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Djurfeldt, Göran; Larsson, Rolf; Jirström, Magnus; Andersson Djurfeldt, Agnes

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Göran Djurfeldt, Rolf Larsson,[1] Magnus Jirström and Agnes Andersson

Lund University

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Address:

Göran Djurfeldt, Department of Sociology, P.O. Box 114, SE-221 00 Lund, Sweden

Mail: Goran.Djurfeldt@soc.lu.se

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[1] Rolf Larsson tragically passed away in a traffic accident in Tanzania in October 2004. This paper is thus posthumously published and dedicated to his memory.

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Abstract

This is a study of farm dynamics in eight African countries, drawing on a sample of more than 3000 farm households. It deals mainly with food crops and in detail with maize and makes a longitudinal analysis by systematically comparing current conditions with those obtaining when the farm was set up under its present management. From the study emerges an overall picture of inadequately exploited production potentials where farmers' commercial energies are driven towards other food crops than grains, especially vegetables for urban markets. Commercial incentives in food grain production favour small groups of well-placed and usually male farmers, while, the lack of seed-fertiliser technology and commercial incentives means that smallholders devote their energies to other crops or to non-farm sources of income.

Sub Saharan Africa suffers a mounting food crisis. The drama that unfolds when drought strikes and famine threatens, like it did in 2002, sometimes hides the fact that African agriculture is not entirely stagnant. Food production is growing, as are yields and areas cultivated, but per capita rates of increase are simply too slow.

This study is part of a project on the relevance of the Asian Green Revolution for Africa reported upon elsewhere (Djurfeldt et al. 2005). That study developed a causal and explanatory model of the Green Revolution stressing that the Asian Green Revolution(s) were not technology-driven, as is often claimed, but *State*-driven and directed towards the goals of achieving self-sufficiency in food grains. The model also emphasised the *small farmer base* and *market-mediation* of the Asian rice revolutions. New high-yielding rice (and wheat) varieties were a pre-condition for these processes.

The following article operationalises and applies this model to survey data, which relates information on current production conditions to the conditions obtaining when the farm was established. In other words, we wish to consider to what extent agriculture in sub-Saharan Africa, as reflected in our sample, has been:

- *State-driven*;
- based on *smallholders*; and
- *mediated by the market*;

Moreover, the role of technology or industrial inputs in explaining farm dynamism will be investigated. In line with the Asian model, we will be stressing the importance of national self-sufficiency in food grains, although this is not generally a primary aim of national agricultural policy in sub-Saharan Africa. Our findings give reason, however, for doubting the wisdom of least developed countries exposing their staple food production to international competition on a playing field, which is far from level (cf. Stevens 2003).

Yet another characteristic of the Asian green revolution will be prominent in our discussion below, *viz.* the steering of investments to high-potential areas. This was contested at the time and is still the subject of debate, since favouring of the already privileged is questionable on ethical grounds. The rationale was, however, that in a situation of imminent famine and generally limited resources, investments should be directed towards areas where they would have the largest impact on agricultural production. Research results indicate that this inequity has been gradually balanced by the linkage effects of these investments (see for example Shenggen et al. 1999).

We thus wish to throw light on both the dynamism and stagnation of African food production, seeing to what extent our causal model can explain these processes. What are the causes of the low rates of agricultural growth and the tendency for farm and rural poverty to increase rather than decrease?

Before describing the methodology and the sample, we will discuss a few concepts used throughout.

Intensification and its drivers

The inadequate rates of growth of food production in Africa are due to *slow rates of intensification*. Part of the reason for this is that land reserves in sub-Saharan Africa tend to be relatively large (see Table 1), which in turn means that area expansion is still a viable option for many farmers. The most land-constrained country in our sample is Kenya (see Table 1)[i]. Land scarcity in Kenya, is mainly a problem of land tenure, however, rather than one of absolute scarcity. Since Ethiopia so often is portrayed as a land-constrained country, suffering a Malthusian crisis, it is not surprising that it comes out high on our list. On the other hand, one would have estimated individual land reserves to be even smaller than what they appear to be from the table. This may be a bias in the sample, but may also reflect a more widespread situation of labour shortages preventing extensification.

(Table 1 about here. Endnote no [ii] to be inserted in heading)

For maize, as we will show, *extensification* is mainly a subsistence strategy and as such it is constrained both by land scarcity and by labour shortages at the household level, the latter problem often aggravated as a consequence of HIV/Aids depleting household labour resources. *Intensification*, on the other hand, is by definition less constrained by the availability of land, but here again labour is a bottleneck. Like in the classical Javanese case studied by Geertz (1965), intensification unaccompanied by innovations lead to *involution.* As we will see in the context of our sample, however, intensification in our case represents a more dynamic type of development, stimulated by commercial incentives.

Farm technology is another constraint to intensification. Our overall assessment of the potential of farm technologies is positive, whether we look at what is available in the field or on the shelf (cf. for example Evenson and Gollin 2003; Haggblade 2005). In the case of maize, however, chemical fertilizers are not available on terms that are affordable and sustainable for smallholders.

Furthermore, and this is where a perspective inspired by Boserup (1965b) proves too narrow, intensification tends to be driven more by commercial factors than by demographic ones. Although commercialisation is a potent driver, it has not been potent enough, however, to stimulate the sustainable intensification, of maize, rice and sorghum. Thus its potential to alleviate the African food crisis in both rural and urban areas has not been tapped.

Our results suggest that increases in food production in sub-Saharan Africa are market-mediated to a larger extent at present than before Structural Adjustment, but that on the whole they are not smallholder based. Although we argue that African governments have the capacity as well as the possibility to drive their agricultural sectors towards augmented levels of national self-sufficiency and thus to improve food security, this opportunity has only been used to a limited extent.

Analyzing macro trends with micro-level data

This study builds on data collected from a sample of farm households in eight sub-Saharan African countries in 2002. Although a cross-sectional analysis, it attempts to capture the dynamics of farm development by means of retrospective data and to use this to throw light on macro level processes.

It is well known that retrospective data suffer from considerable problems of reliability. For this reason information was mainly collected on a few basic points, dealing with changes since the year when the farmer established his or her own household and farm. Thus for example we asked if yields and area had increased since then. A simple cross-classification based on the answers to these questions results in four trajectories, one of which will have been followed by a farm since its establishment.

(**Table 2**. about here)

Although these trajectories can be studied at the micro-level they do not correspond one-to-one with macro-level changes. The closest match is between intensification at micro and macro level, since each recorded growth of yields at farm level contributes to mean yields in the aggregate. Increases in farm or crop area, as in *extensification* and *expansion,* are more complex, as they are not necessarily due to the cultivation of virgin land, but can also reflect changes in land use or the redistribution of land among farmers. Finally, *stability* in area and yields, which includes *stagnation* at low levels, obviously does not contribute to macro-level dynamism. Dynamism is in the context of this paper defined as the reverse of stagnation and decline – that is a progressive change in area or yield.

