioned in the previous section.

Although production increases are connected to macro level developments, such developments are the reflection less of state priorities than of global processes and of domestic economic growth in general. In this sense, a state driven Green Revolution is not (so far) traceable in our case study countries.

Yet another step in the development of the models is the introduction of country dummies.[9] We choose Kenya as the reference country, with the regression coefficients for the country dummies pointing to the difference between a given country and Kenya. During the first period (from the reference year to 2002) three countries stand out negatively. Controlling for technology and commercialization and other variables, Mozambique, Ethiopia and Zambia (albeit only significant at the 5% level in the latter case) had lower production of maize than Kenya.

Nigeria had significantly higher production in the first period, as had Malawi and Tanzania (the latter significant only at 5% level). There is considerable fluidity though, as indicated by the pattern for the longer period, from the reference year to 2008, where Ethiopia and Malawi (the latter only significant at 5% level) stand out negatively,

8 Household age is already controlled for.

9 A 'dummy' is a variable which takes the value 1 (e.g. 1 = Kenya) if a case belongs to a given category (in this example Kenya) and 0 otherwise.

while Ghana, Nigeria and Zambia divert positively from Kenya. In the case of Malawi, tendencies in our sample villages deviate from the debated but politically important national maize surpluses of 2007/2008, which may be due to a bias in our sample of villages, or in the data. In the third equation, finally, Zambia, Mozambique (significant at 0.1% level) and Ghana (5% level), feature positively when compared with Kenya.

As a conclusion to this section we quote in extenso from the recently published book:

"We have used the experience of 1805 smallholders in eight African countries across the maize and cassava belt to identify and evaluate the role of three main types of production drivers, comparing two periods – one lasting on the average between 1982 and 2002 and the latter capturing the past five years. Our interest has been focused mainly on the latter period, since political interest in the welfare of smallholders across the sub continent, both as sources of domestic food production, and more generally as the core sector of broad based development has received increased attention in the last five years. Looking at the three tenets of our original model: state drivenness, technology and market mediation, production increases are primarily connected to commercial drivers and, although to a lesser extent, to inputs and use of technology. In the latter case, public interventions as found for instance through input subsidy programmes in Malawi and Zambia may have played some part in democratizing access to chemical fertilizer and improved seeds for instance. Nonetheless the use of such technology is equally widespread in countries such as Kenya that have not experimented with such programmes. The effects of this kind of state involvement therefore remain the subject of debate. Improved commercial incentives, although they are the strongest drivers of production increases, appear as yet to be largely disconnected from public efforts to improve smallholder market participation and more connected to economic growth in the non-farm sector.

"Thus the much publicized – and in many cases real – state commitment to rural development since 2003 has failed to make its mark on smallholder realities and in this sense production increases arising from improved commercial incentives are occurring despite, rather than because of state involvement. Although the images of heavy handed marketing boards conjured up by references to the pre SAP era are clearly undesirable, the state has an important role to play as an enhancer of smallholder access to markets and provider of technology. The role of the state as a facilitator of both input and especially output markets needs to be revamped to suit the realities emerging from globalized markets for staple foods, growing regional trade and the price volatility connected to unpredictable weather conditions and growing populations.

"When the research underlying this work was started in the early years of the millennium, it was done with the expectation that important changes were underway in African agriculture and that a long recession might be nearing its end. Initially we found little evidence of this (see Holmén, 2005a; Holmén, 2005b; see Larsson, 2005). This analysis however has pointed to two changing drivers: firstly, lower import dependency and hence less competition from producers overseas, in turn connected to changing trade regimes, less protection and

export subsidies in OECD countries, the collapse of the Doha round and subsequent imposition of protective tariffs by African countries etc. Secondly, quite dynamic growth in the non farm sector since the early years of the millennium have, as we have demonstrated, imputed a new dynamism into the maize sector. This driver has of late decelerated due to the global financial crisis. If it does not regain speed in the coming years, the new era may turn into an interlude."

Agricultural policy options[10]

"Reflecting at last over the contrasts between the African Green Revolution (GR), yet to take shape and the well known case of Asia, it is appropriate to ask how the African GR might differ from the Asian one. At one level, the answer is simple: it would involve other crops, be less focused on rice and wheat and be adapted to other water and climate regimes. More fundamentally, the African GR might not show the three characteristics observed in Asia, i.e. state-driven, market-mediated and smallholder-based, and which were the focus in the earlier Afrint study (Djurfeldt and Jirström 2005).

"Attempts to replicate the Asian Green Revolution in contemporary sub-Saharan Africa may not work. Examples of these failures are already seen in Nigeria (Akande, Andersson et al. 2011) and in the first attempts in Ethiopia in the early years of the new millennium to replicate the Asian GR (Wolday 2011). In Nigeria, since the restoration of democracy, after the switch from military dictatorship, governments have pursued agricultural policies that have looked almost like textbook examples of Asian policies, but with rather limited outcomes in terms of production and, above all, on the area productivity of food crops. Similarly, during the early years of the Meles regime in Ethiopia, the government adopted a credit-fuelled extension of high-yielding varieties, with the tragic effect of busting maize markets, making it impossible for farmers to sell their crops and repay their debts.