Although changes at the farm level cannot be directly translated into macro level processes, it is possible to gain insight into the latter through aggregating farm-level trajectories. More importantly, we have the possibility through our data to find out what the driving forces are behind the various trajectories.

A whole range of aspects can be considered in an analysis of trajectories at micro-level. Some of these explain why certain households are more prone to intensify than others and also may contribute to explaining overall rates of intensification. A number of variables are drawn from the causal model of the Green Revolution already mentioned, while others such as a range of household and farm characteristics were added since we are working with micro-level data. Yet other explanations may be found at the meso level and relate to the contextual factors making intensification more probable in some places than in others.

A number of characteristics of farm households are likely to impact on trajectories. For instance institutional discrimination of female farmers may impact negatively on their productivity. According to Chayanovian theory, moreover, the life-cycle (especially in a largely subsistence-oriented agrarian economy) and age influence farm trajectories (Chayanov 1986). Consumer-worker ratios are assumed to have an effect similar to that of age, that is production per worker is presumed to rise with the consumer burden of each worker. Likewise, labour-surplus households are expected to be more dynamic than labour-scarce ones. Similarly, access to social and economic resources leads us to expect that high-status households are more dynamic farmers than resource poor households. Finally, it is important to consider whether farm dynamics rely on family or hired labour and a look at the use of hired labour will enable comparison between African family farms, and farms operating by means of hired hands.

Other factors at the micro-level include the connection between farm size and dynamism, which in turn has a bearing on the discussion of smallholder versus big-farm growth. Likewise, the debate on alternative farm technologies versus so-called conventional ones suggests that it is important to trace their respective effect on farm dynamics. The influence of market-mediation on dynamism in the smallholder sector will also be considered. In principle, the increased market integration of African farmers has two effects; either commercialisation aggravates the food crisis, as many have argued (for example Madeley 2002; and de Grassi and Rosset 2003), or it eases the crisis, as a more mainstream analyst would contend.

Three variables will be discussed in relation to the village or meso-level. Agri-market potential, in terms of agro-ecological potential and market access, reflects the geographical dimension of dynamism. Another fundamental factor at meso-level is population pressure, with Boserupian theory suggesting that the chance of intensification is higher in villages that have reached the land frontier compared to those that have not. Lastly, the extent to which African agricultural development is state driven can be illuminated through correlating farm dynamism with the presence of state, donor or NGO projects at the local level. We call this extension in a broad sense – the variable includes not only agricultural extension, but other types of development projects as well.

The influence of the State on African smallholder agriculture will be considered also at macro level. In the latter case the general impact of national agricultural policy on farm trajectories will be studied in contrast to the selective effects of extension measures. Only a few macro-level indicators will be used, but as we will show they contribute significantly to explaining dynamism at farm level. State-drivenness, operationalised as public expenditure on agriculture as a share of overall public spending, would be expected to correlate with farm dynamism.

Another macro level factor of interest is import dependence. Sub-Saharan Africa is to a large and growing extent dependent on food imports to feed its urban populations. Subsidised grain producers in Western countries compete with domestic producers on African markets, undermining the incentives for local farmers, especially in areas well connected to the larger urban markets. Our analysis considers whether import dependence has an impact on smallholder production at the farm level.

Operationalisation

It is not easy to operationalise this model. One of the reasons for this difficulty is that independent variables preferably should be measured when the farming career starts, as problems of circular or reverse causality may otherwise arise. We have retrospective data for most variables capturing the situation at the time of the establishment of the farm household. For the remainder of the variables we have current data. For some meso-factors that are more or less constant, like village location in relation to markets, the problem of circular causality is less severe.

Another problem is that the dependent variable, that is the trajectory followed, is a nominal one. Thus we cannot use ordinary least square regression, but have to resort to a more complicated and cumbersome method, viz. multinomial regression, discussed in more detail later.

Many of our independent variables are also nominal. Although multinomial regressions can be used with nominal independent variables, the output becomes excessively difficult to read. We have instead opted for using binary dummy variables, retaining only those variables, which contribute to the explanatory power of the regression model. In the case of fertilizer, for example only the variables started using and stopped using do so.

Given the variation in lines of production it would be preferable to operationalise the model at farm rather than crop level. This is quite complicated however, so instead we will look at maize, the commercially most important crop. We will test whether commercially specialised maize producers differ from other grain producers in their maize dynamics. If this is not the case we might not achieve much by attempting to operationalise dynamics at the farm level.

4. Survey methodology

The project and survey design departed from the assumption that the potential for intensification in food crop production is more likely to be found in regions that meet certain requirements in terms of average annual rainfall and access to markets (infrastructure) than in regions that are peripheral in this respect. For this reason we excluded the Sahelian countries from the country sampling frame, limiting the selection to the group of countries located in what may be labelled the maize and cassava belt. Despite a clear potential for an agriculture-led development in these countries, they all face, albeit to a varying extent, problems with low agricultural performance, rural poverty and recurrent food shortages.

The household sample consists of more than 3,000 households in more than 100 villages (Table 1). Also in this case, the sampling design reflects the agricultural potential of the regions in which the households reside. This is illustrated by the graph (below) showing agricultural dynamism as a continuum, where low depicts low productivity potential following the aridity and/or remoteness to markets (Figure 1). At the other extreme, high refers to areas where ecological endowments and marketing infrastructure have combined to create some of the most dynamic and productive environments in Africa (examples are Mt Kilimanjaro in Tanzania, parts of the Kenyan highlands, areas surrounding the main cities, and so forth).

(Figure 1 about here)

Our intention has been to capture the production dynamics in regions above the average in terms of ecological and market (or infrastructure) endowments but excluding the most extreme cases in this regard. While the households sampled are not statistically representative of farmers in rural Africa as a whole, the encircled area can nevertheless be said to be typical of the type of environment in which a majority of the smallholder population in sub-Saharan

Africa lives, and this area is assumed to be sufficiently diverse to yield information about the crucial conditions affecting farmer performance. We believe that by addressing issues of productivity constraints where an apparent potential for agricultural improvement exist, valuable insights into the causal relationships governing agricultural development in sub-Saharan Africa can be gained.

The sampling was thus a multistage one:

Stage 1. **Countries** (purposive sample) – Ethiopia, Ghana, Kenya, Malawi, Nigeria, Tanzania, Uganda and Zambia.

Stage 2. **Agro-ecological regions** (purposive sample), total 20.

Stage 3. **Villages** (purposive sample), total 103.

Stage 4. **Farmer households** (random sample), total 3,047.

A summary of characteristics of the sample is given in Table 3.

(Table 3 about here)

In addition to the survey, which targeted roughly 3,000 farm households, informal interviews were conducted with village leaders and farmer groups in each village to gain more information on the conditions relevant to intensification above household level (for example population densities, market access, land use patterns, land availability, rainfall, state and donor activities and so forth).

The farm households

The sampled households can be said to be typical of African family farms which despite the presence in some countries of state run or private estate farms constitute the backbone of agriculture in Sub-Saharan Africa. Typical of the interviewed households is their generally small area under cultivation, both when measured totally and per crop (Table 4). Production is partly for subsistence, partly for sale. Fields are worked by family members mainly, with women performing the bulk of farm labour using simple hand tools. The use of ox-drawn ploughs or tractors varies among the countries and locally.

(Table 4 about here)

Line of production

Isolating the most important source of income for our sample households reveals that only a minority of farmers are specialised food grain producers. Maize constitutes the most important source of income for 635 (27 per cent) of the 2637 households, which grow maize.

(Table 5 about here)

Given the African food situation the proportion specialising in food crop production may seem low. Our interpretation of this seeming paradox is that weak commercial incentives within food grains direct producers towards non-grain lines of production such as other food crops, non-food crops, animal husbandry or non-farm sources of income. Commercial incentives, thus, are strong for other food crops, given a growing urban demand and less competition with imported goods, (unlike for food grains) and higher domestic prices (in contrast to non-food cash crops which are mainly exported).

Given the importance attached to non-farm sources of income in analysis and debate during the last few years (see for example Bryceson 1999), we note in passing that the proportion of households relying primarily on such sources is quite low. While many households have non-farm incomes, they are not primary more than for a minority.

Comparing crop patterns in the reference year with current ones, we obtain the following table:

(Table 6 about here)

Maize is the most frequently cultivated crop, followed by cassava, rice and sorghum. Only a small proportion of the sample households have moved into or out of the four food crops. For maize a four per cent net in-movement is noted – the largest for a single crop, although a greater net in-movement is registered for other food crops.

Around 81 per cent of the households grow other food crops, often with commercial motives. These crops also show the largest in-movement, as shown by the last row in the above table. Non-food crops are grown by 37 per cent of the sample households, also with a net movement into the category, although much lower than that for other food crops. This is another indication that most of the dynamism has been commercially induced, but it has not favoured growth in staple food crops, like maize, cassava and others.

We note, however, that all food crops except sorghum have increased in prevalence. This increase could be driven, either by commercial incentives, or by the need to increase subsistence production of grains and tubers.

Cropwise dynamics

In the table below, we have classified crop trajectories according to the scheme laid out in the introduction, but here we separate stable at high level from those stable at low level, which we classify as stagnant. Hence we obtain five categories: (i) stable at a high level, (ii) expanded area and yields, (iii) intensified, (iv) extensified and (iv) stagnant at low level or declined.

(Table 7 about here)

Note first that the *rate of stagnation* varies very little between crops, with the only exception being cassava. The latter crop is interesting and has the lowest rate of stagnation of all crops. A look at the intensification trajectory confirms its distinctiveness, because the lowest degree of intensification is recorded for cassava. This is slightly curious, given the reports about an ongoing cassava revolution, especially in West Africa, which according to Nweke (2002), is 'Africa's best kept secret'. From our data it appears that such development remains undisclosed even to its farmers, who frequently tend to report increased areas under cassava, but not equally often report higher yields!

Thus in our sample, overall dynamism for cassava is high but mainly of an extensive nature. Dynamism may be explained by three factors: (i) high yields of cassava do not presuppose heavy inputs of nutrients and for this reason scarcity of fertilizer may spur a movement from maize to cassava in areas where both crops can be grown; (ii) the new varieties of cassava may have added momentum to this process, even though we cannot document their effects on yields (cf. Larsson 2005). Finally, (iii) in the case of cassava the competition with imports is less than for maize.

Unfortunately we are not able to test these hypotheses as the data on cassava is not good enough. Farmers have difficulty in estimating the size of their harvests, since harvesting is spread over a long period of time. Many producers appear uncertain over which variety of cassava they are using and it is also common to mix varieties in the same field.

The *intensification trajectory* is most common in relation to maize, closely followed by rice and sorghum, which are grown by too small a number of households to enable the type of analysis we will carry out for maize.

What is driving the modest intensification occurring in maize? What is keeping back the majority of farmers from intensifying, despite the evident need for more food? We will try to approach an answer by looking in great detail at maize and the determinants of the pattern suggested in Table 6. This in turn will give an insight into the nature of the African farm crisis and the constraints and opportunities in trying to alleviate it.

Determinants of maize dynamics

We will now regress the dependent variable, that is the five farm trajectories for maize on a number of independent variables. An equation for each value of the dependent variable is estimated in relation to a reference category. Stagnation (that is stable at low level) is used as the reference category. The multinomial equations should be read as predicting the *relative chance or risk* of a farm following a certain trajectory in relation to the risk of being stagnant at a low level. Due to the low number of farms stable at high level, we do not expect robust results for this category.

All variables are either binary (dummies) or logged continuous ones. The antilog of the β-factors of the dummies can be interpreted as the change in relative risk of a certain outcome associated with a change from 0 to 1 in the independent variable. Values below 1 indicate a negative correlation. Thus these relative risk ratios can be directly compared, their size indicating their contribution to the probability of the outcome. As an example, look at the results for gender where the relative risk ratios are below one in all equations and with one of them, the one for extensification = 0.50 and highly statistically significant (see Table 8 below). The interpretation of this is straightforward: If you are a woman, the relative risk (or chance) of having extensified, compared to remaining stagnant, is half of that of a male farmer.

The antilogs of the β-factors of the continuous variables on the other hand can be interpreted as elasticities, that is the value of the antilog tells us how much a one per cent change in an independent variable implies for the relative risk of the outcome. Here values below 1 indicate negative elasticities. For instance, the elasticities for number of adult household members, are all positive, with the one for expansion statistically significant and equal to 1.76, meaning that with every additional adult member of the household, the relative chance of expansion increases 1.76 times

Commercialisation

First look at the results for the commercialisation variables (see rows 1 and 2 in Table 8. Striking are the strong positive effects of started selling and always sold maize for the relative chances of intensification and expansion. Farmers who started selling maize almost doubled (182 %) their chance of intensification, compared with farmers who have not started selling maize, given that all other variables are kept at their means. The effect of always having sold maize is even stronger (227 %), indicating that commercialisation is a potent driver for dynamism with respect to maize.

Commercialisation is strongly and negatively related to stagnation, and therefore subsistence farms tend to have stagnated. Promoting the commercialisation of maize farming would therefore contribute to farm dynamism and indirectly also to relieving the food crisis.