"While it can still learn from Asian experiences, Sub-Saharan Africa must find its own way – or, rather, ways. Recent crop bio-technology developments, more adapted to African environments than previously, offer new possibilities for agricultural productivity enhancement. However, crop technologies – today patented by the private sector – will have to play quite a different role from what they did in Asia from the late 1960s onwards. Efforts to create partnerships with the multinational private sector will be critical and such organizations as the Alliance for a Green Revolution in Africa (AGRA) and others may provide some clear examples of how to stimulate Public-Private Partnerships (PPP) in promoting a small-holder-based Green Revolution in sub-Saharan Africa. A redefined division of labour and responsibility between the public and the private sector might thus come to characterize the African Green Revolution when it comes of age and gains pace. The coming decade will show if such a recast of classical Green Revolution strategies will be potent enough to take the edge off the African food-crisis. The one component in the trilogy that should not be re-cast, however, is the focus on smallholders, Africa's as yet untapped resource.

10 This section quotes in extenso from Aryeetey, E., G. Djurfeldt, et al. (2011). Conclusions: What Direction for the Future of African Agriculture. African smallholders – food crops, markets and technology. G. Djurfeldt, E. Aryeetey and A. Isinika. Wallingford, Oxon., CABI.

Concluding reflections on policy relevance

Finally, we will reflect on the relevance of the results reported above for the MDGs, i.e. for Goals 1 and 3, which deal with food security and poverty. We will also discuss gender issues and sustainability. The most important conclusions are highlighted in Box 3.

BOX 3. POLICY RELEVANT CONCLUSIONS HIGHLIGHTED

- Improved access to locally produced food in settings like the one in sub-Saharan Africa would have a direct impact on poverty rates. A programme for poverty alleviation among smallholders would imply expanded distribution of improved seed and, possibly subsidized, inorganic fertilizer. Improved and hybrid seed (of maize, rice, cassava and other crops) are essential to the programme. Growth in the food crop sector has important downstream effects, which are beneficial to the rural poor.
- A programme like the one sketched above can be boosted by economic growth in the non-farm sector. Economic growth alone will not suffice, if not seconded by government investment in the agricultural sector (institutional development, agricultural extension, research, credit etc.) and trade policies treating the domestic smallholder sector as an "infant industry".
- Policies of the kind outlined above will not have detrimental, but neutral effects on women farmers.

Recalling first the methodological discussion above, it deserves being stressed that the results reported here have a quite solid empirical foundation, unlike much of the anecdotal or case-study based evidence which in the debate on developments in sub-Saharan Africa, often is used as a basis for wide-ranging but deeply problematic generalizations.

It belongs to the definition of absolute poverty, e.g. as measured by the World Bank's "a dollar a day" criterion, that being poor equals being hungry. Our results reinforce the conclusion that increased production of staple crops by smallholders is a most effective vehicle for poverty alleviation. The unexploited production potentials in smallholder agriculture that we have pointed to (cf. what is said about yield gaps above) clearly support such a conclusion. Improved access to food in settings like the one in sub-Saharan Africa where a majority of the population still lives in rural areas and where a majority of the poor are smallholders would have a direct impact on poverty rates. Where, on the other hand, the poor are minorities in middle income countries, which increasingly is the case (Sumner 2010), other strategies are more appropriate, for example Conditional Cash Transfer Programmes. As is clear from the above, a programme for poverty alleviation among smallholders would imply expanded distribution of improved seed and, possibly subsidized, inorganic fertilizer. However, it is not likely that such a programme would be very effective without massive investments in infrastructure and institutional development with the aim of facilitating commercial production by the target group of smallholders. Improved functioning and better integration of markets would open up for substantial increases in staple food production, based on higher yields. Given decreasing farm sizes this is a key concern for the future of rural sub-Saharan Africa.

Our results also lead to some critical reflections on development programmes and projects emphasizing the diversification of the agricultural sector and a growing share of non-farm income and employment. Such programmes need to consider that big groups of smallholders, around fifty per cent in our sample, are completely dependent on

incomes from farming and animal husbandry and thus have no off-farm sources of income. It should also be remembered that the share of non-farm incomes seems to be considerably lower than what is often stated.[11]

The effectiveness of a programme like the one sketched above can be boosted by economic growth in the non-farm sector, of the type enjoyed by many countries in sub-Saharan Africa during the last decade. Arguably, this growth in GDP is driven by factors which are largely exogenous to these countries and outside the control of governments, although suitable policies, for example on foreign investments, could help in promoting it. Our results indicate that economic growth alone will not do the trick, if not seconded by (i) government investment in the agricultural sector, for example in rural infrastructure, agricultural extension and research; and (ii) trade policies treating the domestic smallholder sector as an "infant industry", protected from harmful import, for example of subsidized and dumped agricultural commodities produced in the OECD countries. There are many encouraging signs that such policies are being put in place, initiated not only by governments but by regional organizations like NEPAD and donors like the Alliance for a Green Revolution in Africa (AGRA).