Note finally that the commercialisation variables are statistically non-significant for extensification (column 5), suggesting that commercialisation *is not a driver for extensification in maize*. We have already argued that male farmers are more likely than women to have extensified. It can also be seen that big farms and farmers who have increased their overall cultivated area are more likely to have extensified their maize production. Our data reflect a process often pointed to, namely that extensification is associated with areas of relatively low population pressure. This pattern of growth is therefore likely to become less common as population densities increase.

Farm technology and inputs

With regards to technology, we first note the strong statistical significance for the two fertilizer variables. This implies a strong association between fertilizer adoption and expansion and also, but less so, with intensification. Conversely, the probability of intensification decreases while the risk of stagnation increases when the farmer does not use or has ceased to use fertilizer. This indicates that for maize, except in the case of extensification, farm dynamism is strongly connected with the usage of industrial inputs. The use of high-yielding seed varieties is intimately connected with fertilizer use and for this reason has not been in included in our regression analysis. This reinforces a conclusion reached earlier, viz. that the dynamics of the African maize sector is closely associated with industrial-scientific inputs and that stagnation in the sector to a large extent is due to the non-availability or non-affordability of such inputs (Sachs et al. 2004; Holmén 2005; Larsson 2005).

(Table 8 about here)

These findings also point to the importance of tractor or oxen ploughing. In many areas, it is a ready means of increasing labour productivity and surplus production on farms. Here we spot this relation mainly with respect to intensification, where having given up ploughing has a strong negative effect on the chances of having intensified. Probably this is related to ox ploughing easing land preparation in small intensively, often irrigated holdings, where discontinued ploughing adds to the probability of stagnation.

Table 8 indicates that pre-industrial inputs in general are not an important determinant of dynamism. Two types of pre-industrial inputs, nonetheless, show up as significant in the regressions: firstly, farmers who have not given up intercropping are more likely to have intensified, implying that households who have done so are more likely to have become stagnant, in turn perhaps due to labour or land constraints. Intercropping in intensively cultivated maize farms and usage of fertilizer are both significant, however, which suggests that non-industrial inputs cannot on their own substitute for industrial ones. The combination of the two does have a positive impact on intensification, however. Thus we discern no positive effects of the attempts during the past two decades by donors and governments to promote this type of inputs, as an alternative to scientific-industrial ones. Secondly, giving up crop rotation increases the relative chance of expansion, which could reflect the dependency of this trajectory on the availability and use of fertilizer, in its turn reflected in the high β-value for started using fertilizer for this trajectory.

Agroecology and well endowed areas

The geography of farm dynamism is brought out by the variable we call *agri-market potential*. Intensification and expansion are more likely to occur in well endowed areas, which implies that stagnation, unsurprisingly, is more likely in areas of lower agri-market potential. Farm dynamism in sub Saharan Africa, besides being driven by commercialisation and by scientific-industrial inputs, therefore tends to be concentrated in areas, which are both potentially very productive and well placed in relation to markets. By contrast, little dynamism is found in those less well endowed areas towards which many policy and donor interventions have been directed in recent decades.

This situation is reinforced by the striking result that the presence of state, donor or NGO projects in villages tends to be negatively related to farm dynamism.[iii] If these results mirror a more general situation, it would mean that well intentioned interventions in what may be called areas beyond the mountains have been largely unproductive, while opportunities to fuel agricultural development by investing this side of the mountain have been foregone.

In the light of this, must we reject our hypothesis about state driven agricultural development? As we shall see, we will be able to retain a modified hypothesis, pointing to the importance of the state for driving commercialisation through policies affecting the general conditions of agricultural production for example the expansion of markets, rather than through targeted interventions at meso or micro level,

Population pressure

According to Boserup's previously quoted theory (1965a), long-term trends of increasing population pressure are likely to change patterns of agricultural growth, from land use extensive strategies towards a more intensive use of land. Given Africa's high population growth rates, one would expect increasing rates of intensification and falling rates of extensification with gradually diminishing land reserves. Three qualifications must immediately be made, however. First, land reserves are by no means exhausted (see Table 1).

A second qualification is that land scarcity is not a simple function of land availability and population, but tempered by institutional factors regulating the access to land. Several of our sample countries experience such *institutional land scarcity*, for example Kenya where old settler estates have been preserved, although their owners are no longer foreigners. Similarly, Malawi, Uganda, Tanzania and Zambia have estate sectors, creating artificial land scarcity (Bazaara & Muhereza 2003; Engel 2001).

Finally, Boserup's theory assumes a relatively isolated agrarian economy, which may be exporting a surplus to the non-farm and urban sector and even to international markets, but which faces little competition as regards its non-tradable subsistence crops. A higher level of market integration with respect to food crops may thus disturb the tendency for increasing population pressure to result in intensification of land use. All these three factors contribute to the patterns observed in sub-Saharan Africa.

Population pressure turns out to be significantly related only to extensification in our model, where the relative risk ratio of 0.7 corroborates that the probability of extensification is less where population pressure is high.

Population pressure is statistically significant, however, in regressions with a smaller set of independent variables related to ecology and technology. When we introduce variables reflecting commercialisation, changes in cultivated area and so forth, the land frontier loses its statistical significance. The Boserupian hypothesis therefore must be qualified with respect to the institutional and global context.

Hired and family labour

Use of hired labour does not appear in the equations, because it is not significantly related to farm dynamism, reflecting the tendency of the African smallholder sector to be based on family labour and networks of labour exchange, rather than on agricultural labour markets. Mobilizing labour in this way is more conducive to farm development as noted by Toulmin and Guèye (2003) and by Donovan (2001) than using hired labour in general. This also explains why expansion and intensification are both related to the size and composition of the household.

The availability of household labour is of crucial importance for farm dynamism. We have already noted the high positive elasticity of 1.76 for additional household members in relation to expansion. Related to this factor is the importance of the consumer burden carried by each worker, that is the C/W-ratio, which is significantly and positively related to intensification, with an elasticity of 1.51. Both these findings reinforce our contention, that besides being driven by commercial forces and by scientific-industrial inputs, the African smallholder sector is much dependent on its own labour resources and driven to a large extent by the consumer needs of the household. This is an obvious reflection of the family farm or peasant character of the African smallholder sector.

As one would expect, there is also a lifecycle aspect of farm trajectories, as revealed by age and age squared. The relation is most visible for expansion, where the β-factor signals that an increase of age by one per cent increases the relative chance of expansion almost sevenfold

(6.87 times). The statistical significance of age squared points to a curvilinear relation, with the chance of expansion decreasing after the age of 50.

Gender and class

We have already noted the importance of gender: As would be expected female farming careers are much more likely to have stagnated than male ones.

As noted by Djurfeldt and Larsson (2004), female farmers are mostly constrained by their limited access to land and to labour. Thus they are much less likely to have extensified. Interestingly, gender discrimination seems to be less apparent in relation to intensification and expansion, as shown by the non-significant negative correlations between gender and these trajectories. The latter situation may be due to Nigerian and Ghanaian cases of commercially oriented women farmers. The former tendency, suggests that intensive cultivation of small holdings is a feasible strategy for women which in turn points to a scope for outside actors aiming to intervene in support of female farmers.

Poor wealth group is not included in the model because it does not correlate with any of the farm trajectories. At the bivariate level, however, there is an obvious correlation in the sense that a poor household is more likely to have stagnated or declined. In the multivariate analysis, poverty loses its statistical significance, because other variables intervene to explain why poor households tend to follow less dynamic trajectories, that is because they are more likely to be female headed and subsistence-oriented, while also having fewer household members and higher C/W ratios. In contrast, belonging to the rich wealth group increases the probability of having expanded cultivation. Accessing both the land and the inputs needed for an expansive strategy thus seems to depend upon resources mainly commanded by the rich.[iv]

Controlling and summarising the results

We have three variables related to area, all of them included as control variables. Note that they refer to cultivated farm area (the variable total farm size in table 8), not to maize area as such. There are two methodological problems here: Maize area is included in the definition of the dependent variable, which presents a problem of collinearity. In part this is solved as the variable referred to in the table is the cultivated area of the farm as a whole. Moreover, cultivated area refers to the area cultivated at the time of the survey and not the area cultivated during the reference year, which compounds the problem. As can be seen from the table, however, there is no significant correlation between total farm size and any of the farm trajectories, except extensification, a strategy obviously depending on access to land. Thus we conclude that the use of total cultivated area in the regression is not likely to bias the results.

Expansion and extensification are both positively related to increases in cultivated area and thus farmers who have increased their farm size run a lower risk of stagnation in maize. This supports our conclusion that farm dynamism in the maize sector tends not to be smallholder based, but rather dominated by big family farmers who are likely to build their expansive strategy on relatively abundant reserves of labour found within the household and within exchange networks.

Excluding cultivated area would dissimulate two important relations, that is between area increase and decrease respectively and farm trajectory. These help us to see the dynamism: Increased cultivated area is strongly and negatively related to stagnation in maize farming and, at the same time, positively related to expansion and extensification in maize.

The variable maize specialist is also included as a control variable. We see that it is not significantly related to any of the four trajectories. Thus our operationalisation may hold water despite being built on a mixture of crop- and farm-level variables.

Summarising the analysis, we have seen that the risk of stagnation increases when the farmer is a woman. Furthermore, stagnant farms are unlikely to use scientific-industrial inputs, and likely to have lost or given up, rather than gained land and, furthermore, they are likely to be oriented towards subsistence farming rather than towards production for the market. Likewise, stagnant farms are more likely to have given up intercropping, a finding which does not bode well for subsistence cultivation in the long run, since it suggests growing problems with fertility management. Stagnant farmers, finally, are more likely to reside in low- or medium potential areas rather than in well endowed ones.

Extensification is only significantly and positively related to an increase in cultivated area. It is furthermore negatively associated with being a female farmer, reinforcing our conclusion that a major handicap for women lies in their limited access to land. In other respects, the drivers for extensification are the same as those for stagnation and decline, that is non-use of scientific-industrial inputs and subsistence orientation.

As argued in the introduction, in order to overcome the food crisis, African agriculture needs to intensify at much higher rates than at present. On the basis of our findings, we conclude that intensification is primarily driven by the market and connected both to scientific-industrial inputs and mechanised or oxen ploughing and to a lesser extent to demographic factors, although high dependency ratios tend to act as a stimulant. The importance of the market is signalled by the positive correlation with agri-market potential and commercialisation. Furthermore intensifiers are unlikely to have given up intercropping, a finding indicating that these households have found a more sustainable way of using their land than stagnant maize farmers.

The correlations between intensification and wealth group and gender respectively are not significant, indicating that, at least to some extent, intensification is a feasible strategy also for smallholders and women. Finally, intensification is negatively related to the presence of a project in the village, indicating that it is not state-driven, as the Asian model would require. Thus, rather than being driven by the state, the maize sector is driven by commercial factors and its low level of dynamism is related to the weakness of this driver which in turn can be explained by macro level political and geopolitical factors.

Expansion interestingly seems to be facilitated by the availability of labour within the household and like the other dynamic trajectories it appears to be associated with the use of industrial inputs. Expansion in maize cultivation similarly presupposes access to additional land and is strongly associated with an expansion of the general farm area. The strategy is associated with wealth, although wealth may be as much a result as a precondition for expansion. Commercialisation is a driver, as seen by the strong correlation with sale of maize. Good agri-market potential is another pre-condition, but again the dynamic is not state-driven, as indicated by the negative correlation with the presence of a project in the village.

The influence of policy and the world market

To round off this analysis of the determinants of the various farm trajectories, we will introduce variables related to the macro policy environment sourced from outside our survey. According to our causal model the macro policy environment is a fundamental determinant of farm dynamics. Our reformulated hypothesis that agricultural development in an African context is state-driven, not through extension but through the expansion of markets leads us to expect these indicators to be significant in the regression analysis.

Below are some country level data (see Table 9)

(Table 9 about here)

We take the national rate of dynamism as the inverse of stagnation. Despite the fact that our samples cannot be claimed to be nationally representative, yield and production estimates do not deviate much from national data, as Larsson has shown (Larsson 2005) and we take the rates of dynamism to roughly reflect those of the country as a whole. Admittedly, the long time span reflected in this variable, that is the time span from the reference year to the present makes it a crude instrument for drawing conclusions on more recent policies. Nevertheless, as can be seen from Table 9 above, the ranking of countries seems to reflect the development in these countries over the last decade or so (see further below). We further use IMF-data on public budget shares directed to agriculture and data on import dependence for maize. To control for the direction of causality, both variables are lagged. GNI per capita in PPP US dollars is used as a control variable since the share of public expenditure devoted to agriculture is expected to decrease with rising GNI.

The effect of another macro variable, the introduction of Structural Adjustment Programmes (SAP) is, however, possible to trace in household level data.[v] Of the eight countries surveyed, Nigeria stands out as the most dynamic in terms of its rate of dynamism and in addition the country promotes national self-sufficiency in maize and other staples (Akande 2005). Ghana ranks second, which is unsurprising given the fairly good agricultural performance of the country since the inception of its Structural Adjustment Programme in 1983 (Seini and Nyanteng 2005). Similarly, since the fall of the Derg, Ethiopia has run an agricultural development programme, almost a duplicate of the Indian programme from the mid-1960s. Its positive development was disrupted, however, with the drought in 2002, the year when our data were collected. Our figures from a village in the country's maize belt reflect this earlier positive development. It is too early, however, to tell if the positive development has resumed after 2002, although production figures seem promising (Mosley 2003; Mulat Demeke and Teketel Abebe 2003; Dercon 2004).