Our results further indicate that policies of the kind outlined above will not have detrimental, but neutral effects on women farmers. Although the gender issue in African agriculture is a multi-faceted one, we consider women's land access to be a heavy-weight factor. Thus, discrimination of women is entrenched in property and inheritance systems, which are very difficult to reform, at least in the short term.

Like sustainability then, gender issues are medium to long term, while a programme aiming for fulfillment of MDG goals no. 1 and 3 is by definition a short-term one. The same can be said about environmental sustainability. It is often argued against a Green Revolution inspired programme for agricultural development that it is not sustainable, and therefore should not be invested in. This argument, we contend, conflate various time-scales. While a programme of increased food crop production over a time-span of five years, i.e. until 2015, is feasible and likely to be effective, it would be meaningless to problematize the (un)sustainability of agrarian ecosystems over such a short period, as long as we are not referring to catastrophes like droughts, floods and wars.

Under present usage, agrarian ecosystems in sub-Saharan are *not sustainable* over the medium and long term, among other reasons because they cannot feed the population dependent on them. A Green Revolution inspired programme for increased food production would likewise not be sustainable over the medium to long term. However, there are few reasons to think that, over the short term, it could appreciably worsen the unsustainability of the ecosystems it would affect. Sustainability, then, is an issue over the medium and long-term and of little relevance in discussing strategies for poverty alleviation in the short term.

Looking finally at the more donor-specific relevance of our results, it can be said that they agree with the general thrust of CAADP's donor

11 This conclusion will be reinforced by the report from the World Bank's RURALSTRUC project, led by Bruno Losch, who will publish their report in 2011.

platform[12] and its exhortation for donors to support the country-led CAADP processes, for example as has been done by Sida in Mozambique or in Zambia. Similarly, Sida is on right track in its *Strategic Guidelines for Sida Support to Market-Based Rural Poverty Reduction Improving Income among Rural Poor,* although one could wish for a more nuanced discussion of smallholders and other poor people in sub-Saharan Africa and the importance of specifically targeting also the former. Among the reasons for this is that growth in the food crop sector has important downstream effects, which are beneficial to the rural poor,[13] for example in the form of decreased food prices, increased demand for agricultural produce and for other local products and services.

Finally it deserves being pointed out that the Swedish government, in its Policy for *Economic Growth in Swedish Development Cooperation*[14] has pointed, not only to the importance of economic growth, but specifically at growth in the agricultural sector. Our results could have been used as empirical support for such a policy orientation.

Looking ahead

Parts of the Afrint team are currently preparing for a downsized round of Afrint III, with data collection in 2012/13 covering Kenya and Ghana. This project will:

- Add aspects of *non farm household linkages* to the original focus on agricultural intensification.
- Study issues related to how *income diversification outside agriculture* relate to investments and strategies within staple crop production and other types of agricultural activities
- Consider the *poverty* aspects of such linkages
- *The role of gender* will be particularly salient.

Funding for a third round of data collection presently (March 2011) remains to be secured for the other seven Afrint countries.

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12 See http://www.donorplatform.org/component/option,com_docman/task,doc_view/gid,1133.

13 See: https://webmail.lu.se/owa/redir.aspx?C=ef70b45ea5874da793ac33064ca61cf9&URL=http%3a%2f%2fsidapublications.citat.se%2finterface%2fstream%2fmabstream.asp%3ffiletype%3d1%26orderlistmainid%3d1286%26printfileid%3d1286%26filex%3d1734379704940.

14 See: http://regeringen.se/download/1b14fee5.pdf?major=1&minor=139739&cn=attachmentPublDuplicator_0_attachment.

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This increases the world's prosperity.

The Millennium Development Goals and the African Food Crisis – Report from the Afrint II project

AFRICA

This report summarises research carried out among smallholders in nine countries in sub-Saharan Africa . The most salient, policy-relevant conclusions deal with maize, which is the biggest food crop in the region, and with seed-fertilizer technology, commercialisation and impacts of government policies. Some of the main findings are: Yield gaps are high. Ordinary farmers in the nine countries studied produce between 34 and 46% less per hectare than the 5% best producing farmers in the same village. Farmers who are using improved or hybrid seed and inorganic fertilizer produce 40 to 50% more per hectare than their peers. Facilitating for smallholders to participate in markets for food crops is likely to have strong dynamic effects on production. Changing trade policies, implying less dependence on imports of food crops, have had positive effects on domestic staple food production. Production increase of maize from 2002 to 2008 had a pro-poor profile and was largely the result of smallholders cornering a larger share of the maize market.

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