At the lower end of the scale is Malawi, with its rampant poverty and Aids pandemic. Malawi's attempt at agricultural development through the starter pack programme seems to have had little impact (Holmén 2005). When this is written severe drought and threat of famine is again reported from the country. Zambia, over the last decades, has had a stop-and-go liberalisation process and erratic agrarian policies, giving ground for sporadic jumps in production (Saasa 2003). When we conducted our survey, most peasants claimed to be experiencing stagnation in terms of yields and area.

Kenya and Tanzania, finally, appear middling in terms of their maize dynamics. In the case of Kenya, its maize revolution stagnated already in the 1970s and the dynamism in the national farm sector lies elsewhere (Kosura and Karugia 2005). Its southern neighbour Tanzania also ranks low in dynamism. Although it is not drawn into export of horti- and floriculture to the same extent as Kenya, farm dynamism also in Tanzania appears to have occurred mainly outside the maize sector (Isinika et al. 2005).

Visual inspection of Table 9 shows that the rate of dynamism as we define it is strongly correlated with import dependence (more precisely $r = -0.83$, significant at the 5% level). However, rate of dynamism is only weakly correlated with budget priorities ($r = -0.26$) and the policy indicators are similarly weakly correlated between themselves ($r = -0.08$). Although our data suggest national differences in the rate of dynamism and a connection between these variations and the chosen policy indicators, this in itself is not enough to establish that differences in agricultural development are due to the diversity of national agricultural policy. A correlation may, if it is not spurious point to causality running in the opposite direction to the one we are interested in establishing. We will therefore extend the regression analysis already undertaken.

Readers well versed with regression analysis are right at this point to wonder about the soundness of this methodology. Our macro-level variables are likely to be correlated with a number of other macro-level factors not included in the model. Therefore significant ß-factors may equally well point to non-operationalised macro-variables as well as to those factors that we wish to consider in our analysis. Keeping this possible source of error in mind, we will however, carry out the analysis, and cross-check the results later, by introducing country dummies into the model.

(**Table 10 about here. Endnote no [vi] to be inserted in note to table**)

Import dependence appears to be strongly and negatively associated with both expansion and intensification, suggesting that trade policy with respect to food grains has a strong influence on farm trajectories, with low import dependence spurring dynamism. Policy priorities as reflected in agricultural budget shares have less impact: Only in the case of intensification can we trace a positive effect, statistically significant only at the 5% level though, which is on the low side in a multi-level model (cf. footnote iii above).

Similarly, SAP turns out to have had a weak positive effect on farm dynamism: It has increased the likelihood of intensification, contradicting for instance (Gibbon et al. 1993). Our data do not give ground for disputing the positive effects of SAP for household production in our sample, but it is evident that these reforms have not imputed enough dynamism to the African maize sector.

Note also the effects of adding the macro variables to the model, on the relative risk ratios for the other variables. In the table above, we have highlighted the risk ratios that have altered their level of statistical significance after the introduction of the macro variables.[vii] Most of these changes are found in the intensification column, where both of the commercial indicators lose much or all of their statistical significance. Similarly, the significance of one of the fertilizer variables decreases, as does that for ploughing. The significance of intercropping in explaining the relative chance of intensification however increases slightly when macro-policy indicators are taken into consideration. Finally, agro-market conditions lose their statistical significance.

In the expansion column in Table 10, the effects of the introduction of macro variables are fewer: The relative risk ratios decline and the variables for agro-market conditions and for the village receiving state or NGO support lose their statistical significance.

How is this to be interpreted? We take it as pointing to the mechanisms through which agricultural policies affect rates of intensification, viz. by making scientific-industrial inputs more easily available to farmers and by stimulating the use of ploughing and intercropping (by way of commercial incentives). In the case of expansion, state policies seem to affect relative risk ratios primarily in well endowed areas. Here we also discern a positive effect of external support from the state or NGOs, although such support appears to benefit mainly expansive farmers, rather than smallholders and women.

Comparing how the different variables contribute to the explanatory power of the two models,[viii] we can distinguish in more detail how macro-level variables affect farm dynamism (see table 11 below).

(Table 11 about here)

With respect to the first model, the three area variables together account for almost 40 per cent of the total explanatory value. This is an indication of the big farmer bias in African agricultural development. The area variables are followed by the technology variables, which account for 22 per cent of the explanatory power in Model 1. To the extent that technology is scale neutral, this could somewhat balance the big farmer bias. Commercialisation variables rank as number 3, together contributing around 15 per cent, testifying to the commercial drivers of agricultural development. Interestingly, the rank order and percentages turn out different in Model 2: The area variables continue to rank the highest.[ix] The macro variables, import dependence GNI per capita, and SAP, as well as the technology variables are all found at second place with a 19.6 per cent contribution respectively. In percentage terms this is slightly lower than in Model 1. The explanatory power of the commercialisation indicators, however, drops from 15.2 per cent to below 6.0 per cent between the two models.

A possible interpretation of this is that agricultural policies have affected farm dynamics through the conditions they create for commercial development in the maize sector. Macro variables have less influence on technology adoption; hence our modified hypothesis about state-drivenness gains support from the model. African states are encouraging agricultural development, primarily by promoting commercialisation with technological development being market rather than state driven. This is exactly what Structural Adjustment sought to accomplish and in this sense is not a surprising outcome, although it has not appreciably ameliorated the African food crisis.

An immediate rider has to be added, because of the risk of collinearity already pointed to: Import dependence may reflect other variables, and if these were possible to include in the model, the interpretation might be different. Our only way of assessing the validity of the results is by adding country dummies to a third model, not reproduced here. When we do so, we get very few significant ß-factors for the dummies: The Ghana dummy turns out significant on extensification, implying that extensive growth is rare in that country. Similarly, Kenyan farmers are more likely to have intensified than their colleagues from more land constrained countries. In addition to this, import dependence declines in statistical significance throughout, while GNI per capita continues to be significant and with largely stable ß-values. Firstly, this implies that agriculture has been more dynamic in countries with higher GNI per capita in PPP dollars. Secondly, relatively affluent Ghana and Nigeria also emerge as the least import dependent. In these cases low import dependence can equally well be the result of higher growth. Thus, our evidence for the deleterious effects of imports on agricultural dynamism is rather weak and circumstantial.

Still, the following conclusion seems to be well supported by our data: Dynamism in the maize sector is market-mediated, as our model prescribes, but state intervention appears to affect maize dynamics indirectly through the stimulation of market development rather than through extension measures in terms of scientific-industrial inputs. As is well known, what sub-Saharan Africa once had of extension services has been left in shambles after Structural Adjustment. Here is an opportunity foregone, as our data suggests that seed-fertilizer technology contributes substantially to farm dynamism.

Farm dynamism in maize has not been small farmer based. On the contrary, farm dynamism seems heavily tilted against the small farmer and in favour of larger producers. As we have seen, however, the intensification strategy does not seem closed to smaller producers, although it would require their access to industrial inputs. Low dynamism, mediated by the market and with the state, somewhat stimulating the development of markets, thus appears to be the African model. Here lies an important difference between African patterns, as revealed in our data, and the Asian model as specified in the introduction: Smallholders are not included and governments are not driving technological development through extension.

Conclusions

The most important conclusion from this study of the trajectories of more than 3000 farming households is that nearly half of them run stagnating farms; they have not increased their yields, neither their cultivated area since they started their farming career. Many of these farmers are women and lack the human and social capital needed to access land and other resources. Moreover, many stagnant farms are found in villages and areas with low agriculture and market potentials, although many are also found in areas with higher potential. In the latter category there is a potential for more dynamic farming and deeper market involvement, given more conducive macro-economic and political conditions.

At present macro-economic and political conditions are such that they disfavour women and other resource-poor farmers. Except to some extent for maize, conditions on the whole disfavour intensification, which is more rare than extensive growth. Again with the partial exception of maize, intensification is disfavoured compared to expansion, as a result of the advantages enjoyed by big farmers (cf. Athreya et al. 1990). However, intensification is more open to women and to resource-poor farmers than expansion, but it requires access to industrial inputs and markets, which are not readily accessible, except in the case of the dynamic duo, Nigeria and Ghana.

Furthermore, it should be stressed once again that macro-level policies have an impact on farm level dynamics, although our attempt to find empirical support for a hypothesis about the deleterious effects of import was not entirely successful. However, the state is far from irrelevant to agricultural development as some scholarship on the African state could lead one to believe. Structural Adjustment Programmes seem to have had a positive effect in diminishing stagnation and promoting intensification. We would still contend that this effect is largely offset by the competition with imports in the maize and rice sectors. It may be added that even sorghum is affected by dumping. Although very little sorghum is imported to Africa, there are substitution effects with maize, which affect sorghum farmers and which may account for the apparent stagnation also in this sector.

Finally, there is scope for governments, and indirectly for donors, to ameliorate the African food crisis by increasing investments in agriculture and by promoting the industrial-scientific inputs and commercialisation of smallholders. Such a policy would gain from and perhaps also require that domestic markets be protected against dumping. Once again and finally referring to the Asian model, our data support the simple slogan: Africa can and should learn from Asia!

Endnotes

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[i] In this country comparison we do not take differences of land quality into account. For this reason, our figures must be considered merely as indicative of land constraints.

[ii] The survey question was: 'How much extra land would you be able to put under cultivation if you wanted to expand your farm taking into account land that presently is under fallow, (hectares)'

[iii] The exact significant level is 1.9%. Since this is a meso-level variable, with less variance than the micro-level ones, it is often recommended to add 30% to the significance level. Even after making such an adjustment, the result remains statistically significant at 5% level (Hox 2002).

[iv] There is an obvious problem with the direction of causality here and the same goes for hired labour. A dynamic farm trajectory may have made a household rich, not the other way round. Similarly, a dynamic farm development may have led the farmer to use more hired labour.

[v] This major reform of the last decades would be expected to have an effect on farm dynamics and a dummy variable where farmers who began farming before SAP are used as a control variable is therefore introduced. . To assess the influence of SAP, we control for the effects of the farmers'age.

[vi] Nigeria and Tanzania are not members of the IMF, while Malawi only recently became a member. Data on Tanzania and Nigeria have been culled from national statistics. In the Nigerian case data are not exactly comparable to those of the IMF. With the data we have access to, Nigeria appears to be giving less priority to agriculture than one would expect. Data bias in this case works against our hypothesis, rather than for it. In the case of Malawi data are from 2003-4 and thus not lagged. Data for Nigeria and Tanzania have been collected by Prof. Tunji Akande and Dr. Aida Isinika, to whom we are thankful

[vii] The exact change in value and level of significance can be seen by comparing Table 8 and 10.

[viii] The contribution of each variable to the explanatory power of the model can be computed through its Chi-square statistic, which is its share of the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model.

[ix] Remember that there are more variables in Model 2, and for this reason the average percentage contribution is less.

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Tables and Figures

Table 1. Potential for expansion of farm area

Country	Mean	N	Std. Deviation	Coefficient of variation
Kenya	0.23	296	0.51	224.5%
Tanzania	1.08	334	1.35	124.5%
Ethiopia	1.11	133	1.41	126.9%
Uganda	2.04	290	3.28	160.5%
Ghana	2.34	196	3.50	149.4%
Nigeria	2.49	413	4.31	172.9%
Malawi	2.86	391	2.56	89.3%
Zambia	7.74	401	20.59	266.0%
Total	2.80	2454	9.02	321.7%

Source: Own survey data. See below for description of methodology.

Table 2. **Typology of trajectories followed by farms since they were established.**

	Area increased	
Yield increased	*No*	Yes
No	*Stable at high or low level*	*Extensification*
Yes	*Intensification*	*Expansion*

Table 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
Households	322	416	298	400	495	403	320	443	3097
Female headed, per cent	5	17	43	40	12	20	14	24	22

Source: Own survey data.

Table 4. Land under cultivation (total and per crop in ha) and proportion of households cultivating, by type of crop.

	Total	Maize	Cassava	Sorghum	Rice	Other food crops	Non-food crops
Mean farm size	2.5	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

Source: Own survey data.

Table 5. Line of production according to most important source of income

Most important source of income	Per cent
Other food crops	24.1
Non-food cash crops	18.0
Animals and animal produce	6.6
Non-agricultural sources	14.8
Maize	26.6
Cassava	1.8
Sorghum	2.0
Rice	4.9
Wheat	.0
Teff	1.1
Total	100.0
No. of cases	2390
Per cent missing	9.4

Source: Own survey data.

Table 6. Crop patterns at reference year and currently

	Maize	Cassava	Rice	Sorghum	Other food-crops*	Non-food crops
Never grew	12.0	60.9	76.6	78.0	11.8	53.8
Gave up growing	2.8	6.9	0.7	4.6	7.4	9.0
Always grew	78.3	23.2	20.1	14.7	62.7	24.7
Started growing	6.9	9.0	2.6	2.6	18.1	12.4
Total per cent	100	100	100	100	100	100
No. of cases	3096	3091	3091	3091	3094	3091
Missing cases, per cent	0.0	0.2	0.2	0.2	0.2	0.2
Net movement in/out of crop	4.1%	2.1%	1.9%	-2.0%	10.7%	3.4%

Source: Own survey data.

*This figure excludes wheat and teff, which were only grown in Ethiopia

Table 7. Cropwise trajectories

	Crop			
Trajectory	Maize	Cassava	Sorghum	Rice
Stable high	3.01	2.78	3.58	4.21
Expanded	16.18	28.09	20.15	19.84
Intensified	16.84	8.35	15.82	16.23
Extensified	16.80	29.78	14.69	14.63
Stagnant	47.16	30.99	45.76	45.09
Total	*100*	*100*	*100*	*100*
Extensified or stagnant	66.98	63.56	64.03	63.93
Intensification ratio	0.51	0.23	0.44	0.45
No. of cases	2256	826	531	499
Per cent missing	14.4	17.2	25.5	29.0

Source: Own survey data.

Table 8. Logistic regression on farm trajectories, relative risk ratios (Model 1)

Variables, grouped by type	Stable high	Sig.	Expan-ded	Sig.	Intensi-fied	Sig.	Extensi-fied	Sig.
Commercialization:								
Started selling maize	2.08		5.56	***	1.82	*	1.37	
Always sold maize	1.52		2.38	***	2.27	***	1.30	
Farm technology and inputs:								
Started using fertiliser	2.56	*	3.23	***	1.59	**	1.32	
Reduced or given up fertiliser	2.70	**	0.76		0.60	*	0.88	
Given up ploughing	0.89		1.09		0.35	**	0.83	
Given up crop rotation	2.17		1.96	*	0.93		1.00	
Given up intercropping	1.52		0.61		0.46	*	0.70	
Agroecology and extension:								
Good agromarket conditions	0.83		1.59	*	1.52	*	1.06	
Village receiving State or NGO support	1.28		0.58	**	0.71	*	0.87	
Population pressure:								
Land reserves low	1.01		0.85		0.81		0.71	*
Family and labour:								
Age. logged	1.81		6.87	*	1.24		1.68	
Age squared	1.00		1.00	*	1.00		1.00	
CW-ratio. logged	0.94		1.38		1.51	*	1.17	
No of adult household members. logged	1.43		1.76	***	1.09		1.03	
Gender and class:								
Sex of farm manager	0.59		0.66		0.79		0.50	***
Rich wealth group	2.00		1.69	*	1.39		0.90	
Area:								
Cultivated area increased since ref year	1.41		5.56	***	0.95		3.23	***
Total farm size in ha. logged	0.54	***	0.99		1.04		1.28	*
Farm specialization:								
Specialist maize grower	1.05		1.14		1.00		1.00	
Nagelkerke's R^2	0.32							
No. of cases	1636							
Per cent missing	38							

Note: *** indicate significance at 0.1% level, ** significance at 1% level, * significance at 5% level.

Source: Own survey data.

Table 9. Rate of dynamism in maize sector, import dependence, budget allocation to agriculture and GNI per capita in selected countries.

Country	Rate of dynamism	Import dependence	Budget allocation	GNI per capita, PPP USD
Nigeria	0.78	0.02	1.62	780
Ghana	0.72	0.27	3.50	2000
Ethiopia	0.60	1.06	11.46	780
Tanzania	0.60	3.13	3.90	550
Kenya	0.48	14.01	3.75	990
Uganda	0.47	7.39	4.17	1320
Zambia	0.39	17.79	4.70	770
Malawi	0.37	8.47	6.24	570
Overall mean	0.53	1.65	4.26	982

Source of data: column 2: own survey; column 3: Import of maize as percentage of total domestic maize production 1996-2000 (FAOSTAT); column 4: The percentage of government expenditure going to agriculture, forestry, fishing and hunting, which is the category found in IMF statistics (International Monetary Fund); **(insert endnote ix here)** column 5: Gross National Income in PPP USD (World Bank, 2004). For Ethiopia, GNI per capita is from Globalis: http://globalis.gvu.unu.edu/indicator_detail.cfm?IndicatorID=140&Country=ET

Table 10. Logistic regression on farm trajectories, relative risk ratios (Model 2)

Variables grouped by type	Stable high Exp(B)	Sig.	Expanded Exp(B)	Sig.	Intensified Exp(B)	Sig.	Extensified Exp(B)	Sig.
Macro-level policy indicators:								
Budget allocation. logged	0.73		1.61		1.96	*	0.89	
Import dependence. logged	1.12	***	0.69	***	0.75	***	1.01	
GNI per capita. PPP USD	0.19		0.76		1.68	*	0.79	
Reference year after SAP	1.11		0.92		0.67	*	0.91	
Commercialization:								
Started selling maize	2.14	***	2.94	***	**1.59**		1.38	
Always sold maize	2.01		1.47		**1.56**	*	1.38	
Farm technology and inputs:								
Started using fertiliser	2.69	***	3.27	***	**1.55**	*	1.34	
Reduced or given up fertiliser	2.49		0.81		0.65	*	0.88	
Given up ploughing	0.80		1.71		**0.48**	*	0.82	
Given up crop rotation	**2.45**	*	1.90	*	0.86		1.07	
Given up intercropping	1.58		0.59		**0.42**	**	0.69	
Agroecology and extension:								
Good agromarket conditions	0.75		**1.05**		**1.48**		1.05	
Village receiving State or NGO support	1.44		**0.71**		0.71	*	0.86	
Population pressure:								
Land reserves low	1.15		1.03		0.86		0.74	
Family and labour:								
Age. logged	2.14	*	5.98	*	1.50		2.12	
Age squared	1.00	*	1.00	*	1.00		1.00	
CW-ratio. logged	0.90		1.42		1.48	*	1.18	
No of adult household members. logged	1.68	*	1.49	*	1.04		1.08	
Gender and class:								
Sex of farm manager	0.60		0.67		0.81		0.51	***
Rich wealth group	1.84	*	1.89	*	1.50		0.87	
Area:								
Cultivated area increased since ref year	1.55	***	5.13	***	0.88		3.20	***
Total farm size in ha. logged	0.42		0.87		1.03		1.23	*
Farm specialization								
Specialist maize grower	1.24		1.08		0.87		1.00	

Source: Own survey data.

(**The above is a note to table 10. Insert below the table)**

Table 11. Contribution to explanatory power of the variables included in models 1 and 2

Variable type	Model 1	Model 2
Area	39.7	39.8
Farm technology and inputs	22.3	19.6
Commercialisation	15.2	6.0
Family and labour	10.2	6.7
Gender and class	6.1	3.6
Agroecology and extension	5.3	3.1
Population pressure	1.3	1.2
Maize specialist	0.1	0.4
Macro-level policy indicators	-	19.6
Total	100	100

Source: Own survey data.

Figure 1. Sampling frame.